Contracting to Deliver Quality Solid Biofuel to Customers

Bioenergy Association Technical Guide 06

Version 2

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About this Guide:

1. The compilation of this Technical Guide has been facilitated by contributions and oversight of the relevant expert members of the Bioenergy Association.
2. The aim of the Association's Technical Guides is to encourage delivery of high quality and consistent best practice bioenergy solutions. These Guidelines are voluntary but essentially provide a regulatory framework for the New Zealand bioenergy and biofuels sector.
3. The Guide is an outcome of industry discussion and collaboration. It captures the collective technical knowledge of a range of relevant leading bioenergy sector personnel. In addition, it benefits from the collective review and use by relevant asset owners, guide users, policy makers and regulators.
4. This guide is provided in good faith as an addition to the ongoing body of knowledge relating to the bioenergy and biofuels sector in New Zealand and Australia. However, as the guide is general and not specific to any application the Association and none of those involved with its preparation accept any liability either for the information contained herein, or its application.
5. As with all Bioenergy Association technical guidance documents, this guide is a 'living document' and will be revised from time to time and reissued, as new information comes to our attention. If you wish to suggest additions or edits to this guide, please contact admin@bioenergy.org.nz
6. Any enquiries regarding these guidelines should be referred to:

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CAVEAT

Bioenergy Association recommends that any party undertaking a project to upgrade or replace a bioenergy facility should undertake a full life cycle evaluation of all possible options prior to fixing on a specific new project solution.

As a decision maker, it's important to understand the pros and cons of each option and have them set out by an appropriate expert in a way that ensures they are easily comparable. Bioenergy and biofuels equipment may have an economic life of up to 30 years so options should be compared on that time frame. Too often a client rushes into a solution without properly evaluating all the options.

These Technical Guides are only a guide and users should ensure that they have engaged appropriate expert to consider their specific application.

EXECUTIVE SUMMARY

This Technical Guide was developed to assist the sellers and purchasers of solid biofuels to trade and contract these materials for the production of energy. The guide is part of a series of documents prepared by the Bioenergy Association to provide guidance for the sale and purchase of solid biofuels, the other documents to be considered in conjunction with this guide are:

- *Technical Guide 1: Solid Biofuel Classification Guidelines*[1];
- *Technical Guide 5: Standard Methods for Verifying the Quality of Solid Biofuels*[2];
- *Wood Fuel Supplier Accreditation: Scheme Guidance Document for Applicants and Assessors*[3]
- Additional information available on the website www.usewoodfuels.org.nz
- Technical standard *SNZ PAS 5311:2021 Biomass boiler systems for small and medium heat loads*.

This guide provides technical information on the various aspects that should be taken into account when considering and preparing a contract for the supply and delivery of solid biofuels and covers issues related to:

- The manufacturer's technical fuel specification for the owner's specific boiler system.
- The terminology to be used to describe solid biofuels which takes into account the sources, types and properties of fuels which will meet the boiler system specification;
- The important properties of fuels to be considered and how these relate to the supply, management, storage and contracting for the supply of fuels;
- An introduction to the appropriate methods and levels of testing that may be required to assure end-users that they are being supplied with the fuel that is "fit for-purpose" and most cost-effective;
- The influence the fuel supply chain has on the delivery of solid biofuels and how different fuel management options can mitigate risk and potentially cost.
- Information related to the cost of biofuels and factors affecting these and options to manage them appropriately.
- Specific details that should be considered by both sellers and purchasers of solid biofuels in the preparation of contracts, including details on terms, reviews, health and safety, payments, price escalation, fuel verification and quantity specifications;
- An introduction to the Bioenergy Association quality assurance programme for solid biofuel suppliers which allows for the introduction of cost-savings and which encourages more confidence within the solid biofuels market.

Version 2 has been updated with the latest best practice information and expanded to include new sections on the sustainability of using biomass for heat, and information on the availability of solid biofuel into the future.

[1] https://www.usewoodfuel.org.nz/resource/tg01-solid-biofuel-classification-guidelines
[2] https://www.usewoodfuel.org.nz/resource/tg05-verifying-solid-biofuel
[3] https://www.usewoodfuel.org.nz/resource/tnsb04-solid-biofuel-supplier-accreditation-scheme

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1 INTRODUCTION

The contracting of solid biofuels, predominantly wood fuels, is an important process in realising this form of bioenergy as a mainstream energy source. Some of the more critical elements to consider in the contracting process are:

- Clear definitions of the type of biofuel to be contracted for and delivered;
- Clear understanding of the specific properties required by the end-user and ways to manage supply over time;
- The development of an iterative process between fuel supplier, heat plant supplier and the end user of the energy to ensure that fit for purpose fuel is contracted for and delivered cost-effectively;
- Appropriate systems are in place to validate the quality of the biofuel required and subsequently being delivered, and that there are agreed sampling and testing regimes;
- Where biofuel is being supplied by an accredited biofuel supplier then there are potential cost savings and efficiencies that improve the overall operation of the solid biofuels market by the reduction of unnecessary verification testing; and
- The development of market confidence by ensuring best industry practice is being used to supply "fit for purpose fuels' and contractual conditions are practical, ensure costs of fuel are reasonable, and not too onerous to make fuel suppliers reluctant to be in the market.

The Bioenergy Association has developed this guide to assist the contracting process and to be used as a reference in specifying appropriate contract conditions for a particular situation. A high level of flexibility in the contracting process is required to cope with varying scales of operations, different heat plant types, balancing the capital cost of heat plant with fuel quality and its associated cost implications, and the availability of different fuel types.

A model contract for solid biofuels is provided as an Appendix. This is included as an initial template and to assist both solid biofuels suppliers and buyers to develop an appropriate contract relevant for their specific situation[4].

2 THE MARKET FOR BIOMASS USED TO PRODUCE SOLID BIOFUELS

The wood fuel market commenced in New Zealand in the 1800s once homeowners were not able to source firewood for own use by self-collection. Firewood was sourced from sawmills or forest harvest residues. Generally, there was little quality control by firewood suppliers over the moisture content of the firewood except was it wet or dry. People knew that firewood from different species of tree were often hotter or combusted better in their fireplace.

With the establishment of pulp and paper mills in the 1900s, and then engineered wood product manufacturing such as MDF, the contractors collecting, and transporting forest residues to the

[4] A WORD version of the template is available free from www.usewoodfuel.org.nz/documents/admin/TNSB77-Model-fuel-supply-contract.pdf

nearby wood processing facility developed their own collection and treatment processes and quality was specified by the customers.

As the log export trade expanded forest owners had a choice of supplying logs to international markets or domestic sawmillers. The logs were either pruned or unpruned and the residues were never recovered except from areas around pulp and paper or wood processers who wanted good wood chip.

Forest wood has always been sold to the customers who pay the most. When harvested, tree stems are cut to the requirements of different markets. For many years export logs gained high prices but that market is declining and new products from wood are being developed. In some areas domestic sawmillers have struggled to obtain the grades of log they want and at a price that they could pay.

Prior to 2010, traded wood residues were often purchased and sold between wood fuel processors for use as a supplementary fuel for kiln drying boilers. Often the purchaser required a dry biomass to mix with their own sawmill sourced wet biomass to get a blend suitable for boiler operation. Wood residues were also sold to manufacturers of engineered wood products such as MDF. There was minimal open trade in wood fuel to parties outside the wood industries sector. There was one established wood pellet producer supplying biofuel for residential wood pellet fuelled heaters. Firewood was supplied by an essentially unregulated market. Councils were starting to educate users of residential solid wood heaters of the importance of using only low moisture firewood. Open fireplace heating was starting to be banned in some urban areas where airsheds had air pollution issues.

Around 2010 the trade in wood fuel to parties outside the wood industries sector started occurring and the buyers and sellers recognized the need to have common terminology of the different fuel types and fuel quality. The Bioenergy Association responded by establishing a suite of guidance documents[5] and established a Wood Fuel Supplier Accreditation Scheme[6] to give confidence to buyers that the fuel they received met the specification for the fuel they had contracted to purchase.

From 2010 – 2020 the demand for wood fuel grew steadily and some Wood Fuel Suppliers were able to expand and then consolidate their capabilities to supply a range of types of wood fuel, principally wood chip, hogged biomass fuel or wood pellets. The demand was from rest homes, schools, hospitals and food processors. The biomass for this demand was able to be comfortably sourced from wood processor biomass residues, and forest harvest residues. Quality of fuel was maintained as all the larger wood fuel suppliers were accredited and experienced aggregators of biomass from different sources.

With the Government developing financial support programmes for the decarbonization of stationary heat to reduce greenhouse gas emissions, and then the introduction of a ban on the use of coal for stationary heat, the demand for solid biofuels expanded considerably, and in some areas, there grew a perception that demand exceeded local supply of biomass fuel. This was only a

[5] www.usewoodfuel.org.nz/solid-biofuel-suppliers
[6] www.usewoodfuel.org.nz/resource/tnsb04-solid-biofuel-supplier-accreditation-scheme

perception as the large forestry owners were slow to respond to demand signals. However the established Accredited Wood Fuel Suppliers were always able to meet specific contract demands by aggregating the collection of biomass from a wide number of different sources.

The perception of a shortage of biomass available to be processed into being a solid biofuel was eventually recognized by forest owners and since 2023 they have been partnering with the wood fuel suppliers to source biomass residues, particularly for large biofuel supply contracts.

Solid biofuels are still principally sourced from wood as other sources such as herbaceous are still in the evolutionary stage.

2.1 Future biomass availability

As the demand for biomass for energy, engineered wood products and new bio-based products has increased the wood industries have started a transition to obtaining greater value for wood than from current traditional products of timber or export. The wood industries sector and the Government have established a joint funded Industry Transformation Plan[7].

As a result of the increased demand for biomass by a growing pool of new users, and the effects of transformative thinking:

- More harvest residues are being reclaimed as demand for biomass grows.
- Where there is a market, forest owners are removing harvest “slash”, and in some forests undertaking whole tree recovery using new techniques which also reduce the costs of residue recovery.
- Wood processors recycle around 100% of their residues either into secondary wood products, or as an energy fuel.
- Low grade logs are being diverted from export to higher value customers, such as for energy. This also results in greater recovery of biomass which otherwise would be left as residues which would then have to be recovered.
- Farmers are starting to recognize the wide range of markets, such as energy, from which trees of farms can produce additional income, and improve farmland management.
- The need to avoid farmland erosion is forcing hill country landowners and land regulators to better manage trees as a sustainable land management tool.
- Government is supporting the establishment of additional wood processing, which will provide increased quantities of wood residues, some of which can be a source of energy.

Some heat users are independently establishing their own arrangements for ensuring security of supply of the future biomass energy. These arrangements are generally in partnership with landowners or forest owners. A benefit of biomass energy is that heat users can make their own supply arrangements without the need of large energy companies. Heat users have greater control over their future energy costs.

[7] www.usewoodfuel.org.nz/resource/forestry-and-wood-processing-industry-transformation-plan

Projections[8] prepare by the Bioenergy Association of the future availability of biomass for energy, as well as other bio-based products shows that with continued action by all parties that there will not be a shortage of biomass available in the period to 2050. We can be confident about the projections that there will be adequate supply of biomass as the supply market is working efficiently to meet demand as and when demand increases[9]. The main action that will assist this is that the supply and demand participants have good regional information and have the time to respond.

2.2 Competition for biomass

There has always been competition for biomass for sale as bio-products and forest owners have sold to gain the best price. The value of the biomass being set by the price for the different uses.

As New Zealand transitions to be a circular bioeconomy as suggested by the Emissions Reduction Plan then there will be a wider range of demands for biomass. Simple analysis shows that New Zealand has the capability to extensively expand the rotational growing of trees on farms with low productivity land so that there can be adequate quantities of biomass available for all uses. The increased demand will also incentivize greater recovery of residues above what happens today. Bioenergy Association has no doubt that there will be adequate supply of biomass for all uses provided we take action to ensure that the right tree, of the right species is in the right place, at the right time.

3 SUSTAINABILITY OF SOLID BIOFUEL

In New Zealand biomass is derived from four sustainable sources: Municipal waste, agricultural crop and food processing residues, farm forestry residues, and plantation forestry residues.

Using the organic waste or residues from land use, communities and manufacturing is a key objective of sustainable living and a circular bioeconomy. It also makes sound sense and can lead to economic benefits of new products and employment. We are good at producing waste from primary activities and we do it 365/24 so it is a no brainer that we should look at the value that we can extract from what is being wasted. Energy and the co-products of energy are some of those products.

Most biomass used to produce energy in New Zealand is from residues or material which would otherwise be wasted to landfill. Recycling this material to produce energy follows the principles of a circular bioeconomy and the New Zealand Waste Strategy. Biomass that is purpose grown to be a feedstock for production of energy is generally only grown as a supplementary feedstock to manage fluctuations in residue availability. Some biomass is derived from a purpose grown energy crop but this is rarely done because there is generally adequate residues that would otherwise be wasted.

In some countries there are extensive areas of energy crops but in New Zealand this does not occur as the primary products from a plant, be it food, timber or other bio-based products, is the reason

[8] www.usewoodfuel.org.nz/resource/residual-biomass-fuel-projections-for-nz
[9] www.usewoodfuel.org.nz/resource/the-demand-for-biofuels-is-changing-the-value-of-trees

for the plant being grown, Recycling the residues to produce a co-product results in additional value being derived from that plant. The use of biomass residues is therefore fully sustainable.

3.1 Sources of sustainable biomass

Forests provide us with clean water, fresh air, biodiversity, recreation and help combat global warming. They also provide food, medicine, and important natural resources, such as timber and paper. If managed responsibly, forests and plantations benefit land management, rural communities and their people, and wider regional and national economic sustainability. However, in some countries as much as 80% of the timber is harvested illegally. This often involves violation of human rights and felling of protected forests. This is not the situation in New Zealand as by-law indigenous forests are not and cannot be harvested.

Trees on farms as shelterbelts, woodlots or erosion control can be planted with the objective of sustainable farm management and land use. If planted so that the trees can be harvested at end of life or for best practice land use reasons, then this can be a source of farm income, livestock greenhouse gas emission mitigation, and a source of either on-site energy production, or sale for other energy production.

Agriculture crops often produce a residue after the fruit, seed or food component is harvested and which does not have a high value use and thus can be available as a source of biomass to produce energy. Dry herbaceous residues can sometimes be densified into a pellet form and used directly as a combustion fuel. Other higher moisture content residues may be better used as a feedstock for anaerobic digestion to produce biogas and biofertiliser.

Horticulture shelterbelts or crop residues can be recycled, dried and used as a combustion fuel as part of sustainable management of a horticulture operation.

Biomass from municipal applications could be treated used timber or aborist prunnings. These can only be combusted in appropriately high temperature boilers such as the cement factory near Whangarei.

3.2 New Zealand Government Biofuel Sustainability policies

In November 2022 the NZ Cabinet agreed the criteria for regulations to support the then proposed Sustainable Biofuels Obligation.

Specifically, the Minister approving the regulations must be satisfied that both biofuels and feedstocks:

- are not likely to have a significant adverse effect on biodiversity;
- are not likely to lead to the deforestation of native forests or canopy forests or the destruction of wetlands or peatland;
- are not likely to adversely impact food and feed security;
- are not likely to have a significant adverse impact on water quality or significantly restrict its availability in an area;
- are not likely to be associated with a high risk of indirect land use change.

In addition, the Minister must have regard to:

- the impacts on soil carbon of any activities that are associated with the cultivation, production and processing of feedstocks;
- the principles of the waste hierarchy.

Until the regulations are gazetted it is recommended that the criteria set out in this Cabinet decision are adopted.

3.3 Carbon neutral

Because bioenergy is sourced from combustion of plants who absorb CO_2 biomass residues at source are considered by the IPCC to be a carbon neutral fuel[10], if from rotational forests where harvested trees are replaced by new plantings[11].

However, biofuel is not 100% carbon neutral as when the residue is treated to be a biofuel some CO_2 is produced from equipment recovering the biomass, processing it into fuel and transporting it to a customer.

3.4 Land use regulation

The Resource Management Act 1991 (RMA) is the main piece of legislation that sets out how the land is to be managed. The National Environmental Standards for Plantation Forestry (NES-PF)[12] are the regulations made under this legislation that apply to any forest of at least one hectare that has been planted specifically for commercial purposes and is to be harvested. The NES-PF supersedes almost all district council plan provisions, and many of those of regional council plans, except in specific situations where the NES-PF allows councils to apply more stringent rules.

The intent of the regulations is to better protect the land and environment and to apply consistent environmental standards across the country while improving the productivity of the forestry sector and reducing operational costs. Councils previously managed the environmental effects of forestry activities through regional and district plans.

The Ministry for Primary Industries (MPI) has developed guidance to support implementation of the NES-PF[13]. The guidance is targeted at regional councils, territorial authorities, and the forestry industry as the primary users of the NES-PF. The Guide is a useful tool to help interpret the rules.

[10] www.bioenergy.org.nz/resource/tnbb18-bioenergy-is-carbon-neutral
[11] www.usewoodfuel.org.nz/resource/wba-factsheet-carbon-neutrality
[12] www.usewoodfuel.org.nz/resource/tnsb95-national-environmental-standards-for-plantation-forestry
[13] www.mpi.govt.nz/dmsdocument/27930-Resource-Management-National-Environmental-Standards-for-Plantation-Forestry-Regulations-2017-March-2018

3.5 Forest certification

The New Zealand plantation forest estate is covered by two voluntary certification standards administered by the Forest Stewardship Council (FSC) and Programme for the Endorsement of Forest Certification (PEFC)[14].

Many New Zealand plantation forests were originally planted for soil and water conservation reasons on erosion-prone hill country which was formerly in sheep and cattle pasture.

Once young radiata become established, they rapidly stabilise steep hillsides, protecting the soil and regulating the rate at which water is able to run off the land. The vegetative litter on the forest floor acts as a sponge — holding and slowly releasing water for many days after the last rainfall. This helps prevent destructive flooding.

Third party certification of sustainable management practices plays an increasingly important role in NZ plantation forest management. Half of the country's plantations and one-third of the annual harvest are already third party certified by FSC or PEFC.

3.6 Forest harvest practices

The Forests (Legal Harvest Assurance) Amendment Act 2023 establishes a regulatory system for providing legal harvest assurance for the forestry and wood processing sector[15]. It is expected to operate in a manner that will:

- assist in the prevention of international trade in illegally harvested timber; and
- strengthen the international reputation of the New Zealand forestry and wood processing sector; and
- safeguard and enhance market access for New Zealand forestry exports; and
- reduce the risk that timber imported into New Zealand is sourced from illegally harvested timber.

The harvesting, milling and exporting of indigenous timber is managed under the Forests Act 1949[16]. Under the Act, native timber can only be taken from forests in a way that maintains forest cover and ecological balance. Part 3A of the Act discourages unsustainable harvesting and clearance of private indigenous forests and provides for their sustainable management. It gives owners options for managing their forests to harvest and mill timber. It also places controls on the milling and exporting of indigenous timber.

The NES-PF provides a consistent regulatory approach for various forestry activities including earthworks, crossings and harvesting. A major platform of the regulation is that a forestry earthworks management plan and harvest plan (a Management Plan) is to be prepared. The

[14] www.usewoodfuel.org.nz/resource/tnsb96-forest-certification
[15] www.usewoodfuel.org.nz/resource/tnsb94-legal-harvest-assurance
[16] The Forests Act 1949 www.legislation.govt.nz/act/public/1949/0019/latest/DLM255626.html?src=qs

specifications in the NES-PF set out the details of the matters to be included in such a plan. There is a requirement to describe the management practices that will be carried out.

The Forest Practice Guides[17] published by the NZ Forest Owners Association are to assist forest owners/managers and contractors to meet legislative requirements of the Resource Management Act 1991 (RMA) and in particular the National Environmental Standards for Plantation Forestry (NES-PF). The guides provide options and information on a range of practices and methods to manage effects of the operations on the environment.

4 SOURCES OF SOLID BIOFUELS

This Guide covers solid biofuels which includes biofuels derived from both woody and non woody biomass. Because solid biofuel from wood is the main biofuel type in New Zealand the words “solid biofuel” and “wood fuel” are often used interchangeably throughout this Guide.

Typically, solid biofuel classification systems are based on the follow main parameters:

- the origin or sources of the biomass material;
- the type or tradable form of the biofuel[18]; and
- the properties of the fuel.

In the following section the different sources of solid biofuel are briefly discussed from the point of view of appropriately describing solid biofuels for contractual purposes.

Solid biofuels can be sourced from a range of situations including forests, agricultural and horticultural activities, land clearing, land management, wood and food processing operations, and urban land maintenance. Solid biofuels can be found associated with any recovery operation of woody or herbaceous plant biomass. For the purposes of this technical guide woody materials for solid biofuels specifically include all of the following:

- Woody biomass including processed types such as torrefied wood, wood pellets and briquettes.
- Herbaceous biomass
- Fruit biomass
- Urban derived woody materials including arborist tree prunnings and treated used wood
- Blends and mixtures.

Woody biomass is from trees, bushes and shrubs.

Herbaceous biomass is from plants that have a non-woody stem and which die back at the end of the growing season. It includes grains and their by-products such as cereals.

Fruit biomass is the material from the parts of a plant which are from or hold seeds.

[17] https://docs.nzfoa.org.nz/forest-practice-guides/
[18] www.usewoodfuel.org.nz/resource/tg01-solid-biofuel-classification-guidelines

Urban derived woody materials will include, clean wood waste arising from packaging, demolition and construction residues, treated used timber, green urban tree prunnings and contaminated used wood sources.

Typically, the terms **blend and mixtures** will refer to material of various origins. Blends are intentionally mixed biofuels, whereas mixtures are unintentionally mixed biofuels.

Much of the solid biofuel that is currently available in New Zealand is in the form of plantation forest harvest hog or chip residues, or wood processing derived material. Little or virtually no material is available from agricultural residues or short rotation crops grown specifically for energy though this is expected to change over time where supplementary biomass feedstock will be required.

For solid biofuel material to be regarded as renewable fuels it is important that they are sourced from sustainably[19] managed operations and that the net greenhouse gas emissions arising from the use of such materials are less than either fossil fuel sources of energy or alternative fuel systems.

4.1 Wood Fuels from Forest Derived Material

Solid biofuels derived from forests can be sourced from any material that is removed from or is the standing biomass crop at any time over the lifetime of the forest. This material may come from silvicultural practices such as pruning, thinning and harvesting operations. Bioenergy Association sustainability principles require that the material only comes from farm forestry or plantation forests that are going to be replanted within a short period of harvest, or is material sourced from a permanent forest as part of a forest management programme.

Many large forests will be certified by FSC or PEFC[20] but it is unlikely that small woodlots are certified by these international certification bodies, in which case the biomass buyer should satisfy themselves that the woodlot has been managed and harvested to similar sustainability standards.

Bioenergy sector environmental standards for growing and harvesting plantation trees are set out in the National Environmental Standard for Plantation Forestry[21] . The wood must also be taken only from legally harvested forests[22].

4.1.1 Wood Fuels from Prunings and Thinnings

Prunnings and thinnings from plantation forest are usually small diameter stem and branch pieces and are obtainable from the forest as a result of either prunning or thinning silvicultural practices. Often this material will still have branches and needles attached to the stems. Care needs to be taken with chipping or shredding this material as it can often include stones and other non-biomass material which can damage processing and handling equipment or boilers during combustion.

[19] www.usewoodfuel.org.nz/resource/tnsb23-sustainability-of-biomass-fuels
[20] TNSB96 Forest certification
[21] TNSB95 NES-PF
[22] TNSB94 Legal Harvest Assurance

4.1.2 Forest Residues

Forest residues are derived from log harvesting operations which will include material that arises either on the cutover (the land that trees are harvested from) and the landings (areas where trees are pre-processed into logs for subsequent distribution to either domestic wood processors or export facilities). The collection and use of the cutover residues needs to be balanced with leaving sufficient material on the cutover ground for the recycling of nutrients for subsequent crops and the economics of gathering it up as this material is generally spread over quite large areas. The types and quantities of wood residues produced during harvesting operations will vary from site to site according to the types of silvicultural regime deployed for a particular forest stand, the sources of the residues and the harvesting process.

Currently, most forest residues collected for energy are sourced from landings due to this material being cost effective to recover. Typical recoveries of residues from landings and the cutover are around 10-20% of the total extractable volume with the landing residues being around 5-10 % and the cutover being closer to 10-12% - though these yields will vary depending on whether ground-based logging or hauler-based logging is used. Ground-based logging systems will have lower potential yields of residues compared to hauler logging operations.

The recovery, processing and costs of utilising forest residues are covered in a number of reports[23].

4.1.3 Wood Processing Residues

Wood processing residues is the main form of solid biofuel used for energy today in New Zealand and it arises from the processing of logs into either lumber, panel products or for pulp and paper. The main sources of log residues are debarking, wet sawdust from the primary processing (sawing) of logs, slab wood (arising from the trimming of the outside of logs for squaring up a face, and subsequent re-sawing operations to produce dimensional lumber. Other sources of processing residues are dry sawdust and shavings following the drying of lumber in kilns and its subsequent processing. For pulp mills much of the processing residues are from debarking, rejects from chipping operations and log end cut off prior to chipping.

For a typical sawmill around 10% of the total volume of logs processed may finish up as debarker residues, around 12-15% as sawdust from wet log breakdown and where shavings are being produced then this can around 12-15% of the volume being processed.

The types of fuels produced from wood processing operations are usually a mixture which will make up a hog fuel mix. Where sawmills are located within 100km of pulp and paper mills or larger panel manufacturers, then fuel is often transported from sawmills to the larger operations as these later sites often have wood fibre or solid biofuel deficits.

[23] Forest residue harvesting for bioenergy fuels: Part 1 (Scion, 2007).
Forest residue harvesting for bioenergy fuels: Part 2 (Scion, 2007).
Good practice guide: Production of wood fuel from forest landings: EECA Technical Guide No.9.

4.1.3.1 Wet Sawdust

Wet sawdust arising from the sawing of logs will have moisture contents of between 35% and 55% (wet basis) depending on the age of the logs. However, most logs are processed fresh therefore the moisture content of the sawdust is at the higher end of this range.

Wet sawdust is most widely used by pulp and paper mills and as a raw feedstock for pellet production. If wet sawdust is to be used by a sawmill as fuel the material will usually need to be dried to less than around 35% prior to being used as many sawmills have boilers that are designed more for dry fuels rather than wet materials.

4.1.3.2 Dry Shavings

Dry shavings are derived from the gauging of timber to specific dimensions and into a final profile. Dry shavings will have a moisture content of 12-16% (wet basis) and can be readily used by a wide range of boilers. Shavings will have a bulk density of around 90 kg/m^3. However, combustion of shavings can be an issue if there is not enough biomass on the grate as the shavings can combust in suspension and in some boilers this may result in incomplete combustion and therefore smoke.

4.1.3.3 Bark

Bark is sourced from debarking operations and depending on the process used to remove the bark the moisture content of this material will be between 15% - 40% wet weight basis. Higher moisture content bark will be derived from hydraulic debarking systems. Bark size is typically highly variable and depending on the age of the logs being debarked it can be chunky or stringy. Softwood bark will have a bulk density of around 180 kg/m^3 when it has a moisture content of 15%.

4.1.3.4 Off-cuts

Off-cuts are sourced from either the processing of logs through chipping lines, trimming and cutting boards to correct dimensions through a sawmill, or docking boards through both green or dry mill situations. Off cuts may be wet or dry depending on whether they are produced in the Green Mill or Dry Mill. This source of solid biofuel will usually need to be either chipped for hogged prior to its use in boilers.

4.1.4 Combusting treated used timber

Some boilers are designed such that they could safely combust a mixed fuel of treated and untreated wood, and emissions will be within the conditions of the facility's resource consent. High temperature boilers will be able to safely combust greater percentages of treated wood but low temperature boilers may only be capable of combusting untreated wood24.

It would be usual that a consenting authority would issue a conditional consent for a boiler system likely to combust treated biofuel.

[24] www.usewoodfuel.org.nz/resource/tg9-consenting-of-biomass-boiler-systems-using-different-solid-biofuels

4.1.5 Diversion of low-grade logs from export

While not a unique source of biomass, as that is the forests from which logs for export are sourced, the diversion of low-grade logs to be a source of biofuel is a large quantity of biomass potentially available as a solid biofuel. In the South Island the price of low-grade export logs sets the benchmark for sale of wood for processing into solid biofuels.

4.2 Herbaceous solid biofuels

Herbaceous solid biofuels are typically sourced from agricultural or horticultural operations and may comprise of the following:

- Cereal crops including whole plants, stems or grains or seeds;
- Grasses including Miscanthus and switch grass, and include whole plants, stems, seeds and shells;
- Oil seed crops;
- Root crops;
- Legume crops; and flowers.

Generally, it is the residues from primary products produced from this material which can be used as a biofuel.

Where these types of solid biofuels are being contracted it will be important to ensure that they are appropriately identified and fully characterised as these materials can have high inorganic contents which can contribute to ash and slag formation in boilers. Such conditions can contribute to issues of reduced heat transfer and corrosion.

These fuels can be traded in a range of forms which may include:

- Hog fuels;
- Briquettes;
- Pellets or
- Bales.

The nature of the tradable material will affect the bulk density, energy density and the nature of the handling system required.

In some cases, the materials are relatively difficult to chip or hog due to their fibrous nature. When sourcing these types of fuel, it will be important to ensure that the final form of the fuel to be delivered is well specified and if further processing is required for use in a boiler, then the end-user of the fuel is aware of its characteristics and the costs of additional processing.

5 FUEL CLASSIFICATIONS AND CHARACTERS

5.1 Descriptions and Definitions

Solid biofuels can be classified according to a number of different conventions. For New Zealand and Australia a recent review of classification has led to adopting the ISO Solid Biofuel Standards[25]. ISO17225-1 sets out a framework for classification of solid biofuels according to their origin, tradable form and their properties. In the case of the New Zealand and Australia the focus of the specifications is on the tradable form and their properties and thus the standard has been simplified and is recommended as discussed in Bioenergy Association Technical Guide 1: Solid Biofuel Classification Guidelines[26].

Solid biofuels are classified as wood chips, hog fuel, pellets, urban solid biofuels, compressed firelogs and briquettes, thermal treated wood and chip, herbaceous wood fuels and firewood. Each of these solid biofuels is considered in the following sections.

The full details of the classification of solid biofuels are provided In the *Bioenergy Association Technical Guide No. 1: Solid biofuel classification guidelines, Version 6.*

5.1.1 Wood Chips

Wood chips are a common form of solid biofuel used for small and larger scale heat plant and are produced from stem wood, log off cuts, billet or bin wood and wood processing offcuts. Chips are produced by sharp cutting tools which give a relatively consistent particle size.

Wood may be chipped either wet or dry. Wet chips come from relatively fresh wood and dry chips come from dried logging material or dried timber arising from trimming kiln dried lumber.

5.1.2 Hog Fuel

Hog fuel is solid biofuel in the form of pieces of varying size and shape produced by crushing or shredding with blunt tools such as rollers, hammers, or flails and can be sourced from a wide range of woody feedstocks such as wood processing residues, urban clean woody waste or other forest or woodlot derived material.

5.1.3 Pellets

Wood pellets are typically produced from high quality wood residues and their production is standardised to standard ISO17225-2[27] according to the wood feedstock used.

There are three main scale of heat plant in which wood pellets are used:

- Small – generally domestic home heating,
- Medium – generally small to medium sized commercial/industrial boiler plant, and
- Large – generally large industrial process heat boilers and for substitution for coal for electricity generation.

[25] www.usewoodfuel.org.nz/resource/tnsb32-solid-biofuel-standards
[26] www.usewoodfuel.org.nz/resource/tg01-solid-biofuel-classification-guidelines
[27] www.usewoodfuel.org.nz/resource/tnsb28-wood-pellet-standard

Biomass fuel pellets can be consistently produced to specified standards because they are an engineered product. In small scale heating applications such as for residential home heating the electronic control of the heater operation and the consistency of the quality of the wood pellet fuel provides a means of control of the emissions from combustion[28]. As a controlled heat source this ensures that emissions are within Air Plan rules and avoids the need for monitoring emission outputs as they are controlled by the technology and fuel inputs. In larger heat plant where air emission resource consent conditions require external monitoring and reporting the amount of monitoring can be reduced significantly if wood pellets is the fuel because of the consistent quality of the fuel input. Control of the quality of fuel ensures that combustion plants will operate within the consent conditions.

Internationally standards relating to the classification of pelletised biomass fuels are set out in parts of the ISO 17225 series. ISO 17225-2 (graded pellets from wood for household and commercial[29] applications and for industrial use), ISO 17225-6 (non-woody graded pellets for household and commercial applications, and ISO 17225-7 (Graded non-woody briquettes.)

ISO 17225-2 supports the use of graded wood pellets for residential, small commercial and public buildings as well as industrial energy generation applications, which require classified pellet quality. The residential, small and commercial and public building applications require higher quality fuel for the following reasons:

- Small-scale equipment does not usually have advanced controls and flue gas cleaning.
- Appliances are not generally managed by professional heating engineers.
- Appliances are often located in residential and populated districts.

Pellets produced according to ISO 17225-2 may be used in pellet stoves, which are tested according to European Standard EN 14785, pellet burners tested according to EN 15270 and pellet boilers or integrated-pellet burner systems tested according to EN 303–5.

There are four categories of wood pellet standard based on the quality classes of ISO 17225-2 and are named as follows:

- Grade A1 - premium pellets - for use in any residential heater or commercial boiler;
- Grade A2 – large premium pellets - for use in selected boilers;
- Grade B – commercial grade pellets for use in selected boilers subject to resource and boiler manufacturer consents.
- Grade I – industrial grade

There are also grades of pellet produced from non-woody biomass to the standard ISO 17225-6

- Grade NWP – pellets produced from non-woody biomass.

[28] Consent process – When a resource consent is applied for, the boiler supplier must clearly state what category of pellets are to be used in the appliance. This must also be stated in the warranty conditions of the boiler. This requirement will give confidence to the consent issuer that the appropriate technology and fuel are being used. Testing of both the fuel and boiler technology in advance is likely to lead to a more efficient consenting process.

[29] Commercial applications means a facility that utilises solid biofuel burning appliances or equipment that have the similar fuel requirements as residential appliances.

Torrefied pellets are excluded from the scope of ISO 17225-2 and are instead included in ISO 17225-1 and ISO 17225-8.

Table 1 - Specification Parameters for Grade A1 Premium wood pellets

Specification	Measurement	Comment	Testing standard
Diameter	6±1 mm		ISO 17829
Length	3.15 ≤ L ≤ 40 mm	Max of 1% of the pellets may be greater than 40mm, no pellets > 45mm allowed	ISO 17829
Ash	≤ 0.7 %	By weight	ISO 18122
Additives	≤ 2.0 %	By weight. Type of additives to be defined. Examples are slagging inhibitors or any other additives like starch, corn flour, vegetable oil, or lignin.	-
Moisture	≤10 %	By weight	ISO 18134
Bulk density	600 ≤ BD ≥ 750 kg/m^3	As received basis. It is recommended actual value of bulk density to be stated on packaging.	ISO 17828
Net calorific value	≥ 16.5MJ/kg	As received basis	ISO 18125
Mechanical Durability	≥97.5 %	As received. By weight.	ISO 17831-1
Fines	≤1.0% truck load delivery ≤0.5% Large sacks and bulk ware	By weight, ex gate. Particles of size less than 3.15mm	ISO 18846
Ash deformation temperature	≥ 1200 ^{o}C		CEN/TC 15370-1
Chlorine	<20ppm		ISO 16994
Sulphur	<0.04%	By weight	ISO 16994

Grade 2A – Large premium pellets

Grade 2A pellets are typically used for selected boilers.

This grade also represents high quality pellets but is for larger scale applications, e.g. school boilers. This grade can also be used in high emission control areas. Grade 2A pellets are suited for use in large boilers (depending on design). Grade 2A pellets differ from Grade 1A pellets only in terms of their physical qualities (likely to be larger diameter compared to Grade 1A pellets); the pellet quality remains unchanged to a large extent.

Grade I – Industrial grade pellets

Application – for use in selected boilers (subject to resource and boiler manufacturer consents)

This grade is for larger scale applications which are installed outside airshed control areas or where air emission consents are required. Large boilers (dependent on design) can utilise a variety of wood fuels. Grade I pellets offer the benefits of a pelletised fuel (easy handling) but do not offer the advantages associated with Grade 1A and 2A pellets (i.e., low ash and low emission levels). There

are no guarantees on emissions, boiler longevity and boiler efficiency when using this category of pellet. The boiler would need to clearly state that "Grade I" pellets can be used, in addition it would need to place limits in terms of pellet content over and above the specifications listed here.

5.2 Urban Solid Fuels

The term 'urban' is used to describe solid biofuels which are derived from largely urban sources as outlined below:

- Used wood from logistics and freight forwarding companies;
- Used wood from storage, warehousing and distribution centres;
- Manufacturing used wood including furniture, home wear, pallets and board producers;
- Construction timber waste which covers new builds, residential, industrial and commercial properties;
- Used wood from demolition works, mainly residential and commercial units, building refurbishments;
- Arborist tree prunnings;
- Household Waste Recycling Centres where local residents dispose of unwanted wood and timber products;
- Commercial activities, for instance companies who receive significant quantities of palletised products or packaging cases, wooden cable drums.

Although these sources are not mutually exclusive to urban areas, the volumes necessary to make processing of the biomass into a fuel economically viable usually means that this type of solid fuel production is situated close to urban areas.

In the urban solid biofuel market, three main grades are considered:

- Chemically untreated used wood
- Chemically treated used wood
- Arborist tree prunnings

General classification, chip dimensions and specification fall within ISO17225-1.

5.2.1 Chemically untreated used wood

Chemically untreated used wood within the urban solid biofuel classification is usually sourced from packaging material, pallets, untreated demolition wood, and wood processing off-cuts. This type of material meets the classification of wood chips. Moisture content can typically be around 14% and because this fuel has relatively low moisture content it has a high (as supplied) calorific value.

Provided the material is appropriately monitored to ensure that it is not contaminated with treatment chemicals, then there should be no constraints on its use. Given the boiler and burner technology that is prevalent across New Zealand, then untreated used wood chip can be used as biofuel in a wide variety of systems without particular regulatory considerations. It should be considered as being a standard wood chip as referred to in 5.1.1 and be a permitted use under Regional Air Plans.

5.2.2 Chemically treated used wood

Urban wood waste can contain wood preservatives, binders, paints, glues, chlorine bleach, plastic laminating materials, chlorinated adhesives, phenol and urea formaldehyde resins, nails/staples, or other non-wood materials. It may be mixed with other types of demolition waste, such as rubble, reinforcing bars, tiling or dry wall plasterboard.

A large proportion of the waste wood arising in each of the urban waste streams is treated in some form to increase its durability. Treatments commonly used now or in the recent past include surface coatings such as paints, varnishes and impregnated preservatives such as chromate copper arsenate (CCA), ammoniacal copper quat (ACQ), creosote, boric and pentachlorophenol. Treatments with lesser environmental impacts have been, and are being, developed and are likely to lead to more acceptable use of the 'end of life' wood as fuel. Different preservatives require different considerations when they are reprocessed, recovered or used as a biofuel.

The handling of any treated or coated material as a solid biofuel should be undertaken in a safe manner and be approved as a discretionary consent by the Regional Council. Further expert technical advice[30] may be required to process or use this fuel type.

- ***Minor chemical treatment***

Used wood or residues from wood processing which has had minor chemically treatment such as paint should be able to be blended with untreated biomass and used as a biofuel in specifically designed combustion equipment with appropriate control systems for emissions to air. The percentage blend of treated wood able to be blended with untreated biomass should be advised by the combustion system supplier. Guidance for consenting purposes should also be obtained from the combustion system designer or supplier[31].

- ***Medium chemical treatment***

Biomass which has medium levels of chemically treated used wood or residues from wood processing may include manufactured wood panels and furniture (such as MDF or contains formaldehyde etc), boric treatment, paint surface coatings), as long as they do not contain heavy metals or halogenated organic compounds as a result of treatment with wood preservatives or coating. (glued, painted, coated, lacquered or otherwise treated wood).

- ***Heavy chemical treatment***

Biomass which has chemical treatments such as CCA containing halogenated organic compounds (as Cl, F) or heavy metals (as As, Pb) should only be used as a biofuel in suitable designed and operated high temperature combustion systems that are specifically designed to effectively combust such materials and which account for any potential hazardous emissions. Any such installations are likely to require specific discretionary resource consents which will allow the use of treated wood.

[30] www.usewoodfuel.org.nz/resource/tg9-consenting-of-biomass-boiler-systems-using-different-solid-biofuels
[31] www.usewoodfuel.org.nz/resource/tg9-consenting-of-biomass-boiler-systems-using-different-solid-biofuels

5.2.3 Arborist tree prunnings

Solid biofuel included within this classification may be segregated wood from gardens, parks, roadside maintenance, vineyards, fruit orchards and driftwood from freshwater. This classification of biomass is covered by the wood chip category in 3.1.1.

5.2.4 Mixed Grade Urban solid biofuel

Shavings and wood dust can also be included in the mixture and would be typically less than 10% of the total mix. This grade can include a small percentage of treated timber. The moisture content is often slightly higher than the untreated used wood as some of the materials for this grade have greater capacities to absorb moisture, such as hogged MDF. Typically, the moisture content is between 18-25%. The biofuel is also often less dense compared to untreated used wood and therefore has lower energy density.

Verification methods for these solid biofuels are the same as those described in the Verification Technical Guide 5 for other types of biofuel[32].

5.3 Compressed Firelogs and Briquettes

Biofuel briquettes are densified biofuel made either with or without additives in a range of different shapes and are typically produced by compressing pulverized biomass. The raw material for briquettes can be woody biomass, herbaceous biomass, fruit derived materials for blends and mixtures. Biomass briquettes are typically made in a piston press.

The total moisture of briquettes is usually less than 15%.

Classifications of the properties for firelogs and briquettes[33] are set out in Technical Guide 1[34]

5.4 Torrefied Wood Chips

Torrefied wood is relatively new type of upgraded wood fuel produced by heating wood to 240 - 320 °C in the absence of oxygen or a low air environment.

The advantages of torrefaction are:

- Torrefaction (+ densification) enables energy-efficient (>90%) upgrading of biomass into commodity solid biofuels with favourable properties in view of logistics and end-use;
- Favourable properties include high energy density, better water resistance, slower biodegradation, good grindability, good “flowability”, homogenised material properties.
- These characteristics give cost savings in handling and transport, advanced trading schemes (futures) are possible, capex savings to end-users (e.g. outside storage, direct co-milling and

[32] www.usewoodfuel.org.nz/resource/tg05-verifying-solid-biofuel
[33] Briquettes have a range of dimensions. Diameters above should be approximated for briquettes.
[34] www.usewoodfuel.org.nz/resource/tg01-solid-biofuel-classification-guidelines

co-feeding into existing coal fired boilers), higher co-firing percentages and enabling technology for gasification based biofuels and biochemicals production.

- Applicable to a wide range of lignocellulosic biomass feedstock, even mixed waste streams.

Torrefied wood fuels are covered by *ISO 17225-8:2016 Solid biofuels -- Fuel specifications and classes -- Part 8: Graded thermally treated and densified biomass fuels*.

5.5 Herbaceous wood fuels

Herbaceous biofuels are typically sourced from agricultural activities and will include grasses, cereal crops, root and legume crops and flowers. For each of these sources, materials may consist of whole plants, straws, grains or seeds, husks and roots.

The use of herbaceous fuels in heat plant must take into account the chemical composition of the material as typically these types of solid fuels will have high concentrations of inorganic constituents which can contribute to fouling of boiler surfaces and corrosion issues. It is important to have good knowledge of the chemical composition of these materials before using them in heat plants. Herbaceous fuel sources such as straws, cereals and grasses can have low concentrations of calcium and high concentrations of potassium which contributes to lower sintering temperature compared to other wood fuels. The use of these types of fuel requires consideration of appropriate technology to control combustion conditions and the use of effective air emission control equipment.

5.6 Firewood

Firewood is generally larger piece sizes for domestic fire appliances. These fuels may be supplied as either kindling or larger pieces to sustain a fire.

These fuels are typically supplied by a Firewood supplier or alternatively are self-gathered.

Many jurisdictions specify moisture content for these types of fuel to minimize air emissions. The specification for firewood is covered in Technical Guide 1[35].

6 SOLID BIOFUEL QUALITY

6.1 What are important fuel characteristics

Section 4 of the EECA Technical Guide 9: "Good Practice Guide – production of wood fuel from forest landings[36]" gives a good description of how to manage wood fuel quality when wood fuel is sourced from forest harvest residues.

The supplier of wood fuel will produce and supply fuel to meet the conditions of their contract with an end use customer. The contract conditions should specify the fuel characteristics for:

[35] www.usewoodfuel.org.nz/resource/tg01-solid-biofuel-classification-guidelines
[36] www.usewoodfuel.org.nz/documents/resource/EECA-90-production-wood-fuels-from-forest-landings-4-10.pdf

- Particle size
- Moisture content
- Ash content (including chemical composition and ash melting characteristics).
- Bulk density
- Energy density

6.2 Energy Content of Wood Fuels

Section 8.6 of the EECA Technical Guide 9: "Good Practice Guide – production of wood fuel from forest landings" gives a good description of how to calculate energy content of wood fuels. Generally, this can be based upon the following formula

Energy (GJ/t) =18.9 – 0.213*MC_{wb}

Where MC_{wb} is the moisture content measured on a wet basis = water in sample (kg)/total sample (kg).

The derived energy is the net or lower heating value.

6.3 Fuel Specification

Good and appropriate fuel specifications allow heat plant owners to buy solid biofuels with confidence. Much the same as a car, biomass fuelled heat plant need to be fed with the fuel they were designed for. It is therefore vitally important that suppliers measure and describe the properties of their fuel in a clear and consistent way. The availability of acceptable quality fuel is critical to increasing its uptake as a mainstream source of renewable energy.

6.4 Quality assurance

Suppliers of wood fuel are responsible for ensuring the fuel produced meets the contract specification. To achieve a consistent delivery of fuel at the specified quality it is essential that they have a quality assurance (QA) system[37], regardless of whether it is formal or informal. Generally, a QA system will need to be formal if the supplier is to be able to demonstrate to their end use customers that the fuel delivered meets the contract specification.

Where an end use customer is not satisfied that an appropriate quality assurance system is in place they are likely to want to have greater sampling and testing of fuel delivered, which will result in additional cost. A good and appropriate quality assurance system can ensure that costs are kept to a minimum.

A QA system generally will include operator training. There is a significant risk of having untrained operators using chippers and other plant in terms of their personal safety and in terms of the consistent delivery of quality fuel. In addition the equipment can easily be damaged when appropriate quality control systems are not in place. If there is no appropriate control over the

[37] www.usewoodfuel.org.nz/documents/admin/TNSB76-Wood-fuel-quality-assurance.pdf

quality of material being fed into the chipping unit this risks damaging the equipment which in turn may invalidate any warranty or insurance on the plant.

The supplier's QA system will depend on the scale of their business and the type of fuel being produced and delivered. This guide assumes a high level of assurance is required and so focuses on having a formal system but some suppliers may be able to simplify their processes and simplify formalities.

- ***QA Documentation***

The documentation of a QA system shows how an organisation operates. The documentation includes the organisation's policies and procedures, with supporting attachments, such as forms, templates, flowcharts and training manuals. The policies and procedures should be complete, applied, understandable and consistent with actual practice. A well-developed QA System describes how policies and procedures are:

- developed
- documented
- approved
- implemented
- and regularly re-assessed through self-review

While there is no required format for a QA system anyone seeking assurance needs to see evidence of a structured approach to how the supplier manages their day to day operations. Ideally, their QA system should include the following general features:

- It should be appropriate to the size, nature, complexity of the processes and the supplier's business.
- It should document all relevant aspects of any required standards and legislation.
- It should describe in detail the processes used, and how these processes are regularly reviewed, corrected and improved.
- It should explain how quality is monitored and documented.
- All changes made to the QA processes should be subject to a *management of change* review to ensure that all the effects of the change are addressed.
- All key QA documents should be controlled documents.
- The QA system should also outline how:
    - staff are trained;
    - safety and good manufacturing practice are maintained;
    - all details of receipts, fuel processing, deliveries and samples are recorded;
    - nonconforming product is dealt with; and
    - how problems are managed.

Depending on the nature of the applicant's specific activities, it is expected that their QA system will also cover a number of specific elements. This will include details as follows:

- ***Processes***

1. Person accountable for or appointed to manage the quality system;
2. Product specifications for wood fuel supplied;
3. Product certificate of quality;
4. Fuel handling and storage including moisture exclusion and protection;
5. Nature and frequency of sampling and testing;
6. Test methods and equipment:
    a. Maintenance and calibration;
    b. Participation in correlation schemes;
    c. Tests performed in house;
    d. Use of external test laboratories;
    e. Laboratory or test room accreditation status and tester qualifications/experience.
7. What approach is used for working with customers on quality related issues including for example to customers - the provision of information, advice, and management of complaints etc; to contractors – any contractual agreements for services;
8. What processes are there in place to manage non-conforming fuel;
9. Labelling and signage;
10. Transportation – Policy and Practice;
11. Promotional material and activities;
12. Contract management; and
13. Handling of information requests and complaints – how is this done?

- ***Quality assurance internal review***

Having a QA system in place is a significant step towards operating in a quality focused way. This is a key first step but over time it's highly likely that operations change or develop and more effective ways of doing things are identified. It's important therefore that the QA system documentation is kept up to date and addresses all changes or developments in onsite activities and processes. An internal review is somewhat like a process of checks and balances in order to ensure that the QA system is effective. It's important that the responsibility for managing, reviewing and implementing the QA system is allocated and that it is regularly monitored.

- ***Quality assurance external audit***

Having a QA system in place is a significant step towards operating in a quality focused way. Internal reviews are a first step in managing the effectiveness of the QA system but external audits can be the best way to assess the true effectiveness of the system. Quality audits are essential to verify the existence of objective evidence showing conformance to required processes, to assess how successfully processes have been implemented, for judging the effectiveness of achieving any defined target levels, providing evidence concerning reduction and elimination of problem areas and are a hands-on management tool for achieving continual improvement in a business.

To benefit the supplier's business, quality auditing should not only report non-conformances and corrective actions but also highlight areas of good practice and provide evidence of conformance. In

this way, other departments may share information and amend their working practices as a result, also enhancing continual improvement.

- ***Ongoing quality control***

Ensuring that fuel quality is maintained from the point of production to the point at which it is used is essential. This focus on the maintenance of quality in both practical and contractual terms is of fundamental interest to any purchaser. This is achieved by good control of all processes involved and confirmed using an appropriate level of sampling and testing along the whole supply chain.

The tests and other processes applied at each stage of fuel manufacture and distribution should be appropriate to the supplier's own circumstances and the types of fuels being delivered.

- ***Managing Wood Fuel Quality Contractually***

To ensure clarity between the seller and purchaser of wood fuel it is important that the contract specify how assurance is to be addressed. This could be through the testing regime or could involve external monitoring as provided by ISO9000 certification, DIN Plus or through the Bioenergy Association Solid Biofuel Supplier Accreditation Scheme[38].

Having an external certification scheme provides additional assurance to the customer and generally will reduce their requirement for excessive fuel quality verification.

7 VERIFICATION METHODS

Suppliers of solid biofuel and those purchasing it need to have assurance that the fuel being delivered meets the contract specification. This assurance will primarily be done by taking samples of the fuel being delivered and testing it. The level of sampling and testing will depend on the type of fuel, size of contract and degree of confidence that the purchaser has in the supplier to consistently supply the specified fuel.

7.1 Sampling

Solid biofuel is generally very variable as to its composition and so the methods of sampling are important so as to give assurance that the samples tested are representative of all the fuel being delivered.

Sampling must be carried out appropriately and with sufficient frequency as to represent a credible picture of the supplier's activities. The location and frequency of sampling will depend on the fuel type. Refer to the *Bioenergy Association Technical Guide 5 "Standard Methods for Verifying the Quality of Solid Biofuel"*[39].

Where fuel is sold on an energy basis the Bioenergy Association recommends that for hog and wood chip fuel that wherever possible that each load be sampled at the point of delivery. This provides

[38] www.usewoodfuel.org.nz/resource/tnsb04-solid-biofuel-supplier-accreditation-scheme
[39] www.usewoodfuel.org.nz/resource/tg05-verifying-solid-biofuel

reassurance that the moisture content is appropriate. Measuring at the point of delivery may not always be practical so the point of sampling should be agreed between the buyer and the seller.

7.2 Equipment for Fuel Quality Assessment

Fuel quality can be assessed by simple methods and equipment or by laboratory analysis. Bioenergy Association Technical Guide 5 discusses the options but these can be simplified into three categories;

Level 1 **on site and point of delivery moisture assessment using simple portable moisture analysers**[40]. This is usually only used for assessing the moisture of fuel being delivered and should be backed up by Level 2 testing. Each truck load of fuel should be tested at delivery.

Level 2 **Limited laboratory testing of particle size, moisture, % ash and calorific value**. This is usually used for contractual verification testing of fuel being delivered. This is often undertaken by an external testing laboratory at least monthly and is to confirm that the level 1 test results are accurate.

Level 3 **Detailed laboratory testing of fuel**. This is usually used for diagnostic analysis to identify what may be causing a problem in the heat plant or the efficiency of the fuel supply.

Field equipment used for Level 1 testing of samples should be calibrated regularly to ensure accuracy and consistency of results. Customers should be advised on calibration results as part of the supplier's QA system.

7.3 Product Testing

It is important that detailed product tests of properties related to wood fuel type and quality are carried out periodically to at least Level 2 testing regime. The degree of product testing will depend on the fuel variability and be set out in the fuel sale and purchase contract. Technical Guide 5 sets out recommendations on the number of samples to be taken per truckload according to the quantity of fuel being delivered.

It is important to appreciate that these tests not only give a customer confidence but also signal to potential customers the supplier's commitment to quality and performance. These tests and the actual delivery performance are what helps to set high quality focused solid biofuel suppliers apart from others.

[40] TNSB89 portable moisture meters

7.4 Assessments Methods for the Quantity of Wood Fuel

Regardless of whether fuel is sold based on weight or energy, the weight of every load delivered should be determined. This may be undertaken at a local commercial weighing station.

7.5 External verification of quality assurance

Suppliers of biomass fuel should have quality assurance systems as set out in section 6.4 which ensure that the fuel delivered meets the buyer's contract specification (refer section 6.3). Having a quality assurance system will give buyers confidence that they are receiving the fuel they have specified in the fuel supply contract for their heat plant.

There are certifying bodies which can verify that the fuel supplier has an adequate quality assurance system and that it is being used consistently. Currently certifying bodies recognised by the Bioenergy Association are:

1. DIN Plus – covers production of wood pellets and is based on EN ISO 17225-2. Certification scheme developed by Germen Pellet Institute.
2. ENplus[41] – covers production of wood pellets and is based on EN ISO 17225-2. The ENplus® trademark is owned and administered by the European Biomass Association.
3. Bioenergy Association Solid Biofuel Supplier Accreditation Scheme [42](SBSAS) - covers all biomass fuels including wood and non-woody pellets included in Technical Guide 1 'Solid biofuel classification guidelines'. DIN Plus and ENplus certification is recognised and accepted as part of SBSAS accreditation. SBSAS is overseen by the Bioenergy Association Professional Standards and Complaints Committee. SBSAS covers biomass fuel suppliers based in New Zealand, Australia and the Pacific.

Potential purchasers of biomass fuel should require suppliers to provide evidence of their certification when tendering for fuel supply.

8 SOLID BIOFUEL SUPPLY CHAIN

8.1 Pretreatment of Solid Biofuels

The value of solid biofuel can depend on the level of pretreatment undertaken prior to delivery. If the fuel purchaser has a boiler system that can take unsorted or untreated solid biofuel, then this may allow cheaper fuel to be purchased and delivered. However, most solid biofuel will require some degree of pretreatment with regard to fuel particle size and moisture content.

Unfortunately, too often wood fuel is considered to be waste or simply "wood fuel" without consideration of its actual characteristics. The result has often been an unhappy relationship

[41] www.usewoodfuel.org.nz/resource/tnsb16-enplus-standard
[42] www.usewoodfuel.org.nz/resource/tnsb04-solid-biofuel-supplier-accreditation-scheme

between the fuel supplier and the end user. By differentiating the characteristics of fuel through sorting and grading then a higher price may be able to be asked for the higher quality fuels. The nature of the fuel market will determine the price structure.

Wood fuel is sourced for a wide range of applications and equipment so a supplier should supply fuel that meets the customer's boiler system specification as set out in their contract with the fuel purchaser. It is poor business to provide high grade fuel when a cheaper lower grade fuel is within the fuel specification for the boiler system and it will work just as well. The higher-grade fuels should be sold for applications which need that characteristic of fuel.

8.2 Solid Biofuel Drying, Storing and Handling

The energy content of solid biofuel is highly correlated with the fuel's moisture content. The drying of the fuel will increases its calorific value.

Fuel can be air dried by leaving the biomass out in the weather prior to processing it into fuel or it can be mechanically dried after processing into fuel. Processed wood fuel is best kept dry by keeping it away from water such as in a covered facility. This will result in higher net calorific value fuel being delivered and thus a higher value received. Delivery of wet fuel either from lack of drying or from poor outside storage is likely to result in a lower income.

Some fuels such as wood pellets must be kept out of the rain as otherwise they can turn to mush and be no better than sawdust.

The means of storage and handling of wood fuel can have a significant effect on its value and thus income. This is particularly important if the income from the sale of wood fuel is determined at the point of delivery as is recommended by the Bioenergy Association.

8.3 Equipment for Processing and delivery of Solid Biofuels

The type of solid biofuel and its quality will depend on the equipment used in its production and handling. For example the wood fuel that comes from a chipper has quite different characteristics to the fuel derived from a hogger as they have quite different cutting mechanisms . Similarly, the fuel will be different if it is screened and graded compared to unsorted fuel coming directly from the chipper or hogger.

The type of fuel produced may affect its handling and storage characteristics and even its suitability as a fuel for particular heat plant. This can be important in ensuring smooth and trouble-free operation of heat plant and also affects the cost of fuel.

Similarly, the means of delivery of solid biofuel can affect the quality of the fuel at the purchaser's site. For example, if wood pellets are transported by open truck and they get wet then their quality will be significantly degraded.

A contract for purchasing fuel may not necessarily specify how the fuel is made or delivered but it is very important that it specify what is required. For example, if particle size is important to ensure smooth operation of handling equipment then this must be clear in the fuel specification.

8.4 Management of Solid Biofuels

To ensure that solid biofuel is of the appropriate quality where it is to be used it is important that a contract involving delivery specifies that the fuel specification be met at the point of delivery. Any test samples should also be taken at that point.

Once delivered the ownership of the fuel will generally pass from the supplier to the purchaser.

9 SOLID BIOFUEL COSTS

9.1 Cost and Pricing of Solid Biofuels

Solid biofuel can be sold in volume, weight or by energy content. If sold by volume or weight then the end use customer is taking all the risk as to what they are getting in terms of useable energy. It is recommended by the Bioenergy Association that solid biofuel should only be sold by energy content. This may not be practical for firewood but it is still recommended as the value to a customer of purchasing dry firewood, compared to wet firewood where they have to do the drying will be a significant price difference. The customer would understand the difference in price if the sale were in terms of the net energy content. Firewood should be labelled with its moisture content at the time of sale.

Selling woodchip by weight is not ideal because the weight will then include the water content of the fuel. The end user generally wants the fuel to be as dry – and therefore as light – as possible Selling by the tonne is only a sensible option for woodchip supplied to high moisture content combustion processes and installations.

Sale by the loose cubic metre is possible for both chip and pellet where material is delivered to site and can be measured in a square sided (and therefore easily calculated) lorry or tipping vehicle. However, chip and pellets will settle during transport so the volume when loaded can often be very different from the volume when delivered.

Even with sale by volume or weight it is important that the end user specifies the moisture content of the material to be delivered and that this moisture content is sampled on a per load basis[43] . The ash content of wood fuel may also need to be carefully considered depending on the source of the fuel being supplied.

Wood fuel (primarily woodchip) can be sold by the cubic metre as round wood. This works well on more industrial installation sites where the timber can be hauled in roundwood form. As

[43] www.usewoodfuel.org.nz/resource/tg05-verifying-solid-biofuel

roundwood has roughly twice the density of finished chip, the fuel supplier is able to halve the number of vehicle movements and therefore reduce haulage costs.

Alternatively, most suppliers will be near a weighbridge where it is possible to weigh their loads. The moisture content will be a key question for conversion to energy content.

Solid biofuel can be sold ex-yard. It is processed and prepared to the correct specification at a depot, haulage is arranged by the fuel buyer, and the fuel is sold at the yard gate, or the fuel may be sold at the point of loading. With this approach the buyer is taking ownership and thus all risks from the yard gate or point of loading.

Bioenergy Association recommends that fuel should be sold at the point of delivery so that the purchaser has clarity over what they have purchased and can test the fuel delivered against the contract specification.

9.2 Revenue for Resource Growers

Because forest harvest or wood processing residues have often been considered as “waste” there has been an expectation that a wood fuel supplier should be able to obtain it for free. As wood fuel has increasingly become recognized as a mainstream energy fuel the owners of the “waste” have recognized that it is a product alongside the log and timber products that they produce.

Land and forest owners now see that wood fuel can be a product from forest harvesting alongside the grades of log they traditionally have sold from the harvest. Treating residues from forest operations as a valuable product has resulted in forest owners and harvest crews taking greater care of the biomass in order that they get a higher price for it.

There is a value to forest owners of having residues cleared from a log recovery site, and sites being as small as possible, as a site is essentially an area which is unlikely to be replanted to produce wood. There is also greater attention from regulators who do not want areas of unrecovered wood which may flow to lower areas in the event of large weather storms. Regulators are requiring that post-harvest land does not become an environmental hazard as happened in Tairawhiti in 2023.

Some forest owners who are located near heat plant where there is a demand for wood fuel now expect a financial return from discarded logs and residues. The amount of financial return from residues will increase as demand for wood fuel increases and as residue supply chains mature.

9.3 Trends and Factors affecting Solid Biofuel Costs

The price of wood fuel is determined by the price of alternative fuels for heat such as electricity, coal or gas. As the price of coal or gas increases because of difficulties of sourcing them this will impact on the price of wood fuel. Similarly, as more and more electricity is required for transport, heat and other decarbonisation activities there is a significant need for new electricity power stations to be built. Because the cheapest electricity power stations have already been built the new ones will be more and mor expensive, and resource consents are going to be more difficult to obtain from nearby communities.

In the North Island of New Zealand the availability of natural gas has been the lowest cost fuel for producing stationary heat. However with the Government ban on off-shore gas exploration natural gas is becoming less available and where it can be purchased, is significantly more expensive than biomass.

The National Policy Statement (NPS) and National Environmental Standards (NES) for Greenhouse Gas Emissions from Industrial Process Heat gazetted by Government in 2023:

- Prohibit discharges of greenhouse gases from new low to medium temperature coal boilers immediately and from existing coal boilers after 2037 (no further consents can be issued after this date)
- Require resource consent to be held for new and existing fossil fuel boilers that emit 500 tonnes and above of CO2-e per year, per site, and
- Require resource consent applicants to prepare and implement greenhouse gas emission plans that set out emission reduction actions.

The consequence is that after 2037 heat will only be able to be produced from electricity or biomass. Because electricity is more expensive than biomass as a fuel this results in electricity being the price setting fuel for heat production. If solid biofuel can

In many areas the cost of producing wood fuel is greater than the market price for it. This gap can be reduced by suppliers differentiating wood fuel into its different characteristics e.g. delivering dry fuel instead of wet fuel, and ensuring that it is of high quality.

The cost of producing and delivering wood fuel will also be determined by its proximity to heat plant users.

Forest owners are now recognizing that the low grade (K) logs which they have been exporting may gain a higher price if sold domestically as a source of biofuel. Selling low grade trees as a source of biofuel also results in greater biomass recovery from the tree as essentially near 100% of the tree can be sold as biomass for energy, whereas export logs are of specified length and up to 20% of the tree could be left in the forest as residue.

With the availability of boilers which can take a wider range of solid biofuels the recovery of biomass which previously would not be recovered is reducing fuel costs. The caveat on this is that the fuel must meet the manufacturers specifications. Similarly, some boilers may be able to combust a higher moisture content fuel.

Some boilers are also suitable for combusting a blend of treated and untreated wood and still remain within the air emission limits of their resource consent[44]. These applications usually will require a discretionary resource consent and need to be discussed with the relevant consent authority.

[44] www.usewoodfuel.org.nz/resource/tg9-consenting-of-biomass-boiler-systems-using-different-solid-biofuels

The growth of the demand for biomass to produce solid biofuel is stimulating more and more forest and landowners to enter the market for selling biomass for energy. This pressure from new entrants can affect prices in regions where there is competition for biomass.

9.4 Opportunities to Reduce the Cost of Solid biofuels

Like any product the cost of solid biofuel depends on its cost of production, storage and distribution. Differentiation into fuel type and grade can affect its selling price. The cost of fuel however can be reduced if production and distribution processes are most efficient.

Transaction costs such as the cost of product verification can also be reduced if a supplier has an efficient quality assurance system and appropriate sample testing. Certification of the quality assurance system can also reduce costs as the fuel purchaser can rely on the external monitoring and auditing of the supplier's processes and less testing is generally required.

Fuel suppliers are gaining greater value from the biomass they purchase by often purchasing it a long time ahead of when it will be required as a fuel, and letting it air dry on forest landings etc.

10 SOLID BIOFUEL CONTRACTING

10.1 Contracts for the Sale and Purchase of Biomass to a Fuel Supplier

A solid biofuel producer could simply be a grower selling felled or un-felled trees; a grower selling residues from harvest; a harvester selling the residues of harvest, or a wood processor selling process residues to a fuel supplier. There are a number of ways in which a contract can be structured for the transfer of the ownership of wood fibre from the producer to the supplier however, these are not covered in this Guide.

A solid biofuel supplier may simply be a broker organizing for the collection and processing of harvest or process residues and delivery to an end user, or they could undertake all of the actions necessary to get wood residues into a fuel form and delivered to the end user.

10.2 Contracts for the Sale and Purchase of Solid Biofuel between Fuel Supplier and End User

The development of formal contractual arrangements provide benefits to both end user and fuel supplier. A fuel supply contract provides the end user with a clear statement of their requirements and how they expect the agreement to be fulfilled. From the suppliers' point of view, a long-term contract allows the supplier to put in place both the investment in plant and machinery and the logistical arrangements necessary to comply with the contract terms.

The contract is vital: in conjunction with the fuel classification described in the Bioenergy Association Technical Guide 1. It underscores the professional and reliable reputation of the biofuel supply industry and reassures fuel purchasers that the supplier will provide the fuel or service they

require, and that the supplier does not merely view biomass as a useful way of dumping waste or co-product.

Suppliers of solid biofuel are generally aggregators of biomass from a number of disparate sources who process the often variable quality biomass to be a homogenous contract specified biofuel.

To ensure realistic commitments the fuel supplier must comprehensively understand what the customer requires and be confident that it can be provided once an agreement is entered into. Failures by fuel suppliers to meet their contractual requirements may result in the energy user citing breach of contract and purchasing fuel from elsewhere. Where capital investment on specialist equipment has been made, any loss of revenue will seriously affect the viability of the fuel supply business. It is therefore in the fuel suppliers' best interest to only agree to undertake what is achievable and be transparent regarding potential risks.

A suggested model contract is available as a template in Appendix A and Microsoft WORD version copies are available from the Bioenergy Association[45].

10.3 Model Contract Terms

A contract for the sale and purchase of solid biofuel may include the following terms and components:

Preamble: The document should open with details of the parties to the contract plus the context of the contract so that there is no misunderstanding between the parties as to the purpose of the biofuel and reliability of supply expectations etc. This could also include a basic statement of what the contract relates to, for example fuel supply for an installation at a certain address, and a brief outline of what the parties are responsible for.

The end user and fuel supplier should agree the parameters of the fuel supply, contract term, delivery method,

Biofuel Specification: The contract should state the exact specification of the fuel to be supplied as per the boiler manufacturer's recommendations. For pellets, diameter and length; for woodchip, moisture content, particle size and the parameters of particle size, etc.

It is also helpful to provide a description of the boiler system, including its fuel storage and handling system, and to set out the key details pertinent to the plant performance.

Quantity: The contract should describe the anticipated volume of supply, and the end user should ensure the contract states a guarantee of fuel supply over a set period, including any exceptions, and what indemnities should be in place in the event of the failure, or for example where the supplier can no longer trade.

[45] www.usewoodfuel.org.nz/documents/admin/TNSB77-Model-fuel-supply-contract.pdf

It is important for the end user to identify the potential consequential loss associated with making alternative arrangements for energy, liability for loss of use of a public building (school, leisure centre, etc.), or interruption of business.

From the supplier's view, fixed annual costs can be covered either by agreeing the minimum annual requirement of fuel or energy to be supplied, or by using a stepped charging system similar to electricity accounts, where the first units are charged at a higher rate in order to cover these fixed costs and after a certain consumption rate the price per unit decreases to near the marginal cost of production. It also gives cover against the site shutting down for any reason outside the supplier's control, such as a boiler system malfunction, or where the end user stops trading leaving the supplier holding stock.

Duration of the contract: For a very long-term contract, anything over three years, it is wise to set an annual review period when the logistics of fuel supply, any changes to the boiler system set up etc can be discussed and issues resolved.

Set a renewal date prior to the termination of the contract to ensure that the heat plant owner can acquire satisfactory stock to feed the boiler, and a transition to a new supplier can be arranged if necessary.

Price: Clearly state a unit price by the tonne, energy (Gigajoules), loose cubic metre, solid cubic metre, etc. Detail how units are to be measured, and how and when parameters such as moisture content, particle size and volumes will be verified.

The Bioenergy Association recommends that because biofuel is very variable as to its energy composition because of moisture content, that biofuel should only be sold on an energy basis. This removes any conflict over the variability of what is being delivered. But the terms of sales should be determined between the supplier and purchaser.

For longer-term contracts a price escalation clause should be included to allow an annual price increase in line with both inflation and rising labour and fuel costs. Confirm the exclusion or inclusion of GST. Refer to Section 10.4 below for recommendations on the escalation clause.

Sources if biomass: In order to limit uncertainty, the purchaser may wish to specify what biomass material is acceptable. This may be of particular importance where the supplier is sourcing the fuel from a number of locations e.g. from a number of farm forestry blocks some of which may be on silica prone land.

Terms of payment: State the terms of payment, what penalties might accrue if the fuel is sub-standard, when invoices are expected to be paid, and whether interest is chargeable after this period? It is also helpful to clarify the invoicing process, requirements for order numbers, receipts, delivery notes and self-billing invoices.

Clearly state at which point the fuel is transferred to the customer. The Bioenergy Association recommends that the ownership transfer at the point of delivery into the receiving facility. This should be very specific e.g. lip of the storage bunker so that there is limited opportunity for dispute in the event of an entry of contaminant or spillage.

Delivery of biofuel: The fuel delivery should be described, stating responsibilities for opening and closing the fuel store, ensuring that any receiving equipment is activated during delivery, disconnecting and reconnecting hydraulics when using hook bins and other important details.

The times of delivery and to whom the delivery driver should report to and obtain a receipt are key details to also describe.

The purchaser will generally be responsible for establishing a delivery schedule, check the fuel store to ensure satisfactory residual security levels of fuel are maintained, and ordering additional fuel. The means of communication and confirmation of an order for delivery should be explicit in the contract.

A minimum notice period for ordering fuel should be described and any potential penalties within the time period the contractor is required to deliver. The process of emergency deliveries should be described, and whether an additional charge should be made and in what circumstances.

If a purchaser sources fuel from more than one supplier and places it into the same storage facility there can be conflicts over responsibility if some fuel is not up to specification. Should mixed fuel be sub-standard or contain contaminants that damage the boiler system it may result in a dispute between the parties to determine responsibility. Where the end user has material from a second supplier which they wish to put into the supply chain for their boiler it is better to keep the fuels separate. Where the end user prefers a more “ad hoc” approach the supplier should ensure that the contract indemnifies against any resultant problems.

Standard Terms: Detailed proposals relating to health and safety responsibility on site, together with insurance details, i.e. product liability insurance, transport and ownership liability should be stated.

The contract should include a dispute resolution process which should cover all aspects of the contract performance, setting out what actions are deemed as a “breach of contact” and the termination process.

Miscellaneous detail: Occasionally ash removal is included in fuel supply contracts and it may be appropriate for the supplier to remove ash at the same time as making a delivery but this must be covered in the contract.

Include a specific clause to cover the fuel supplier in the event of plant shutdown outside the supplier’s control and any costs incurred by the supplier as a result. In addition, the fuel supplier may wish to include a clause covering failure to commence the operation of the boiler. Boilers may be proposed but not go into operation due to issues beyond the supplier’s control, leaving the supplier holding fuel stock.

10.4 Solid biofuel price escalation

For contracts with a term longer than one year the biofuel seller may wish to propose a price escalation clause in the contract. There are many things that may affect future prices and sellers and buyers may agree an escalation clause specific to their locality and the sources of biomass fuel being offered. The base price for the biomass supplied would be adjusted annually on the

anniversary of the contract according to any movement in the indices set out in the clause. However, offering a simple percentage increase, or not including any escalation clause, can be attractive for some buyers as their fuel is then fixed for the duration of the contract.

From the fuel supplier's perspective, the cost base and log sourcing arrangements for each supplier may be quite different, hence adoption of any particular type of inflator will depend on the individual business model of the supplier.

From a buyer's perspective, when they are adjudicating tender offerings they would like sellers to use common industry wide escalation formula as this makes comparison easier. Purchasers may also specify in their tender request an escalation formula that all respondents are to use.

Where potential suppliers each have their own unique escalation formula this makes comparison of prices more difficult for the potential buyer. In many industries there are commonly agreed escalation formula which all sellers use when making offers. This makes adjudication of offerings much easier.

The cost of source biomass which is to be made into fuel and sold can move quite independently of the log, export chip or pulp market in a region. For small volumes and for buyers without analytical staff the price over more than one year can be simply linked to the Consumer Price Index (CPI). However, CPI and other simple indices are too blunt an instrument when the biomass is linked to the export chip or pulp market and more relevant indices are recommended. For longer-term contracts it is important that the cost of biomass derived fuels relates as close to the cost of the main specific inputs as is reasonably practicable.

A price escalation formula suitable when dealing with residues that may be competing with the pulp or K grade log market is set out below. This type of formula ensures transparency with pricing and reduces the chances of unjustified price increases. However, there are some components of a wood energy supply chain that do not get captured in this formula. For example, price increase relating to the additional distance from forest operations. In this situation, the wood fuel supplier may wish to add a component which is related to movements in the cost of fuel.

For the purposes of the Purchase Price Adjustment the applicable indices for biomass, production and labour can be defined as follows:

$$\mathbf{APP\ (\$/GJ)\ = PP \times [LPI_W \times LPI_L/LPI_B + PPI_W \times PPI_L/PPI_B + LCI_W \times LCI_L/LCI_B]}$$

Where:
APP = Adjusted Purchase Price to be applied for the time period specified

PP = The original Purchase Price to be adjusted

- **LPI** means the Agri-Hq[46] S1/S2 or K grade Unpruned Log Price Index as published by NZX Limited (or any successor organisation) on a monthly basis. (The recommended index is related to the pulp or low-grade export log price but other specific regional indices

[46] https://agrihq.co.nz/forestry

applicable to the Delivery Point may be used). The supplier should specify the regional index being used (Northern North Island, Southern North Island, Northern South Island, Southern South Island); [The Ministry of Primary Industries also publishes log price indices[47].]

- **PPI** means the Producers' Price Index (Inputs – All Industries SN9) as published by Statistics New Zealand (or any successor organisation) on a quarterly basis;
- **LCI** means the Labour Cost Index (LCIQ.SH31K9) as published by Statistics New Zealand (or any successor organisation) on a quarterly basis.

LPI_W, PPI_W or LCI_W = LPI, PPI or LCI Weightings (The weightings between indices may be specific to the loacity and source of biomass. Recommended default weightings are (LPI_w - 55%; PPI_w - 30%; LCI_w - 15%)

LPI_L, PPI_L or LCI_L = Latest published values for LPI, PPI or LCI

LPI_B, PPI_B or LCI_B = LPI, PPI or LCI values used for the previous Purchase Price Adjustment or, for the first adjustment on the Commencement Date, the Base Index values in the Key Terms

Escalation of fuel costs for fuel delivery could be added as a fourth component.

10.5 Complaints and solid biofuel supplier professional development

The Bioenergy Association has established a members' Code of Conduct[48] supported by a Professional Standards and Complaints Committee. The Committee has oversight of members professional conduct and provides support to the accreditation schemes. The professional standards processes[49] are based on assisting member's resolve any issues or complaints themselves in the first instance, but with a formal process to back this up if necessary.

If you have a complaint, or there are issues that need association assistance, then these should be brought to the attention of the Bioenergy Association Executive Officer.

The Bioenergy Association has a number of programmes and events which are aimed at ensuring that members are providing services and products that meet best practice standards.

Membership of the Bioenergy Association is an indication of quality and best practice. Engage only Bioenergy Association Registered Advisers[50] and buy only from Bioenergy Association listed equipment suppliers[51]. Purchase solid biofuels only from Accredited Wood Fuel Suppliers[52].

[47] https://www.mpi.govt.nz/forestry/forest-industry-and-workforce/forestry-wood-processing-data/historic-indicative-new-zealand-radiata-pine-log-prices/
[48] www.bioenergy.org.nz/resource/banz-code-of-conduct
[49] www.bioenergy.org.nz/documents/admin/BPP10_Professional-Standards-and-Complaints-Committee.pdf
[50] www.usewoodfuel.org.nz/registered-wood-energy-advisors
[51] www.usewoodfuel.org.nz/wood-equipment-catalogue
[52] www.usewoodfuel.org.nz/solid-biofuel-suppliers

Membership is an indication that they are up-to-date within the sector and are covered by the Association's professional standards oversight.

11 Accreditation of Wood Fuel Suppliers

11.1 Certification and Declaration of Fuel Quality

Wood fuel purchasers will usually specify in their purchase contract that suppliers must take samples of the fuel supplied and have it tested by an approved testing laboratory. The frequency and level of testing that is specified in the contract may depend on the quantity of fuel being delivered, type, source and demonstrated performance of the supplier. Guidance is available from *Technical Guide 5: Standard methods for verifying the quality of solid biofuels*[53].

After testing, the testing laboratory will provide the supplier with a certificate setting out the characteristics of the fuel tested. These may be required to be submitted to the fuel purchaser at specified times e.g. once a month.

The Bioenergy Association has a list of appropriate testing laboratories that meet criteria appropriate for testing of solid biofuel samples[54].

Bioenergy Association is developing a sustainability declaration for suppliers to confirm that the biofuel has been sustainably sourced and produced[55].

11.2 Accreditation of Suppliers

The Bioenergy Association has established a Solid Biofuel Supplier Accreditation Scheme[56] which is based on the demonstration that a supplier has an acceptable solid biofuel supply quality assurance system and methods for testing of fuel samples.

Details of best practice quality assurance are set out in *Wood Fuel Supplier Accreditation – Scheme Guidance For Applicants and Assessors*[57]

By a purchaser of solid biofuel purchasing from an Accredited Solid Biofuel Supplier they gain confidence that the fuel delivered is what they specified in their contract, and because the supplier has a best practice quality assurance process, the purchaser is able to reduce fuel purchase costs.

The Bioenergy Association Solid Biofuel Supplier Accreditation Scheme recognises other international fuel certification systems such as ISO9000, EN Plus and DIN Plus.

A list of accredited solid biofuel suppliers[58] is available from the www.usewoodfuel.org.nz website.

[53] www.usewoodfuel.org.nz/resource/tg05-verifying-solid-biofuel
[54] www.usewoodfuel.org.nz/solid-biofuel-testing
[55] www.usewoodfuel.org.nz/sustainability
[56] www.usewoodfuel.org.nz/resource/tnsb04-solid-biofuel-supplier-accreditation-scheme
[57] www.usewoodfuel.org.nz/resource/sbsrs01-solid-biofuel-supplier-registration-scheme-guidance-document
[58] www.usewoodfuel.org.nz/resource/is53-register-of-solid-biofuel-suppliers

12 APPENDICES

12.1 Appendix A – Model contract for the sale and purchase of solid biofuel[59]

[A Microsoft WORD version of the model contract is available at https://www.usewoodfuel.org.nz/resource/tnsb77-solid-biofuel-supply-model-contract]

Contract between

<*SUPPLIER*> hereinafter referred to as **"the Supplier";**

of <ADDRESS>

and

<*END USER*> hereinafter referred to as **"the End User";**

of <*ADDRESS*>

for the supply of wood fuel to

<*SITE LOCATION*> which is the site (owned and) operated by the End User where the delivery of wood fuel is required by the End User, hereinafter referred to as **"the site".**

1. Supply of wood fuel

1.1. The Supplier agrees to supply to the End User and the End User agrees to purchase from the Supplier wood fuel to the specifications, in the quantities, for the period, at the price, and on the terms and conditions set out in this contract.

2. Duration of contract

2.1. This contract is for a period of <*XX*> and will commence on <*DATE*> and end on <*DATE*>, (with a formal review after the first three months of the contract to assess the need for any adjustments to the contract).

[59] https://www.usewoodfuel.org.nz/resource/tnsb77-solid-biofuel-supply-model-contract

2.2. Any adjustments requested in terms of Clause 2.1 need to be agreed jointly between the End User and Supplier. If the Supplier or End User cannot agree or meet adjustments, each party may terminate the contract after 3 months if it wishes to.

2.3. Any adjustments made to the contract in terms of Clause 2.1 must relate to the;

- Ability of the Supplier to meet the fuel specification, or
- The appropriateness of the fuel supplied to ensure efficient performance of the End User's equipment for which the fuel is supplied.

2.4. This contract may be extended by agreement of both parties not less than three months before the end of the original contract period.

2.5. In the event of either party failing to meet their contractual obligations under this contract the other party has the right to terminate the contract at three months notice unless such breach of contract is remedied by the defaulting party to the reasonable satisfaction of the non-defaulting party. If any material breach is committed by either party which, in the reasonable opinion of the non-defaulting party, can not be remedied within 10 working days the non-defaulting party may terminate this contract immediately by way of written notice.

3. Quantity

3.1. The monthly quantity of wood fuel supplied during the defined contract period averaged over each twelve month period of the contract term, starting from the date of contract signing, will be a minimum <*XX*> tonnes and a maximum of <YY> tonnes at the fuel specification defined in Schedule 1.

3.2. The End User may order amounts in addition to the maximum specified in Clause 3.1 by requesting an additional delivery from the Supplier, specifying the quantity required, and the date and time by when the End User requires the delivery in accordance with Clause 6.4. If the Supplier is able to satisfy the request, it shall notify the End User accordingly and deliver the amount requested as soon as is reasonably practicable. The Supplier may charge the contract price for any additional delivery made in accordance with Clause 4 or any other price by mutual agreement. If the Supplier cannot satisfy the request, it shall notify the End User of the reason why.

3.3. The Supplier is under no obligation to supply greater quantities of wood fuel other than that specified in Clause 3.1.

3.4. The proof measurement of quantity of wood fuel supplied is to be by providing the End User with a weigh bridge docket for each delivery showing the truck identifier and the weight of wood fuel supplied in each delivery load. The weighbridge must be operated by a suitably licensed operator.

3.5. The End User reserves the right to audit the bill of loading of any load using an alternative weighbridge. In the case of substantial discrepancy between the Supplier's bill of loading and the End User's audit, the invoiced amount shall be adjusted as appropriate. If repetitive and substantial discrepancies occur, it is expected the Supplier will rectify the cause of the discrepancies to the satisfaction of the End User, otherwise the End User reserves the right to terminate the contract.

4. Price

4.1. The value of fuel supplied will be based on energy content (gigajoules delivered) and be calculated by weight and moisture content, which will be measured and agreed at each delivery, and fixed price for the term of the contract.

4.2. The price (exclusive of GST) for wood fuel delivered into the fuel store of the End User will be based upon the following tariff up until <DATE>: $<XX> per GJ of biomass.

4.3. The energy content value of each delivery load will be calculated as follows;
Energy Content = (18.842 – 0.212 x MC) x Weight

Where:

- The derived Energy Content of the load is the net or lower heating value of energy in gigajoules (GJ).
- MC is the wet basis moisture content in percent.
- Weight is the delivered fuel in tonnes.

(This formula is based on the 'Scion NZ – Woody Biomass for Boiler Fuel -Guidelines for Payment by Energy Content' document.)

4.4. Unless otherwise specified in Clause 4.3, prices shown in Clause 4.3 shall include all costs and expenses of insurances, freight, local cartage and/or any other services in the delivery of the wood fuel.

4.5. The price of the biomass will be adjusted annually on the anniversary of the contract being signed according to any movement in the New Zealand Department of Statistics Producer Price Index (Inputs).(*applicable only for contracts over one year of duration)*

5. Fuel sources

5.1. The wood fuel will be derived from the following sources (*delete as appropriate):*

- forest harvest residues;
- wood processing residues;
- arboricultural arisings;
- short rotation coppice (SRC);
- agricultural arisings (e.g. straw);
- energy crops, such as miscanthus;
- urban wood.

The parent source of the wood fuel is declared as being (*insert as appropriate).*

6. Delivery of wood fuel

6.1. Wood fuel will be supplied in bagged/baled/loose form [*delete as appropriate*] and delivered to the End User by a suitable vehicle for delivery into the End User's fuel store. The fuel shall be delivered by a truck/trailer suitable for unloading wood fuel directly into the fuel store. The Supplier is to provide all associated equipment for the safe delivery of the fuel.

6.2. The driver is to report to the main site office each visit prior to unloading.

6.3. Delivery of wood fuel will be according to requests from the End User. Requests are to be made by electronic mail or facsimile. The Supplier will confirm receipt of a request by

electronic mail or facsimile within one working day. The confirmation from the Supplier will create a commitment for purchase by the End User.

6.4. The notice period for requesting delivery of wood fuel from the End User will be a minimum of <*XX*> days.

6.5. On the dispatch of any consignment of wood fuel, the Supplier shall send a Delivery Note and a Fuel Quality Declaration to the End User by electronic mail or facsimile. A paper copy of the Delivery Note and Fuel Quality Declaration shall be provided to the End User at the site with the delivery of each consignment.

6.6. Responsibility for checking levels of wood fuel within the fuel store and informing the Supplier of the need for a fuel delivery rests with the End User.

6.7. In the event of the requirement for a delivery at less than the notice period in clause 6.4 an additional fee of $<*XX*> per tonne of biomass will be payable to cover the costs of an emergency delivery.

6.8. Unless otherwise agreed in advance with the End User, deliveries shall be made between the hours of <*XX*>.00 and <*YY*>.00, or any other time agreed with the End User in advance between Monday and <*XXX*>day.

6.9. If a delivery cannot be made within the hours specified in the contract and the whole or part of the delivery is not possible due to obstructions on the End User's site that are beyond the control of the Supplier, the Supplier will be entitled to compensation to cover the cost of transport and payment of an additional surcharge of <*XX*>% of the value of the wood fuel ordered, unless the End User informs the Supplier of said obstruction within the notice period specified in Clause 6.4 above.

6.10. Upon delivery of the wood fuel to the End User, visual checks shall be made by the End User to ensure conformity to the agreed specification.

6.11. If checks reveal that the wood fuel does not conform to the agreed specification as per Schedule 1, the End User reserves the right to reject the load in full. In the event that it is not possible to visually check the fuel load until it is in the fuel silo, but the wood fuel is subsequently found to not conform to the agreed specification within 24 hours of delivery, then the End User reserves the right to reject the fuel. Rejected fuel will be removed by, and at the expense of, the Supplier. Any such dispute over the specification of the wood fuel delivered will be resolved as per Clause 13.

6.12. The Supplier shall be responsible for immediately clearing up any wood fuel spilt during offloading and shall provide suitable tools for this job. If the Supplier does not undertake such clean up within a reasonable time then the End User may undertake the clean up and pass on the costs of clean up, which must be reasonable, to the Supplier.

6.13. If the Supplier is not able to safely, or without spillage, deposit the wood fuel being delivered into the End Users fuel store then the Supplier must not make the delivery and must immediately advise the End User of such action. If the End User does not remedy the ability of the Supplier to deliver the wood fuel safely and without spillage then the Supplier may avoid the delivery and invoice the End User for any reasonable costs involved.

6.14. The wood fuel shall remain at the risk of the Supplier until delivery to the company is complete (i.e. the biomass is offloaded into the End User's store), when ownership of the wood fuel shall pass to the End User.

6.15. Where the Supplier is unable to provide the wood fuel or the full quantity of wood fuel requested by the End User in terms of Clause 6.3 for any reason whatsoever, the Supplier must immediately notify the End User and the End User may, at its discretion, vary the Contract or terminate the Contract in accordance with the Termination clause.

6.16. If the Supplier is unable to supply part of the quantity of wood fuel requested the Supplier may, with the End User's prior written consent, provide other fuel from a third party to meet the objectives of this Contract. The Supplier shall have full responsibility for ensuring this Contract is complied with.

6.17. In the event of the parties for whatever reason agreeing to discontinue the supply of wood fuel and/or replace the same with alternative fuel, then any approved alternative fuel may be added to Schedule 1 by way of Variation and any fuel agreed to be discontinued shall be identified as such in Schedule 1.

6.18. All deliveries must be accompanied by a delivery docket which must be signed for and retained by an End User officer.

7. Supply Certainty

7.1. The End User's primary requirement is for a guaranteed supply of fuel.

7.2. In the event that the Supplier fails to supply adequate quantities and/or quality of fuel for the continual operation of the End User's plant at any stage during the contract period, the End User reserves the right to source fuel from an alternative source. The Supplier, under these circumstances, will be required to pay all additional costs incurred by the End User directly related to the supply shortfall. This includes, but is not limited to, all reasonable additional fuel cost, transportation cost, supply fees, cost of work by End User staff, and administration cost.

7.3. A failure to supply adequate quantities of fuel for continual operation of the plant at any stage will give the End User the right to terminate the contract.

8. Fuel Quality and Consistency

8.1. The quality and consistency of the fuel is important because it affects the performance of the End User's plant.

8.2. The End User has the right to audit random samples from any delivery of fuel to check that the quality specifications are being met by the Supplier.

8.3. The Supplier is financially responsible for any damage to the fuel feed system, heat plant, and air quality equipment caused by any wood supplied which does not meet the specification in the contract (e.g. high moisture content, contaminants, etc).

9. Wood fuel quality verification

9.1. The Supplier grants the End User the right to audit and inspect the Supplier's records concerning delivery of the wood fuel.

9.2. The Supplier grants the End User access to the Supplier's premises, facilities and staff concerning the delivery of the wood fuel.

9.3. The End User's failure to inspect does not relieve the Supplier of any responsibility to perform according to the terms of this Contract.

9.4. The wood fuel shall be subject to inspection and test at all reasonable times and places by the End User or those parties representing the End User, during and after delivery. The End

User may, at its sole discretion, require the Supplier to replace any rejected fuel that does not meet the specification in Schedule 1.

9.5. The Supplier must undertake fuel quality verification as set out in Schedule 1. The Quality Verification Reports are to be provided to the End User along with the monthly invoice.

9.6. Where the moisture content in the Quality Verification Report differs by more than 10% from the results of delivery sampling for more than three loads of every ten loads delivered the Supplier is to clarify the discrepancy with the End User and agree a remedy.

9.7. Where the moisture content arising from discrepancy identified in Clause 9.6 is less than the delivery sampled moisture content used to calculate invoice amounts, an adjustment to the invoice payment will be made to reflect the lower moisture content.

9.8. The End User may at any time send representative samples of wood fuel for evaluation, analysis, testing and approval. All samples must meet the fuel specification as set out in Schedule 1. Such tests are to be at the End User's expense.

9.9. The methods for maintaining the original quality of the wood fuel once the Supplier has delivered it on site is the responsibility of the End User.

10. Terms of payment

10.1. The Supplier will invoice the End User on a monthly basis. This will be based upon the number of loads recorded and delivered (by weight) and will be assessed on the <*XX*> day of each month. The invoice amount will be the energy content delivered multiplied by the price as outlined in clause 4.3.

10.2. The End User shall be entitled to query any aspect of the Supplier's invoice. The Supplier shall fully and promptly co-operate with the End User to resolve any such query. While any matter is being queried, the Supplier shall continue to supply the wood fuel without interruption or delay.

10.3. Terms are monthly payment at <*XX*> days from date of invoice.

10.4. Payment will be effected by Electronic Funds Transfer (EFT) (direct credit).

10.5. In the event that any payments are overdue the Supplier has the right to refuse to make further supplies until all outstanding overdue invoices have been settled.

10.6. Interest shall be payable on amounts overdue at the daily published <Bank> base rate plus 2%.

11. Disputed Payments

11.1. If either Party disputes the accuracy of any invoice, it shall notify the other Party accordingly within 10 Business Days of receipt of such invoice. The invoiced Party shall pay the undisputed amount of the invoice and may withhold the disputed amount. The Parties shall endeavour to reach agreement on the disputed amount and if agreement is reached, make any payments necessary. If agreement is not reached the matter shall be referred to mediation in accordance with clause 16. No part payment shall be treated as being in full and final settlement of any obligation of either Party unless expressly acknowledged in writing by the other Party to be such.

11.2. If any amount has been disputed under Clause 11.1 and as a result of the dispute resolution one Party has to pay an amount to the other Party, interest shall be payable on that amount

calculated daily from and including the due date of the invoice in dispute but excluding the date of payment of the amount at a rate equal to the <*BANK*> overdraft rate.

12. Variations

12.1. Unless otherwise specifically provided for under this Contract, any variation, amendment, modification or alteration to this Contract will only be valid when endorsed by both Parties in writing.

13. Health and Safety

13.1. The End User shall provide a copy of their site safety manual to the Supplier.

13.2. A risk assessment and method statement shall be prepared in advance of the first delivery by the Supplier following an initial site visit and discussion with the End User, to take account of the hazards on site and the risks posed to pedestrians, vehicles and property on the site during wood fuel delivery and offloading. This method statement will agree with the End User and shall be formally reviewed annually, or whenever a change to the hazards and risks on site are identified.

13.3. The Supplier shall use all reasonable endeavours to ensure that all requirements of the Health and Safety in Employment Act 1992 are complied with by its employee(s) while on the End User's site. This includes taking all reasonable steps to:

a) ensure employees of the Supplier are safe while on the End Users site making fuel deliveries and that the work they do will not harm any other person;
b) identify all hazards the Supplier's employees may be exposed during deliveries on the site;
c) ensure that before any of the Supplier's employee commences work on the site they are:
    a. informed of hazards they may be exposed to or may create through their work and methods to control such hazards;
    b. informed of emergency procedures and the location of safety equipment; and
    c. sufficiently experienced to carry out the work safely or are supervised by someone who is.

13.4. The Supplier will use all reasonable endeavours to ensure employees of the End User are safe while making deliveries.

13.5. The End User shall advise the Supplier of any site hazards and their current procedures for controlling such hazards.

13.6. The End User shall provide a site induction course for all new Supplier employee(s) to ensure that they are familiar with and understand site safety requirements in the areas where deliveries are to be made.

13.7. The Supplier is required to report to the End User within 24 hours any accident that has harmed or might have harmed any person.

14. Other terms and conditions

14.1. The wood fuel shall be delivered in a prompt and timely manner to meet the reasonable requirements of the End User and within the delivery dates requested and agreed;

14.2. The Supplier shall use the highest reasonable standard of skill, care and quality and employ techniques, methods, procedures and, where necessary, materials of a high quality and standard in accordance with best professional practice in providing the wood fuel;

14.3. The Supplier will exercise the specific skills and experience required to source and supply the wood fuel and will ensure that the fuel is provided to the End User's satisfaction;

14.4. The Supplier shall comply with all relevant New Zealand standards and international standards (if not in conflict) (both general and industry-specific) applicable in respect of sourcing and supplying of the wood fuel;

14.5. The wood fuel is of a quality and fitness for the purpose for which the fuel is supplied to the End User and, in particular:

- . The Supplier acknowledges the End User has described to the Supplier the particular purpose for which the wood fuel is required. The Supplier acknowledges the End User relies upon the Supplier's skill and judgment and the wood fuel shall be reasonably fit for such purpose;
- . The Supplier acknowledges that it is not released from its obligations as a result of the End User failing to observe defects in the wood fuel which an examination ought to have revealed.

14.6. Wood fuel that does not meet the required quality standards remain at the risk and cost of the Supplier who shall be required to remove such fuel in accordance with the direction of the End User.

14.7. Damage to equipment as a result of sub-standard quality wood fuel and/or foreign objects contained within the fuel will be the responsibility of the Supplier, and as such, the Supplier indemnifies the End User for the cost of repair or replacement of damaged equipment.

14.8. End user plant outage or operational problems that are a direct result of sub-standard maintenance, equipment misuse/neglect or equipment defects are not the responsibility of the Supplier. In this instance, any reasonable cost that is incurred by the Supplier as a result of not being able to deliver fuel will be charged to the End User.

14.9. The Supplier will indemnify the End User against the cost of repair to fuel handling and combustion equipment caused by the Supplier or supply of wood fuel not in accordance with the specification set out in Schedule 1, with the exception of consequential losses such as having to pay for heat supplied from other sources to a limit of $<*XXXX*>

14.10. The Supplier shall hold at its cost, at all times during the continuance of this Contract, Public Liability Insurance of not less than two million dollars ($2,000,000.00).

14.11. The Supplier shall, if requested by the End User, provide it with written evidence that all insurances are in force and, when required by End User, the Supplier shall produce the policies and evidence of payment of current premiums. If the Supplier fails to provide such evidence the End User may, after notifying the Supplier in writing, arrange that insurance, pay its premium and deduct the cost from any moneys payable to the Supplier or recover it as a debt owing.

14.12. Where the Supplier is in breach of any of its obligations under this Insurance clause, the End User may suspend the commencement of the supply of wood fuel until the obligations have been complied with. No such suspension shall entitle the Supplier to a Variation.

14.13. The Supplier's liability under this contract (including under any indemnity) shall be limited to $<*XXXX*>

15. Indemnity

15.1. The Supplier indemnifies the End User in respect of all costs (including legal costs), claims, liabilities, losses, damage and expenses suffered or incurred by the End User and any other person claiming through the End User as a direct or indirect consequence of any unlawful, negligent, tortuous, criminal, reckless or dishonest errors, acts or omissions of the Supplier in the performance of its obligations under this Contract.

16. In the event of a dispute

16.1. Both parties shall attempt in good faith to negotiate a settlement to any dispute between them arising out of or in connection with the contract within thirty days of either party notifying the other of the dispute. Initially the party who wishes to bring the dispute to the notice of the other will do so in writing. The other party will respond to this in writing within 5 working days of receiving the notification of a potential dispute. Where the potential dispute relates to on-site issues at either the end-user or Supplier sites, a joint site meeting will normally take place within 8 working days of the potential dispute being brought to the other party's attention.

16.2. Where a resolution has been agreed after one or more meetings, including a site meeting (if appropriate), this shall be communicated in writing and noted by both parties.

16.3. Except as otherwise expressly provided, any dispute between the Parties arising out of or related to this contract shall, in the first instance, be the subject of a meeting between the Parties to negotiate a resolution of such dispute. The meeting shall be attended by individuals from each Party who have decision making authority with respect to the matter in question. Should the negotiations not lead to a settlement of the dispute within thirty days of the date of the meeting, the Parties shall use their best efforts to select an alternative dispute resolution procedure ("ADR"), such as a mini-trial, mediation or arbitration, to resolve the dispute. If the Parties are unable to agree upon a form of ADR within twenty days, then, upon seven days written notice to the other party specifying the intended course of action, any Party may pursue other available remedies. If the Parties are able to agree upon a form of ADR, they shall pursue the implementation of the ADR in good faith and in a timely manner. In the event the ADR does not result in resolution of the dispute, then upon seven days written notice to the other Parties specifying the intended course of action, any Party may pursue other available remedies.

16.4. Unresolved disputes shall be referred to arbitration in accordance with the Arbitration Act 1996.

17. Remedies

17.1. The rights of both parties under this Contract shall be in addition to their rights and remedies at law or in equity.

17.2. The Supplier shall not be entitled to anticipatory profits or to special (including multiple or punitive), incidental or consequential damages.

17.3. Any wood fuel the Supplier fails to supply in accordance with this Contract so that it constitutes a material breach of this Contract may be obtained elsewhere by the End User. Any damages, losses, costs and expenses incurred by the End User, due to the Supplier's failure, may be offset against moneys owed to the Supplier or recovered as a debt owing.

18. Force Majeure

18.1. A party, provided that it has complied with the provisions of clause 16.3, shall not be in breach of this agreement, nor liable for any failure or delay in performance of any obligations under this agreement (and, subject to clause 16.4, the time for performance of the obligations shall be extended accordingly) arising from or attributable to acts, events, omissions or accidents beyond its reasonable control (Force Majeure Event), including but not limited to any of the following:

a) Acts of God, including but not limited to fire, flood, earthquake, windstorm or other natural disaster;

b) war, threat of or preparation for war, armed conflict, imposition of sanctions, embargo, breaking off of diplomatic relations or similar actions;

c) compliance with any law;

d) fire, explosion or accidental damage;

e) extreme adverse weather conditions;

f) collapse of building structures, failure of plant machinery, machinery, computers or vehicles;

g) any labour dispute, including but not limited to strikes, industrial action or lockouts;

h) non-performance by Suppliers or subcontractors (other than by companies in the same group as the party seeking to rely on this clause); and

i) interruption or failure of utility service, including but not limited to electric power, gas or water.

18.2. The corresponding obligations of the other party will be suspended to the same extent as those of the party first affected by the Force Majeure event.

18.3. Any party that is subject to a Force Majeure Event shall not be in breach of this agreement provided that:

a) it promptly notifies the other parties in writing of the nature and extent of the Force Majeure Event causing its failure or delay in performance; and

b) it could not have avoided the effect of the Force Majeure Event by taking precautions which, having regard to all the matters known to it before the Force Majeure Event, it ought reasonably to have taken, but did not; and

c) it has used all reasonable endeavours to mitigate the effect of the Force Majeure Event to carry out its obligations under this agreement in any way that is reasonably practicable and to resume the performance of its obligations as soon as reasonably possible.

18.4. If the Force Majeure Event prevails for a continuous period of more than three months, any party may terminate this agreement by giving 14 days' written notice to all the other parties. On the expiry of this notice period, this agreement will terminate. Such termination shall be without prejudice to the rights of the parties in respect of any breach of this agreement occurring prior to such termination.

19. Termination

19.1. The End User may immediately cancel this Contract, either entirely or in part, by written notice to the other party if the Supplier commits one or more of the following events of default:

a) The Supplier is, or becomes, unable to pay its debts when due, or there is an enforceable judgment, distress, attachment, execution or other process in an amount in excess of $25,000 enforced against the Supplier;

b) The Supplier enters into, or resolves to enter into, any voluntary administration, compromise with or assignment for the benefit of its creditors, or enters into, or resolves to enter into, a court-approved arrangement or a capital reorganisation or reconstruction or there is a change in the effective management or control of the Supplier;

c) An application or order is made or a resolution passed for the winding up of the Supplier other than for the purpose of amalgamation or reconstruction approved by the End User;

d) A receiver, a receiver and manager, an official manager, a liquidator, a statutory manager, a trustee or an equivalent person is appointed over all or part of the Supplier's assets or undertaking;

e) The Supplier ceases to carry on its business in whole or in part (except in the circumstances of a Force Majeure Event);

f) The Supplier, by act or omission, allows circumstances to occur as a consequence of which any rights, powers, licences, permits or authorisations necessary for the proper management and supply of the Product are cancelled or are liable to cancellation;

g) If an individual, the Supplier dies or suffers a disability which prevents him or her from performing the Supplier's obligations under this Contract;

h) The Supplier is the subject of repeated complaints (on matters such as the Supplier's health and safety practices) from the End User or from other recipients of the wood fuel;

i) If the Supplier's fuel consistently does not meet the contractually agreed upon fuel specification. In this particular case, if the End User elects to do so, which they can do at their sole discretion, the End User may give the Supplier an opportunity and a specified time frame for altering their fuel material in order to meet the specifications;

j) There is, in the End User's reasonable opinion, an irretrievable breakdown in relations between the End User and the Supplier.

20. Confidentiality

20.1. Each Party must unless otherwise required by law keep confidential the information gained about the other party through the exercise of this contract.

20.2. The covenant contained in Clause 15.1 shall survive termination of this contract.

21. Third party rights

21.1. A person who is not a party to this contract shall not have any rights under or in connection with it.

22. Governing law and jurisdiction

22.1. This agreement and any dispute or claim arising out of or in connection with it or its subject matter shall be governed by and construed in accordance with the laws of New Zealand.

22.2. The parties irrevocably agree that the courts of New Zealand shall have exclusive jurisdiction to settle any dispute or claim that arises out of or in connection with this agreement or its subject matter.

Agreed this *<DATE>*

Name……. Position ……

(On behalf of *<END USER>*)

Name…… Position……. (On behalf of *<SUPPLIER>*)

Schedule 1 – Fuel Specification

1. Wood fuel specification

1.1. Wood fuel to be supplied is to meet the specification of Grade <*XX*> <*FUEL TYPE*> as defined in the 'Bioenergy Association Technical Guide 1 – Wood Fuel Classification Guidelines'.

Or

Meet the following characteristics

Moisture content: The target moisture content on a wet basis shall be <*XX*>% by weight but in any event shall not exceed <*XX*>%.

Contaminants such as soil or stones, metal and plastics should be less than <*XX*>% by weight of the total biomass load.

The biomass particle size shall be less/greater than P<*XX*>

Ash shall be less than <*XX*>%

2. Sampling fuel for invoice calculations

2.1. The payment for fuel delivered will be based on sampling of the moisture content of the fuel as it is delivered.

2.2. Moisture content will be determined by the average of three random samples collected every delivery by the End User's representative. The method used will be by a <TYPE, MODEL, BRAND> 'Moisture Analyser' used according to the manufacturer's instructions and supplied by the End User.

2.3. Sampling of the delivered fuel will be as per the recommendations of the 'Bioenergy Association Technical Guide 5 – Standard methods for verifying wood fuel quality in New Zealand'.

3. Verification of fuel quality

3.1. The Supplier is responsible for undertaking detailed sampling of the fuel to verify that it meets the specification set out in this schedule, Clause 1.1

3.2. The wood fuel is to be sampled according to the methodology set out in Bioenergy Association Technical Guide 5 – Standard methods for verifying wood fuel quality in New Zealand.

3.3. Three verification samples are to be taken from every third truck load and one sample chosen randomly from every nine samples is to be sent for verification testing at the cost of the Supplier. The verification samples may be taken at the Supplier's location of delivery loading.

3.4. The body undertaking verification testing is to be accredited for wood fuel supply testing by the Bioenergy Association of New Zealand.

3.5. The testing body is to provide a copy of the test results directly to the End User.

3.6. If the Supplier has been accredited by the Bioenergy Association of New Zealand for the supply of wood fuel then only every twentieth sample is to be verification tested.

3.7. All verification samples tested are to be labelled as to the date the sample was taken, time, truck identifier and the method of sampling.

3.8. All verification samples are to be held in storage for 3 months from the date of sampling in sealed plastic bags or containers to minimise moisture loss.

3.9. The Supplier shall, when submitting an invoice for payment to the End User, include a Quality Verification Report providing an accurate breakdown of date, time, weight, moisture content, particle size, ash content, percentage of contamination and calorific value for each load of wood fuel delivered during the invoice period.

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