Kilfinan Community Forest Company

Woodfuel Feasibility Study

Prepared by Scottish Native Woods

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Summary

Kilfinan Community Forest Company (KCFC) owns 91 hectares (ha) of conifer plantation. KCFC are committed to using this community resource to deliver the optimum mix of social, economic and environmental benefits. This document analyses the potential to include a fuelwood enterprise in this mix, describes ways in which a fuelwood operation might be organised, and makes recommendations for the development of a fuelwood enterprise.

The principal benefits of using wood for heat generation include sustainability, local availability, minimal production of carbon and a good way of adding value to low grade material. Benefits are optimised when demand for heat is reduced, and woodfuel is used in an efficient manner.

Stocking information provided by the previous owner indicate that there is the potential to produce between 253.67t and 428.34t of woodfuel at 20% moisture yearly.

KCFC will be able to meet the woodfuel demand of a substantial percentage of local users from timber harvested in Kilfinan Community Forest. Supplying this market with $1m^3$ bags of firewood will minimise handling & provide a standardised good value product. It is also envisaged that a proportion of production will be bagged for the higher value retail market in central Scotland. This will be best achieved by working with other existing businesses.

There are access and extraction constraints at Kilfinan Community Forest, which limit the opportunities for conventional clearfell operations. These constraints, linked with KCFC's social and environmental objectives, suggest that alternative approaches to forestry management will be appropriate for most of the site.

The report recommends that KCFC acquire a medium sized tractor and timber trailer, coupled with a firewood processor, and develop an appropriate working area and drying shed. This capital investment will provide the platform necessary for employees of KCFC to develop the woodfuel business in parallel with other activities centred at the Kilfinan Community Forest. This arrangement will also allow KCFC to develop and market a quality dry product, while minimising the environmental impact of the operation by seasoning material in the forest and timing timber extraction.

The operation of a woodfuel business is not without risk, and the margins are tight. However it can provide KCFC with a means of

- adding value to the lowest quality wood that will be produced from Kilfinan Community Forest
- sustaining local employment directly related to forest management
- implementing Low Impact Silvicultural Systems
- providing a reliable supply of low carbon fuel to the local community.

Recommendations

The Report includes a number of recommendations, which are summarised here.

1 A proportion of KCFC firewood should be exported to the higher value central Scotland market.

2 KCFC should seek out a trading partner is Central Scotland to facilitate distribution of the higher value product. Another Social Enterprise could make an ideal partner.

3 KCFC should commit funding to marketing a high quality product, using a range of marketing techniques including demonstration events, new media and leaflets.

4 Should demand exceed the sustainable supply of the existing landholding, KCFC should investigate means of funding the acquisition of additional land under the NFLS, or of acquiring roundwood timber supplies from elsewhere in Kilfinan.

5 KCFC should continue dialogue with existing local woodfuel suppliers

6 Establishing a trading partner in central Scotland will give KCFC a useful means of establishing a co operative arrangement with potential competitors.

7 Clear fell operations and associated high impact infrastructure in the forest should be minimised, although it is recognised that in the first year of operations, there are potential advantages in terms of timing and site clearance associated with clear fell.

8 Full environmental and financial evaluation of the potential systems for timber harvesting should be performed taking into consideration the short and long term benefits.

9 KCFC should acquire an ex demonstrator 88hp Kubota tractor with a Binderberger RW5 trailer and FK5300 crane.

10 KCFC should establish in-forest seasoning as a part of their approach to forestry and woodfuel production.

11 Processing yard to include minimum of 108m^3 of roundwood storage

12 KCFC should ensure that the firewood processing site is constructed with sufficient timber stacking at the height of the infeed table of the processor to allow one machine (Kubota) to efficiently load the processor and operate the processor.

13 KCFC should acquire a Hakkie Pilki 1x37 PTO driven firewood processor

14 KCFC should acquire and erect second hand steel buildings (c£1.50m^2) to provide cover of 300m^2, with electricity laid on. Additional staff accommodation will be provided in a portacabin.

15 KCFC should establish the one metre net stack as the standard unit for firewood consumption among their local customers.

16 KCFC should develop a bulk transport system based around 20kg sacks to supply markets in central Scotland.

17 KCFC should establish a consistent approach to firewood quality by ensuring that firewood is sold at a maximum of 20% moisture content. This will build confidence in the product, and provide a key marketing message.

18 KCFC to establish a local delivery service, based upon the tractor and trailer already specified.

19 Central Scotland demand to be met by a containerised delivery system, with transport contracted out to a haulage company.

Kilfinan Community Forest Company Woodfuel Feasibility Study

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1. Introduction

Kilfinan Community Forest Company (KCFC) purchased 127.48ha of land adjacent to the village of Tighnabruaich on the Cowal peninsular, Argyll, in March 2010. Much of the ground was afforested with fast growing conifers during the 1960s and 1980s. KCFC are investigating ways in which they can add value to this resource and provide benefits for the local community.

The Study defines models for the development of a woodfuel supply chain at Kilfinan Community Forest, based upon a social enterprise owned by KCFC. The Study aims to

- be practicable and therefore economically sustainable for KCFC.
- to give realistic development recommendations for a 5 year period

This Woodfuel Feasibility Study sets out to provide the information that Kilfinan Community Forest Company (KCFC) require to be able **to assess** what is an **appropriate scale** for a community based woodfuel supply company. KCFC intend to use this information to assist in the preparation of funding applications.

KCFC see meeting the demands of a growing local market for quality firewood as a valuable social outcome from community ownership of the forest, as well as a key part of the economic model which will sustain the finances of their developing forest based social enterprise.

The Feasibility Study gathers existing information on supply and demand, as well as looking at the potential to grow demand, and the potential for the forest to supply that growing demand. It also provides KCFC with practical information on the best equipment and arrangements to meet their requirements. Financial projections for this information are included in section 14.

2. The Resource

KCFC owns 127.48ha of land, the Kilfinan Community Forest, which is adjacent to the village of Tighnabruaich on the Cowal peninsular, Argyll. The Forest was purchased in March 2010.

The KCFC land area, through its natural form and geographic location has inherently restrictive access, from the point of view of its location within the region, in terms of the local road network and over the area of land itself (due to restrictive soils and terrain).
The land is dominated by plantation mixed conifers of varying ages and growth rates interspersed with remnant native woodland. A range of other habitats are also represented.
Of the total land area, woodland cover is an estimated **91 hectares**, although due to the irregular nature of the plantations and layout of unplanted land within the plantations, the exact area is nearly impossible to assess accurately. However on the basis of supplied aerial photographs, it is estimated that an additional 7% is open space or woodland edge. Tree growth varies widely (from 2 to 20m³/ha/yr) between species, within

species and over the varied geology of the site. Growth rate has a dramatic effect on sustained yield and stand volumes per hectare.

With the information provided by the previous woodland manager (Forestry Commission Scotland) on species composition and yield class, it is estimated that **a volume of 1027m³** of softwood timber is produced as a sustained yield each year and possibly available for harvesting.
Assuming that a proportion of this timber is suitable for saw milling (c.35%) then it is estimated that there is the potential to produce between **253.67t** (@380kgs/m³) and **428.34t** (@640kgs/m³) of woodfuel at 20% moisture, yearly.

Access to the site is limited, KCFC have started a roading operation, and there is narrow track way, with some built sections within the wood.

3. The Benefits of using Wood for Fuel

The principal benefits of using wood for heat generation can be summarised as follows:

- If correctly managed, woodlands are a sustainable resource and will continue to provide a fuel source indefinitely into the future.

- Provided that harvested woodfuel crops are replanted or encouraged to regenerate and sustainably managed it is possible to offset the carbon emissions from burning against the carbon uptake of the trees during the growth of the crop. *The term 'carbon-neutral' is sometimes used to describe woodfuel but strictly no form of renewable energy can make this claim. All of the leading types of renewable energy such as solar, hydro and wind are better described as 'carbon lean', referring to the small amounts of fossil fuel energy needed as part of the energy of production and/or heat generation process.*
When used for the right applications, woodfuel and other forms of bio-energy can claim to be as green as any other renewable energy source, and there is a substantial body of evidence to support this.

- Woodfuel releases lower quantities of atmospheric pollutants such as sulphur dioxide and the oxides of nitrogen than fossil fuels.

- Producing and using the woodfuel locally helps to minimise the impact of haulage costs. Lower haulage distances are also likely to result in lower associated fossil fuel emissions.

- Regions and communities with limited alternative natural resources for energy production can achieve a greater degree of self-sufficiency in their energy requirement and can also secure a reliable, consistent energy supply for the future.

- Woodfuel provides opportunities for new companies to develop, creating new business opportunities for rural areas, stimulating the rural economy and providing a source of employment.

- Rural businesses can add value to a low cost material and exploit shortages in nearby urbanised areas.

- Woodfuel provides a potential market for small dimension early thinning material, allowing this work to be carried out economically, with positive silvicultural benefits for the woodland stand.

- Woodfuel harvesting can have environmental and amenity benefits. For example, selective removal of conifers for woodfuel can be used during restoration of Plantations on Ancient Woodland Sites (PAWS), where there is a desire to remove conifers to return an area to the species composition associated with ancient woodlands.

- Currently a large proportion of wood residue and arboricultural debris is disposed of at landfill sites. This material could be used for energy generation and help to reduce the burden on limited landfill resources. Costs for disposing of waste to landfill are currently in the range of £13–£23 per tonne therefore there is potential for significant financial savings in finding alternative uses for waste wood.

4. Firewood and energy consumption

Woody biomass contributes about 1334 petajoules (1 petajoule is approximately 30m kilowatt hours) to households each year in the EU, 50% of this energy production comes from traditional firewood (logs).

The energy consumption of a private house varies considerably through the year, with the energy requirement peaking in the coldest months. Contributors to total energy requirement are; geographic location, main structure and house design, number of windows and level of insulation.

A regular private house that conforms to building regulations consumes an average of 90-140 KWh/m² of heat energy per year. Although a marked reduction in total heat requirement is seen with improved efficiency in design. A low energy house has a range of between 40-65 KWh/m², while a "passive house" requires 15-30 KWh/m² per year, equivalent to about 20% of the energy required by a conventional house.

The amount of firewood required each year depends on how it is used. In private houses firewood is typically burnt in fireplaces for comfort and heat. If firewood provides the only source of heating, the amount of firewood required will depend on a number of factors, the size of space being heated, the weather conditions, the level of insulation and the efficiency of the heating appliance, currently modern stoves are 80 to 85% efficient.

5. Demand

KCFC produced, circulated and collected a fuel questionnaire (see appendix 4 for questions and summarised results), during Autumn 2010. 31 surveys were completed, giving a snapshot of the way in which Kilfinan residents use woodfuel at present, and giving some indication of the potential to increase demand.

Summarising the results shows that

- Over 90% of respondents already use some woodfuel
- Less than 20% use it as their main heating fuel
- Over 40% would like to increase their use of wood
- the majority use an enclosed stove, rather than an open fire
- Cost is the main driver, although environmental considerations are a close second
- Nearly 40% had fitted their own woodburning equipment
- Nearly 40% self process their firewood
- Nearly 50% would prefer to buy seasoned, processed wood
- The average storage space available is 5.5m3
- Average annual usage varies widely, but is not calculable as it is expressed in various measurements, however it is often larger than the available storage space.

Kilfinan has approximately 450 houses, so the immediate market is limited, however there is an increasing interest in the use of woodfuel, so there is scope to grow the existing demand. If every house used wood in their heating requirements, this might give a demand of 3600tonnes (at 8t/house), far exceeding the sustainable firewood yield of KCFC's holding.

Our estimate is that the plantation can yield a maximum of 428 tonnes per annum of air dried firewood, or 61 houses at 8 tonnes, however if some of the material is exported to higher value markets, then the figure might be reduced to below 40.

6. The market price for firewood

The current local market price for seasoned softwood firewood is £70/t delivered to the door, although there is no record of merchants actually weighing their produce, and so this is an estimate from the volume provided to the customer. This could therefore be considered to be the minimum local value of one tonne. At this value, potential income from the sale of softwood logs at the sustained yield would range between £17,567 and £29,983.

However elsewhere in Central Scotland, the value of softwood logs is higher due to an increase in demand and winter 2010 has seen the price for seasoned softwood logs rise to £120/t for bulk loads and £340/t for individually netted sacks (£6.80/20kg net) (SNW retail survey, November 2010). Softwood kindling, conventionally the highest value woodfuel product, sells for between £670/t and £915/t in 10 to 30kg nets.

The sale value of KCFC firewood at these higher prices increases to between £51,400 and £145,635 for a production of 428.34t. Even with the increased cost of netting and transport to the market these figures would provide significant increases in profitability.

Recommendation 1 A proportion of KCFC firewood should be exported to the higher value central Scotland market.

Recommendation 2 KCFC should seek out a trading partner is Central Scotland to facilitate distribution of the higher value product. Another Social Enterprise could make an ideal partner.

Recommendation 3 KCFC should commit funding to marketing a high quality product, using a range of marketing techniques including demonstration events, new media and leaflets.

Recommendation 4 Should demand exceed the sustainable supply of the existing landholding, KCFC should investigate means of funding the acquisition of additional land under the NFLS, or of acquiring roundwood timber supplies from elsewhere in Kilfinan.

7. Other firewood businesses

The land owned by KCFC has the ability to produce c.1000 m^3 (c.600 wet tonnes), of timber per year of which **650 m^3 is suited to woodfuel production (65%).** This volume of timber is classed in the medium to high volume of production range in Scotland where the **average is 420m^3/yr.**

There are two existing suppliers on the edges of Kilfinan Parish, and any new social enterprise must find a fit with these existing suppliers. Co operation offers opportunities to minimise local transport of firewood, while also offering the scope to increase the amount of material exported to higher value markets in central Scotland.

Recommendation 5 KCFC should continue dialogue with existing local woodfuel suppliers

Recommendation 6 Establishing a trading partner in central Scotland will give KCFC a useful means of establishing a co operative arrangement with potential competitors.

8. Organisational structure

This document is based upon the premise that KCFC is to develop a social enterprise, based at Kilfinan Community Forest, Tighnabruaich. It is assumed that the enterprise will be driven by the need to generate a social and environmental return in addition to an economic return.

It is assumed that existing employees of KCFC will be trained to include fuelwood production within their working time, filling a part of their annual work programme, while also allowing them to be available for other KCFC activities and enterprises.

Further there are synergies between fuelwood production and efforts to increase the resilience and reduce the carbon footprint of Kilfinan, and it is assumed that these will be acted upon.

However the firewood business could also be developed as a stand-alone enterprise, run by a member of the community.

9 Producing firewood at Kilfinan Community Forest

This section of the document looks at the practicalities of harvesting timber in Kilfinan Community Forest, and processing the firewood elements of the harvest. It is recognised that approximately 1/3 of the harvest will not be used for firewood, and that this 1/3 will go to higher value end markets. This document focuses on providing a viable business model for material which has often been loss making in conventional forestry plantations.

9.1 Constraints imposed by the terrain and access

The variable terrain and quality of the conifer crop, in combination with limited 'conventional' access, imposes a number of constraints but also offers opportunities for timber production and extraction.

Due to the conventionally difficult terrain of the KCFC land holding, the use of large forestry harvesting and extraction equipment will incur high financial and environmental cost and will require significant investment in suitable access tracks, roads and stacking areas. It is also questionable whether the local road network immediately adjacent to the KCFC land holding is suitable for 44 tonne lorries due to their narrow nature, tight bends and proximity to housing.

9.2 Primary Production Systems Analysis

Many alternative systems of timber harvesting are used within the UK and, to a much greater extent, in the EU. Lower site impact systems, although producing smaller amounts of timber per unit, use significantly less fossil fuel energy and could therefore be argued to be inherently more efficient. On initial assessment 'conventional' harvesting may appear to be lower cost than alternative systems, but when fully evaluated conventional harvesting is shown to incur much greater financial and environmental costs as well as providing limited socio-economic value, which is a key primary measure of all rural land based production systems, because only a very limited number of operators are required and they are unlikely to be local inhabitants.

Two approaches to harvesting timber are described

9.2.1 Large Scale Clear Fell

Advantages

- Currently the main method of cutting and extraction of plantation conifer crops, providing high volume outputs per man/day. This is a system that is currently well known and understood, easily obtainable with little management input required.
- There is a range of machine sizes/outputs available depending on the local scale and terrain, local systems (clear fell or thin and clear fell).
- Harvesters can cut up to 200t per day requiring the deployment of two forwarders to maximise production and cost efficiency.
- Forwarder size range from 8t to 20t (load weight), the smaller machines are suited to difficult and wet ground conditions.

Fell and extract cost as low as £8/t depending on distance of extraction and size of machinery used.

Disadvantages

- A minimum tonnage is required to offset high set up costs; bringing machines to site and the infrastructure required to handle the machine weight and timber volumes produced. This can become an excessive cost if the infrastructure is not utilised to its full capacity in the longer term.
- There is a high possibility of permanent soil damage if the harvesting operation is not specifically tailored to site and seasonal conditions.
- High reinstallation costs associated with drainage and roads are often required and should be assessed/costed in to the whole cost analysis of the operation. Soil damage may hinder future crop establishment and development in the longer term.
- Offers little socio-economic benefit to the local community, as this system requires minimal, specialist labour input, especially if timber is sold to distant markets prior to any local value add.
- Little control over the operation once harvesting has commenced.
- The ability of sites that are suited to Low Impact Silvicultural Systems (LISS) (as assessed by FCS) to establish more robust woodland that can cope with climate change scenarios is likely to be compromised (FCS Scottish Forestry and Climate Change – final report 2009)
- Roading cost of c. £45-£110/m (for stone at 5.5-8.0t/m) to cope with the large equipment and timber volumes.
- High replanting cost and the requirement to deer fence relatively small areas. To restructure an area to mixed native broadleaves cost will be c. £2350/ha with a restocking grant of £900/ha.
- Large quantities of timber and branch wood are left on site, due to the inefficiencies of the harvesting machinery. These are due to the wide range of stem diameter and the ability of the harvesting head to de-limb small diameter sized material. Harvesting heads work best with relatively uniform stem diameters. Timber 'spoil' left on site is often difficult to reprocess due to contamination with soil which is very damaging to cutting machinery, requiring a second phase of collection, stacking and burning.

It is understood that two areas of the KCFC forest are currently under consideration for clear felling: one at the eastern end of the land holding beside the school, and the other at the western end adjacent to FES managed forest.

It is essential to fully assess the site in terms of suitability for vehicle access for both the harvesting equipment and for timber haulage. The public road at the eastern boundary is deemed unsuitable for 44t timber lorries although currently this route is under consultation (Argyll Timber Transport Group). The western location may benefit from links to the new extraction roads developed by FES in adjoining forests, giving much shorter extraction routes and access to a more suitable road.

9.2.2 Low Impact Small Scale

Advantages

- Minimal site disturbance from lower weight more agile machinery plus greater flexibility to tailor operations to site and seasonal conditions as minimal haulage cost to bring machines to site.
- Higher long term yields from continuous cover crops as tree growth is maintained across the full spectrum of diameter size classes.
- Small scale or no track and road installation requirement (£20-45/m – stone 1.5/2.5t/m), minimal infrastructure establishment and maintenance costs.
- Lower energy cost per cubic meter of extracted timber, 19-26% that of larger scale machinery.
- Increased local employment due to higher labour opportunities, brings high socio-economic benefits both short and long term. Added benefit of skills development within local community and stronger tie-in to forest management.
- New system that requires higher labour and an increased number of machines to produce similar volumes can provide much needed rural employment – both job and business opportunities.
- Simple machines are more suited to the available rural repair and maintenance facilities, requiring more conventional skills sets.
- Continuous thinning may provide the ideal conditions for tree regeneration eliminating the cost associated with restocking following a clear fell.
- Becoming more popular for appropriate scale harvesting and thinning operations, due to minimal site destruction and negligible reinstatement costs.
- Opportunity to increase machinery utilisation rates by acquiring tractor based extraction equipment that can work in the wood yard and also deliver to local markets.

Disadvantages

- Higher cost of extraction per cubic meter (usually) with added management cost to develop and run the operations.
- Lower output will require longer operations and or increased operational labour force to undertake primary production operations.
- Need to have available and willing semi skilled labour force locally, to undertake a range of operations so need for community buy-in.

- Less familiar systems than those used currently therefore there may be a need to re-skill current forest /woodland management labour force.

9.2.3 Costings

Harvester/forwarder costs of production are c£12/ m^3, compared with hand cutting/tractor and trailer extraction costs of c£18/m^3.

These figures assume that primary system provided logs directly to the secondary processing without additional handling. Additional handling will add a minimum of £3.5/m^3.

Recommendation 7 Clear fell operations and associated high impact infrastructure in the forest should be minimised, although it is recognised that in the first year of operations, there are potential advantages in terms of timing and site clearance associated with clear fell.

Recommendation 8 Full environmental and financial evaluation of the potential systems for timber harvesting should be performed taking into consideration the short and long term benefits.

Recommendation 9 KCFC should acquire an ex demonstrator 88hp Kubota tractor with a Binderberger RW5 trailer and FK5300 crane.

9.3 Roundwood Seasoning and Storage

Leaf seasoning is a method of reducing timber moisture content from the cell saturation point while the timber remains within the forest. Trees are cut in the early summer once full leaf area cover has been reached or, for conifers, in May and left to dry through transpiration from their canopy foliage. Once moisture has fallen bellow the cell saturation point the leaves or needles will fall off, and the timber can be further processed.

This form of sour felling can be coupled with in-forest seasoning of the roundwood. Covering log stacks over with rain protective material will greatly assist in drying prior to secondary processing. Logs stacked off the ground on bearers and with secondary breaks (crossed logs) within the stack to allow draught through, will reduce mould and accelerate drying.

This sour felling approach couple with in-forest partial seasoning can reduce handling weights by up to a third. This dramatically reduces the costs associated with extraction, with energy savings and reduced wear and tear on both operator and equipment.

Careful planning can couple roundwood storage with timed extraction of the roundwood from the plantation. Where possible extraction should be linked to dry weather, thus reducing the impact of extraction equipment on the forest.

A stacking area large enough to hold 160m³ of round logs will be required close to the firewood processor to store the logs prior to processing. These logs should be a consistent 3m in length and stacked 1.5m high. This would require minimum area of 36.0m x 3.0m plus room for manoeuvring.

Health and safety. Where public access is close to stacked material, the implications of public safety around timber stacks must be carefully managed, as described in Arboriculture and Forestry Advisory Group Guide 304.

Recommendation 10 KCFC should establish in-forest seasoning as a part of their approach to forestry and woodfuel production.

Recommendation 11 Processing yard to include minimum of 108m³ of roundwood storage

9.4 Secondary Production Systems Analysis: firewood processing

There are a varied range of potential production methods and systems. This constitutes a considerable challenge to producing an accurate and comprehensive cost assessment for woodfuel production.
The method of conversion of the raw material into saleable produce is dependant on a number of key factors; size and quantity of the timber, range of timber species, whether fresh cut or partially seasoned and the range of produce deemed suitable for the market.

9.4.1 Low Cost Small Production Log Splitters

Low production firewood production involves cutting logs with a chainsaw into predetermined length or 'rounds' for splitting. Length is determined by the end users firewood requirements (ie. size of stove, oven, etc).

The traditional log splitters are human powered splitting mauls, splitting axes and splitting wedges. Firewood production speed is dependent on the physical condition of the operator, operator stamina, wood weight, type of wood (some species split easier) and wood quality (knots, grain direction, etc). Blocks must be lifted and placed in the vertical position onto a cutting block to be split. During the splitting process the wood falls off the block and must be lifted again if subsequent swings are required.

Powered log splitters consist of placing a block against a wedge (2, 4 or 6 way) and activating a ram which applies a force to the opposite end of the block. The ram pushes the block into the wedge which splits it into multiple pieces of firewood. Firewood production speed is dependent on the physical condition of the operator, the cycle time of the ram and the amount of force the ram can exert. Larger machines can exert more force (tonnes) and thus overcome any splitting difficulty due to wood type and quality. Some machines offer extra options to reduce the effect of the operator's physical condition on production speed. These include out-feed conveyor belts, out-feed trays, wedge height adjustment, auto cycling and devices to assist

lifting.

Log splitters are typically hydraulic and powered by small petrol/diesel engines or by the Power Take Off (PTO) from a tractor. They come in horizontal and vertical configurations and are usually portable so they can be towed easily behind a pickup truck or ATV. Mechanically driven splitters also exist and tend to have faster ram cycling times than hydraulics.

9.4.2 Circular and Chainsaw Saw Firewood Processors

High volume firewood production involves loading multiple logs into a machine which cut the logs, into predetermined 'round(s)' and then split the rounds into firewood. With these machines the operator does not handle the wood over the entire process.

Multiple logs are loaded on to an in-feed deck that is positioned 500-600mm above the ground, using a fork lift, log loader or other lifting device. A system that conveys the logs directly from the ground up to the height of the processor reduces the reliance on machinery. The operator can move the deck/lifting chains forward and feed a log into the in-feed conveyor. The in-feed conveyor is then advanced till the log reaches an adjustable mechanical stop or visual indicator (fixes the length of the 'round'). This allows the operator to ensure that all pieces of firewood are consistent lengths.

Before the cutting operation the operator lowers an arm or hold down spiked roll to hold the log in place. The operator activates the cut-off saw (circular saw/chainsaw) and cuts through the log either by mechanical, usually hydraulic, or operator movement of a lever. The cut 'round' falls into a trough below where the ram is activated and the 'round' is forced into a wedge (2, 4, 6, or more ways) and split into firewood. The split firewood either falls on the ground to be stacked or falls into a conveyor to be piled in a truck, bin or the ground. To repeat the cycle the operator raises the hold down arm (hold down rolls are not raised) and advances the in-feed conveyor till the log reaches the log stop or indicator.

Firewood production speed is dependent on the ability to feed the processor logs, log size, operator skill and ability to remove the firewood quickly. Production speeds depending on equipment range from 1 to 6 m^3 per hour. Log diameters capacity ranges from 100mm (4in) to 450mm (16 in). Additional options include integral or separate out-feed conveyor belts, auto wedge adjustment (height and number of wedges), auto cycling and self loading in-feed decks.

Firewood processors are typically hydraulic and powered by medium to large petrol/diesel engines or by the Power Take Off (PTO) from a tractor. They come in horizontal configurations, are portable and can easily be towed behind a medium/heavy duty pickup truck. Electric drive / stationary units are also available.

One operator is deemed to process c.5m^3 of round timber per standard day (0.714m^3/hr). This is achieved by using a medium scale firewood processor

(350-380mm log capacity) with log deck and a system of loading the log deck (timber trailer/forklift).

To convert 650m³ would take on average 130 man days; a 10% contingency would bring this figure to 143 man days. The system works to best efficiency with three operators, so that particular tasks can be rotated daily between the operators. The three primary operations are: loading the processor, operating the processor and loading/stacking the produce. Three operators would bring output up to 15m³/day, therefore time to convert 650m³ would be 43 man days, plus 10% contingency, total time required 48 man days.

9.4.3 Costings

Secondary processing cost calculated at c£365/day (3 operators £240/day, machine cost (processor £50/day and tractor loader £60/day) at hire-in value plus fuel total £125/day).
This gives a figure of £24/ m³ (figure based around a solid m³ prior to bulking following splitting).

Recommendation 12 KCFC should ensure that the firewood processing site is constructed with sufficient timber stacking at the height of the infeed table of the processor to allow one machine (Kubota) to efficiently load the processor and operate the processor.

Recommendation 13 KCFC should acquire a Hakkie Pilki 1x37 PTO driven firewood processor

9.5 Packaging and Storage

Effective stacking and storage systems are a prerequisite to maximum production efficiency. Two systems of log storage are proposed for KCFC

For local markets, customers should be encouraged to take advantage of the low costs associated with bulk buying in one metre cubic net sacks Given a bulking factor of 2.5 on splitting, 650m³ of logs will, expand to 1625m³ or 1625 cubic metre net sacks.

The production system (3 operators) can produce 37.5 cubic meter net sacks per standard day. There will be a requirement to store this material under cover to finish drying to the desired moisture content. This would ideally be 3 months if initial moisture has been reduce to between 30 and 35% prior to processing. This would potentially result in 4 batches of 400 cubic meter net sacks annually.
If these net sacks are stacked two high, a storage area of 200m² would be required.

This will need to be a building that is ideally long and narrow with open sides for access and a covered porch, running along the narrow side to cover processing operations. This building would be 7m deep (plus additional 4m porch) and 28m long

Central Scotland markets will be supplied with 20kg sacks of firewood. A system involving 20 foot containers will minimise handling, and provide secure storage for the product in central Scotland.
.
Additional on site covered space is required for equipment storage, giving a total shed area of 300m3.

Recommendation 14 KCFC should acquire and erect second hand steel buildings (c£1.50m²) to provide cover of 300m², with electricity laid on. Additional staff accommodation will be provided in a portacabin.
Recommendation 15 KCFC should establish the one metre net stack as the standard unit for firewood consumption among their local customers.
Recommendation 16 KCFC should develop a bulk transport system based around 20kg sacks to supply markets in central Scotland.

9.6 Seasoning

Firewood that is dry or seasoned has optimum heating performance if the wood moisture content is less than 20 percent. It burns cleaner with less creosote and less unburned char in the ashes. New finely tuned wood burning stoves are particularly problematic if they are fed wood that is not properly seasoned.

Firewood drying/seasoning is typically handled by air drying. Wood is either stacked in rows or loosely piled. Depending on weather and stacking methods the firewood is seasoned in 7 to 12 months (or longer). Due to seasonal demand for firewood, full air drying for large volumes can be problematic due to the space required for storage.

Recommendation 17 KCFC should establish a consistent approach to firewood quality by ensuring that firewood is sold at a maximum of 20% moisture content. This will build confidence in the product, and provide a key marketing message.

10 Woodfuel Delivery

The immediate area around the KCFC plantation will comprise the main market for firewood.

Utilising 1 cubic meter net bags for storage, drying and delivery will greatly reduce secondary handling following production. The delivery of 1625 net sacks of wood fuel will require dedicated transportation.
The logistics of delivery will be critical in making the system of production as efficient and as economically viable as possible.
If transported by flat bed non HGV truck then a system of lifting will be required in order to offload the material without damage to the net sacks. Assuming that the logs are dried to below 20%mc then each net will weigh in the region of 350kgs. A flat bed truck will be able to carry 3 net sacks,

assuming a maximum load weight of 1000kgs. The projected yearly output will therefore require 541 delivery trips.
A trailer behind a 4x4 vehicle capable of towing 3500kgs will have added delivery capacity, with the possibility of towing 8 net sacks, equating to 203 trips.
Use of a tractor and trailer will have much greater capacity with the potential to transport 12 net sacks on an 18ft trailer (longer trailers will be problematic to handle in such a rural location on a daily basis). The high capacity for potential haulage may be hindered by the volume of a single order unless orders are 'backed-up' to ensure that delivery is only undertaken at full capacity each outing.

Delivery to central Scotland will be by the container-load, with transport supplied by an external party.

Recommendation 18 KCFC to establish a local delivery service, based upon the tractor and trailer already specified.
Recommendation 19 Central Scotland demand to be met by a containerised delivery system, with transport contracted out to a haulage company.

11. Marketing

Most users expect firewood delivered to be ready to burn straightaway, and are prepared to stack it at least for a short time. Customers want to know what type of firewood is being delivered, and how long it has been seasoned, and prefer easily handled, clean wood.
A number of factors identified as having a positive influence on the choice of firewood as a fuel, including the pleasure of a real fire; cleaner than coal and helping to avoid using fossil fuels. A few problems with burning firewood have also been identified, including its relative **un-cleanliness** compared with oil, gas and electricity, and the work involved.
From Northern Woodheat Project 2007

Local marketing can be conducted in a number of ways.

In the first instance there are good links with KCFC's aspirations of reducing the carbon footprint of Kilfinan. Helping community members provides good opportunities to relay positive messages about the value of woodfuel, especially when the woodfuel is of reliable quality and available locally. Woodfuel also potentially provides a positive link between the community and their forest, and this message can be reinforced by demonstration events.

Additional marketing can be provided by a website, which should provide information on the quality and ready availability of the material.

12. SWOT Analysis

Strengths Control of an available plantation resource Determination to make the plantation work Existing climate change ethos No mains gas	**Opportunities** Scope to deliver sustainable and affordable fuel to Kilfinan Community members have enhanced skills as woodfuel operators. Profile of project raised by marketing, both to local people and to central Scotland
Weaknesses Lack of infrastructure Distance from large scale markets High windthrow hazard increases risks of ATC Firewood will be one link among several in KCFC's forest management regime. Efficient burning of woodfuel requires the right equipment and attitude	**Threats** Increasing interest in woodfuel business by other operators Price competition from other operators Maintaining quality in the face of demand: building dry stockpiles. Failure to secure start up funding assistance. Fluctuating fossil fuel prices

13. Risks

Marginal financial returns
The model proposed in this study has a relatively low return, with limited margins for error. Small differences in the price achieved for firewood will make a major difference to the profitability of the enterprise. However the figures show the firewood business bearing a considerable portion of the costs for other sectors of KCFC's business, and as business models for these sectors are developed, the project might appear more attractive.

Demand
The model assumes that there is a ready market for firewood in Kilfinan and and central Scotland, and that the supply produced by KCFC. Demand for firewood has tended to vary with the price of fossil fuels, which are currently high

People
The model assumes that the people that KCFC are developing as a forestry workforce will be capable of successfully taking on the new tasks proposed for the fuelwood business.

Business model
The document assumes that the firewood business is one part of KCFC's social enterprise. Failure of other elements of KCFC's enterprise would have a detrimental impact on the viability of the firewood business.

Business Partners
The model assumes that KCFC will successfully establish a relationship with an existing business in central Scotland, and much of the profitability of the fuelwood enterprise depends upon this relationship. KCFC will need to successfully negotiate the terms of the agreement and ensure that it runs smoothly.

Supply
Firewood is a low cost business, with low entry costs and a market where product is not well differentiated. One man, a chainsaw and a splitting maul can produce a product from a lower cost base, and a successful business will attract competition. KCFC will need to ensure that their product is known for being consistent, reliable and of good quality.

Seasonality
The model aims to minimise damage to the environment by extracting timber during dry weather periods. These dry periods are neither regular nor reliable, so there is a risk that damage will be above the desired level.

14 Financial Analysis

Notes	COST	PROJECT EXPENDITURE	£	Year 1 £	Year 2 £	Year 3 £	Year 4 £	Year 5 £	TOTAL £
1	**Capital**	Roading & site preparation		30,000					**30,000**
2		Timber Tractor		15600					**15,600**
3		Timber/delivery trailer		13,500					**13,500**
4		Firewood processor		7,145					**7,145**
5		Site set up/log bunk		4,000					**4,000**
6		Bio diesel plant		3,200					**3,200**
7		Storage & equipment shed		7,800					**7,800**
8		Electricity supply		3000					**3,000**
9		Port cabin		1450					**1,450**
10		20ft containers		5,000					**5,000**
11	**Revenue**	Insurance		1,500	1,500	1,500	1,500	1,500	**7,511**
12		Project management		7500	3000	3,000	3,000	3,000	**19,512**
13		Consumables		8400	2,200	3,200	3,600	4,200	**21,613**
14		Harvesting costs	21	6720	9030	8967	8967	8967	**42,686**
15		Processing costs	24	7980	11010	11148	11148	11148	**52,473**
16		Delivery costs	8.5	3,255	4,886	5,235	5235	5235	**23,871**
17		Promotion & marketing		4500	650	650	650	650	**7,117**
19		Office costs		340	340	340	340	340	**1,719**
22		Professional fees		1,000	1,000	1,000	1,000	1,000	**5,022**
		TOTAL COSTS		**131,890**	**33,616**	**35,040**	**35,440**	**36,040**	**272,026**
		PROJECT INCOME							
24		Reserves							
25		Capital grant assistance		90,695					**90,695**
26		Revenue grant assistance		23,240					**23,240**
27		round logs @£32	32						**-**
28		Unseasoned split firewood @ £50	50	7500	5500	1000	0	0	**14,000**
29		Seasoned split firewood @ £70	70	8400	14350	17990	19390	19390	**79,520**
30		"exported" firewood @ £120	120	6000	13800	18000	18000	18000	**73,800**
		TOTAL INCOME		**135,835**	**33,650**	**36,990**	**37,390**	**37,390**	**281,255**
		ANNUAL NET FLOW		**3,945**	**34**	**1,950**	**1,950**	**1,350**	
		CUMULATIVE FLOW		**3,945**	**3,979**	**5,929**	**7,879**	**9,229**	**9,229**

Note These figures are based on working assumptions, and should be treated with care.

Line	Heading	Comment
1	Roading & site preparation	Creation of 300m of forestry road & flat yard area
2	Timber Tractor	Ex Demo 88hp Kubota tractor
3	Timber/delivery trailer	Binderberger RW5 trailer with FK5300 crane
4	Firewood processor	Hakki Pilki 1x37 PTO
5	Site set up/log bunk	300m^2 2nd hand steel portal at £1.50/ft2 plus erection
6	Bio diesel plant	Refined oil produces less by product than Biodiesel.
7	Storage & equipment shed	second hand equipment
8	Electricity supply	200m underground cable @£5/m & installation
10	20ft containers	for "exported" firewood
11	Insurance	Notional share of KCFC insurance costs
12	Project management	Notional share of KCFC's management costs
13	Consumables	Net sacks, assuming 50% reuse
14	Harvesting costs	hand cutting
15	Processing costs	higher costs for exporting in retail nets
16	Delivery costs	£8.5/t for local costs, plus £300/container to central Scotland
17	Promotion & marketing	Firewood festival & brand development in year 1, ongoing costs thereafter
19	Office costs	Phone, paper & other consumables
22	Professional fees	Notional share of KCFC professional fees
26	Revenue grant assistance	Excludes harvesting, processing & delivery
27	Round logs @£32	Model allows for saw log production
28	Unseasoned split firewood	Production declines as dry supplies are increased. There is scope to import roundwood to meet this demand
29	Seasoned split firewood	
30	"exported" firewood	exported in bulk to central Scotland

Delivery & production costing	**Yr 1**	**Yr 2**	**Yr 3**	**Yr 4**	**Yr 5**
local delivery costs	2295	2678	2355	2355	2355
exported delivery costs	960	2208	2880	2880	2880
total delivery (£)	**3255**	**4886**	**5235**	**5235**	**5235**
Production in tonnes					
tonnes unseasoned	150	110	20	0	0
tonnes seasoned	120	205	257	277	277
tonnes exported	50	115	150	150	150
total tonnes	**320**	**430**	**427**	**427**	**427**
Processing costs unseasoned (£)	3600	2640	480	0	0
processing costs seasoned (£)	2880	4920	6168	6648	6648
processing costs exported (£)	1500	3450	4500	4500	4500
Processing costs	**7980**	**11010**	**11148**	**11148**	**11148**

Appendix 1 Extracts from KCFC documents

The advantages of the community-based model include:

- The ability to restructure the forest gradually; harvesting and restocking small coupes over an extended time period, perhaps leaving occasional small stands as long-term retentions.
- The potential ability to utilise timber that may have very low or no commercial value on the open market.
- The avoidance of the landscape and visual implications of large-scale coupe felling on the visually sensitive slopes above the village.
- The avoidance of the landscape, visual and cost implications of a Class A forest road above Tighnabruaich village. It is easier and cheaper to make a low-specification road fit well into the landscape.
- Local utilisation of a local resource.
- The involvement of local people with their local area over an extended period of time.
- The development of local skills needed to keep the project going.
- The ability to develop recreational resources in response to local needs.

KCFC Forest Management Aspirations

"Kilfinan Community Forest Project Management objectives"
from the Acharossan Community Forest Management Plan: June 2007

1. To utilise the timber resource of the forest in order to:
· meet the needs of the local community for construction material and fuel.
· create employment and new skills opportunities within the local community.
· generate income for community projects.

2. To enhance the biodiversity value of the forest through:
· harvesting conifers when economically mature and restocking selected sites with mixed conifers, including species known to attract red squirrel.
· harvesting conifers when economically mature and restocking sites with native tree species in order to increase the area of native woodland.

· leaving significant areas of clear-fell sites as open ground.
· controlling rhododendron.

3. To enhance the amenity value of the forest through:
· diversifying the species and age ranges of the conifer forest.
· controlling rhododendron.
· upgrading the Kilfinan right of way.
· creating waymarked routes to viewpoints and other landscape features.

4. To conserve and enhance the landscape value of the forest by:
· a gradual restructuring of the forest on the southern slopes and higher hills using relatively small-scale access tracks, felling coupes and harvesting machinery.
· allowing clear-felled coupes to revert to open hill habitat or restocking with a wider range of conifer species or with native broadleaves.]

Sources of woodfuel

Poorly grown timber (***in conventional market terms***) is suitable for woodfuel. This could be in the form of firewood logs or, if suitable boilers were installed in local buildings, woodchips. Materials available for chipping ***(and logs)*** could include all the following categories of wood:

- Complete stems of probably ***(all)*** all the trees of these species: Lodgepole Pine, Corsican Pine, Western Hemlock.
- All Japanese Larch, except for good straight sawlogs over 18cm top diameter, or any straight larch poles suitable for fencing rails, posts, strainers.
- Tops of Sitka and Norway spruce, ie all the stem growing above the 18cm diameter point.
- Whole spruce trees with a diameter at breast height (dbh) of less than 20cm. (***thinnings***)
- Dead but sound trees of all species (***allowing a proportion to remain for deadwood habitat***)
- Badly bent spruce stems under tension, alive but long windblown.
- Very knotty, branchy, tapered, curved, and forked trees of all species.
- All the slabwood from milled sawlogs. (***knotty timber is good for posts and beams in large section, giving added durability, 'defects' can make for interesting design)***
- Side trimmings, and rejected, waney edged boards from the sawlog milling (approx 30% of the sawlog volume).
- Branches from felled trees. These can also be chipped and burned after the needles have fallen off but may give lower quality chips***.(high chlorine from green bark and foliage creates degrading acids)***

Appendix 2

Understanding Your Raw Material

All tree species can be used as firewood, although each species has its own specific characteristics. Softwood such as Spruce, Pine and Fir produce sparks when combusted and so are not suited to use on open fires. Beech, Oak and Birch have the highest density (usually) and so correspondingly a higher energy production on burning when dry.

Moisture content is by far the main governing factor in energy production from wood burning. The ideal moisture content of wood is below 20%, with 13% being achievable if kept and managed effectively. Further reductions in moisture contend require more elaborate techniques; in initially drying and also in maintaining these lower levels through the seasons. The holy grail is 8% moisture.
Dry wood is not only easy to ignite but it also produces much more heat that unseasoned, 70% more, as well as having lower emissions due to ignition of volatiles at higher temperatures.

Net Calorific value of different tree species

Tree Species	**Cal Value @20%mc Kwh/stacked m²**
Poplar	1,110
Spruce	1,300 -1,310
Aspen	1,330
Fir	1,350 -1,370
Pine	1,360 – 1,570
Alder	1,230 – 1,400
Willow	1,440
Larch	1,780
Maple	1,675 – 1,780
Birch	1,700 – 1,810
Ash	1,870
Beech	1,850 – 1,930
Oak	1,890 – 2,030

Splitting logs, bulks the volume, from the solid tree by a factor of c.2.5 for loose and 1.49 for stacked, that is one solid cubic meter split will occupy c.2.5m³, this is a ‘loose meter’ or 1.49m³ for a stack of closely fitting logs as “stacked meter”.

The weight of one dry ‘stacked meter’ (at 20% mc) for hardwood is between 410-550kgs, for softwood this is between 350-450kgs. However these

variations are for average material, as hardwood can reach 780kgs and softwood 640kgs per stacked cubic meter in exceptional circumstances such as with Robinia and Northern Larch that have often very high densities due to slow growth rates.

The moisture content of growing trees fluctuates seasonally, with a peak for deciduous tree in April and May generally. Although for each species the fluctuating highs and lows do not often correspond to each other.

Moisture Range and Time of Year

Species	Highest Month & % mc	Lowest Month & % mc
Alder	End May - 54%	July – 43%
Spruce	End Feb – 52%	End June - 43%
Pine	End Feb – 54%	End Aug – 50%
Birch	End May – 49%	Aug – 37%

Split logs dry quicker than whole logs. Logs with a full bark cover do not dry as well as those that have their bark cut or sliced. This is certainly the case for Pine, Oak and Birch that have an almost water tight bark, that tends to encourage sweating and decay if left entire. Maple, Spruce and Beech bark tends to naturally open within the first year of seasoning encouraging and increasing drying.
Splitting is also a method of reducing log size to suit varied applications and depends on the types of appliance that the logs are destined to be used in. Having a varied fuel size is also useful, starting the fire with kindling and smaller logs, building with medium sized and ultimately larger logs to control the burning speed.

Appendix 3

Firewood quality standards

Quality assurance and long-term confidence in supply

Logs may be described as green, seasoned, or two-year seasoned.
It is important both for the woodfuel producer and user that a consistent quality of woodfuel is achieved for each set standard. To ensure that the type of woodfuel meets the required standard (in terms of quality and moisture content) for the boiler/burner, a simple common standard for end users is required. Such a specification/standard for woodfuel should aim to guarantee a predetermined level of quality, in terms of size and moisture content. It provides reassurance to purchasers and end users that a batch of woodfuel of a given specification will be of consistent quality. This enables a

producer/supplier to decide on the species and size of trees and processing machinery that is best suited to produce that specified woodfuel.
Similarly, the buyer can more accurately assess the amount of woodfuel needed to produce the required heat for their requirements.

A common standard for woodfuel encourages wider acceptance, builds understanding and reassurance, engages new users and maintains a sustainable market for the long term.
Standards are available in the EU and elsewhere, although there is no indication that they are finding widespread application.

Countries within the EU are at different stages of developing standards for woodfuel relative to the UK. Scandinavian countries and Austria, where woodfuel is an integral and important part of heat and energy production, have produced their own standards, focused on standard length of 25cm, 33cm and 50cm and strict maximum levels of moisture. The CEN standard EN14961 is currently being developed giving a recognised standard for Scandinavian countries. While in Austria the ÖNORM standard is used for 'log-wood', both M7104 and M7132.

The EU is currently preparing a European standard (CEN/TC 335) for the various types of biofuel which includes woodfuel in various forms. It is investigating the standards and commonality from the various European countries and will formulate a standard that can be implemented throughout the EU.

Standard reference	**Title**
CEN/TR 15569:2009	Solid biofuels – A guide for a quality assurance system
CEN/TS 14588:2003	Solid biofuels - Terminology, definitions and descriptions
CEN/TS 14778-1:2005	Solid biofuels - Sampling - Part 1: Methods for sampling
CEN/TS 14779:2005	Solid biofuels - Sampling - Methods for preparing sampling plans and sampling certificates
CEN/TS 14780:2005	Solid biofuels - Methods for sample preparation
CEN/TS 15234:2006	Solid biofuels - Fuel quality assurance
CEN/TS 15290:2006	Solid Biofuels - Determination of major elements
CEN/TS 15296:2006	Solid Biofuels - Calculation of analyses to different bases

CEN/TS 15297:2006	Solid Biofuels - Determination of minor elements
CEN/TS 15370-1:2006	Solid biofuels - Method for the determination of ash melting behaviour - Part 1: Characteristic temperatures method
EN 14774-1:2009	Solid biofuels - Determination of moisture content - Oven dry method - Part 1: Total moisture - Reference method
EN 14774-2:2009	Solid biofuels - Determination of moisture content - Oven dry method - Part 2: Total moisture - Simplified method
EN 14774-3:2009	Solid biofuels - Determination of moisture content - Oven dry method - Part 3: Moisture in general analysis sample
EN 14775:2009	Solid biofuels - Determination of ash content
EN 14918:2009	Solid biofuels - Determination of calorific value
EN 14961-1:2010	Solid biofuels - Fuel specifications and classes - Part 1: General requirements
EN 15103:2009	Solid biofuels - Determination of bulk density
EN 15148:2009	Solid biofuels - Determination of the content of volatile matter

Appendix 4

Summary of results from Woodfuel Demand Survey undertaken by KCFC in autumn 2010.

Number of surveys completed	31		
Do you use wood for			
Space Heating	29	Radiators	7
Hot tap water	8	None	2
Heating - Is main fuel wood?			
Yes	6	No-oil or gas	11
No-coal	14	No-electr'y	12
Hot water - is main fuel wood?			
Yes	1	No-oil or gas	15
No-coal	6	No-electr'y	13
Woodburning Equipment			
Open fire	11	Multifuel stove	12
W'burn stove	14	Log boiler	
Why did you start using woodfuel?			
Cost of other	14	Aesthetics	9
Environment	12	Already in	5
Access to cheap fuel	4	**Other:** coziness, kitchen heating,	
How long have you used woodfuel?			
Less 2 years	6	5-10 years	7
2-5 years	9	More 10 years	9
Before that, what did you use for space heating?			
Coal	8	Oil	10
Electricity	12		
Before that, what did you use for water heating?			
Coal	4	Oil	8
Electricity	9	wood	1
Who installed your equipment?			
DIY	13	HETAS contractor	9
Stove supplier	6	Already in	3
Do you have a dedicated wood store / woodshed?			
No-porch/garage	11	YES	18
Approx size in metres?			
0-3m3	4	3-6m3	4
6-9m3	3	>9m3	7
average size (m3)	5.65		
NB: average excludes one outlier, which appears to confuse metric with imperial measurements			
Yearly amount			
2 shedloads	3	5-10m3	5
shedloads	1	10-30m3	3
2-3 trailers	1	70-81m3	2
1 tonne	1	3-4 tonne	4
6 tonne	1	0.25 of a garage	1

How is it delivered / bought?

Net collected	1	Big Bag delivered	1
Loose delivered	13	Self processed	13

Would you prefer to buy your wood..

Green, in round	4	unseasoned /processesd	4
seasoned & processed	16	seasoned. stacked	2

What length of logs do you require?

20cm	6	30cm	10
40cms	6	50cms	3

Would you like to increase use or replace other fuel?

Yes	14	No	9
maybe	3		

Would you like a Free Home Energy Check?

Yes	9	No	16

Comments

only 1 tonne at a time
delivered
We're insulating our loft
creosote query in letter
potential Glasgow based customer with local link
upgrading central heating stove to heat hot water too
frequently used holiday home
are you going to sell hard or softwood
are there grants for renewable energy
tell me when you start selling
advice on buying stoves
needed
wants to buy seasoned hardwood
considering replacing open fire with stove
need info on insulation & solar panels