Woodwaste Arisings in Scotland

Assessment of Available Data on Scottish Woodwaste Arisings

Remade Scotland

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Report prepared by

Remade Scotland

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Executive Summary

Consumption of timber and timber-based products has been rising in the UK for a number of years, with now almost 48M m3 of timber being consumed annually[1]. Timber and timber-based products are central to the UK economy, with the average citizen consuming the equivalent of 1 tonne per annum.

The total land area covered with forest in the UK is 9.3%, with most of these being planted in the last 50 years. Historically, wood supply in the UK, has fluctuated, with mush of the natural woodland being over-felled, and then the demands of industrialisation meant that the UK became reliant on imports of timber.

Despite a marked increase in size of the national forest cover since the end of the First World War and the introduction of the Forestry Commission, Britain still currently only produces approximately a fifth of its own needs.

With the UK consuming vast quantities of timber and timber products every year, there are large quantities of wood residues and wood waste arising in a variety of waste streams. The condition wood waste arises is often variable in both quantity and quality, and with little or no accurate information documenting wood waste arisings, it is extremely difficult to develop comprehensive detailed plans for expansion of a collection infrastructure for wood waste.

This document examines the main sources of wood waste, identifying the main characteristics of these arisings and the potential marketability of the material.

In most cases wood waste will contain some degree of contamination and will require further processing in order to meet end market specifications. As a general rule the heavier the contamination the greater the processing required, reducing the net value of the material.

[1] Dr Georgina Magin, Fauna & Flora International (UK): An Introduction to Wood Waste in the UK (2001)

1. Introduction

Wood waste arises from a variety of sources and can vary considerably in composition, quality and quantity. Each of these factors can greatly influence the recyclability of wood waste.

In order to understand the wood recycling industry and make the best technical and economic use of this resource, it is important to develop an accurate database concerning all aspects of wood waste. This information can help the industry plan the best way to improve wood recycling and reduce the amount of wood waste currently being consigned to landfill.

The Timber Research and Development Association (TRADA) has stated that it is very difficult to obtain reliable information on wood waste arisings partly due to quantitative data on wood waste not being available at the company level. Many companies do not collate exact figures on volumes of residues generated, but rather base estimates on containers used such as bins, skips, trucks etc.[1]

The UK wood industry employs approximately 35,000 people in forestry and primary wood processing alone and the total value of timber production industry is approximately £2.5 billion per year[2].

Approximately two-thirds of the UK softwood consumption is used by the joinery and construction sector, with a further 12% being utilised for pallet and packaging production, 10% for fencing and 4% for furniture production.

Figure 1: Wood Waste

In 2001 the UK timber production was approximately 2.5M m^3 of sawn wood. The UK imports approximately 85% of the softwood timber it consumes, and is one of the largest European markets for forest products. Softwood timber constitutes approximately 80% of the wood products used in the UK[3].

With vast quantities of timber products being consumed in the UK, considerable volumes of both wood residue and wood waste is produced through processing and end of life products. In some cases less than half the feedstock timber ends up in the end product.

The quantity and condition of wood waste can often determine the final disposal route. Historically waste wood which is heavily contaminated has been consigned to landfill or been incinerated, with cleaner residue being utilised principally by the board manufacturing industry; however new advances in technology and the development of alternative markets are creating greater opportunities to further utilise this valuable resource.

Greater volumes of contaminants can now be consistently extracted from wood waste, producing a high quality material suitable for a variety of end markets. Generally, wood residues decrease in value and degenerate into 'waste' materials, the smaller the particle size and the greater the destruction of the wood fibre, for example sawdust is generally less valuable than woodchips suitable for chipboard or paper pulp manufacture[3].

New fiscal and regulatory drivers such as the Climate Change Levy and the Packaging Regulations are also significantly encouraging wood waste recycling in the UK.

[1] Riddoch, S, TRADA: Wood Residues - Waste or Resource? (1999)
[2] Timber Recycling Information Centre, The UK Timber Market, www.recycle-it.org
[3] Forestry Commission (2002): UK Wood Production and Trade

2. Wood Waste Arisings in Scotland

2.1. Scottish Wood Waste Arisings & Characteristics

Wood waste arises at all stages of the material's lifecycle, with residue being generated at each of processing stages. The following table summarises the types of residues produced by each of the main processing operations

Table 1 Common Sources & Types of Wood Residues[1]

Sector	Source	Output
Forest Harvesting	Thinning, logging, harvesting operations	Bark, branches, leaves, rejected trees, roots, stumps, thinnings, top wood
Primary Processing	Sawmills, board mills	Bark, edgings, off-cuts, rejects, sawdust, slab-wood, shavings, wood chip
Secondary Processing	Flooring, furniture, joinery, pallet & packaging manufacture	End-trim, damaged products, off-cuts, reject material / products, sander dust, sawdust, screening and grinding dusts, shavings, veneer clippings / waste
Traders	Distributors, importers, merchants, wood residue traders, timber salvage operations	Possible secondary processing residues and rejected / damaged products
Construction and Demolition	Construction, demolition, refurbishment, deconstruction, scaffolding	Cable drums, coated material, cladding, dimension timber, doors and door frames, fences, flooring, framing timbers, pallets and fencing (whole & broken), panels and engineered wood composites using adhesives, piles, poles, solid wood, stakes, window frames
Landfill / Municipal Solid Waste	Residential, commercial, institutional and industrial products	Residential, commercial, institutional and industrial end-of-life products including durable and non-durable goods, containers & packaging, furniture, toys, paper and board, scrap timber and panels, garden & parkland waste (clippings, brush and removals)

Wood waste generated by each of these sources will vary considerably in both quantity and quality. Each source having associated contaminants and characteristics, which greatly influence the end markets available to that particular source of wood waste.

Figure 2: Contamination

[1] Riddoch, S, TRADA: Wood Residues - Waste or Resource? (1999)

Not all wood waste can be utilised, with landfill or incineration remaining the only option. Source segregation may be necessary to obtain the highest value from the material. Contaminants in wood can vary considerably and can in many cases be removed mechanically, physically or chemically.

Table 2 categorises the main contaminants and the type of separation available to each.

Table 2 Potential Contaminants in wood residues[1]

Mechanically Separable	Physically & Chemically Separable
Aggregates, bricks, ceramic tiles, concrete, glass, gypsum, plaster	Creosote
Asbestos	Waterborne / Organic preservatives
Asphalt shingles	Waxes, oils
Carpets, linoleum	Paints, lacquers
Dirt, soil, stones	Glues, adhesives
Drywall lining	Fire retardants
Fibreglass insulation	Water
Laminates, veneers	
Metallic (ferrous & non-ferrous) compounds	
Plastic compounds	
Paper, cardboard, tarpaper, wall papers	

Moisture may also be considered a contaminant by some end users, such as in board manufacturing or wood fuel production, where further processing may be required to remove any excess moisture.

Wood waste can arise from several sources. The principal sources of which are discussed below.

Forestry Harvesting

Wood waste is first produced when forestry harvesting occurs. It is estimated that approximately 50 - 60% of the total material produced at this harvesting stage can end up as waste. However, rather than clearing the site most of this waste resource is left in-situ to naturally biodegrade, saving on collection / transportation costs and ultimately returning valuable nutrients back to the soil.

At present in the UK only the Forestry Commission and the Forest Industries Development Council of Great Britain, regularly collect information regarding timber. These sources indicate that whilst UK timber production is set to expand to around 25M m^3 by 2025, the UK is unlikely to exceed 25% self-sufficiency in timber and wood products[2].

UK forestry waste arisings have been estimated as 1.5M tonnes per year. However with approximately 45% of the UK's forest being located in Scotland[3], there could potentially be up to 675,000 tonnes of wood waste arising in Scotland per annum, from this source. Some of this is material is chipped and sold to board manufacturers, but most is left to decompose in-situ.

Sawmills

Once wood has been felled it is generally taken to sawmills where primary processing takes place. At the sawmill stage vast quantities of waste can be produced with the final product in some cases only accounting for 20 to 30% of the input log; however this is more often 40 to 50% depending on the feedstock, equipment and end product.

Most sawmills not only rely on the revenue from the timber they produce, but also from the residue material generated by processing operations; therefore end markets such as board and paper manufacturing are important. The residue generated at this stage is considered to be relatively 'clean' and consistent, proving attractive to end users.

The Sawmill Survey 2000 conducted by the Forestry Commission identified 85 operational sawmills in Scotland, with a softwood consumption recovery rate of 55%, which indicates that approximately 790,000 tonnes of

[1] Riddoch, S, TRADA: Wood Residues - Waste or Resource? (1999)
[2] Timber Recycling Information Centre: Timber Utilisation (2001)
[3] Keys, J (2001) – The Tree Station Project: Forestry Commission

softwood residue were produced. Hardwood consumption with a 56% recovery rate produced almost 3,500 tonnes of hardwood residue. Therefore there are potentially 793,500 tonnes of clean wood waste revenue being generated from this source alone in Scotland.

This residue can be in the form of cut-offs, wood chip and sawdust, the majority of which will be utilised by the board manufacturing sector, however other markets must be found for the remaining residue which consists of approximately 7% bark, 10% sawdust and 25-30% wood chip[1].

Some sawmills will also utilise this wood waste on-site for generating heat and power.

Construction & Demolition

The construction industry in the UK has been growing for several years now, increasing its consumption of timber products. Latest figures from the Construction Forecasting and research (CFR) show that on the back of government spending the UK construction output is likely to rise 9% during 2002[2]; therefore wood residues produced by this sector look set to increase. With much of the waste generated by this sector currently being consigned to landfill, there is considerable scope to recover this material, reducing both the burden on landfill sites as well as disposal costs to the contractor.

Waste Watch estimate that wood waste accounts for 25% of all construction and demolition waste[3]. During 2000 approximately 6.28M tonnes of waste were produced by construction and demolition activities in Scotland[4], suggesting that some 1.57M tonnes of wood waste is available in this waste stream.

Construction and demolition wood waste is not homogeneous, due to the diverse range of types of activities which can take place. For example wood waste could arise from scaffolding, off-cuts, shuttering / formwork and rejects.

Wood waste can be reduced by the construction industry at several stages. Wastage can significantly be reduced at the design stage of a project by incorporating simple waste reduction and recovery procedures. Education of the workforce and sub-contractors can play an important role in the success of any wood recycling project. There must also be provisions made to allow for recycling facilities on-site.

Although there may be considerable scope to recover significant quantities of wood waste from this source it should be noted that not all wood residues produced are recyclable, due to the condition or quantity of material produced. However, in many cases it may be possible to recycle up to 95% of all construction / demolition residues provided effective separation at source is implemented[9].

With careful planning and effective source separation, the percentage of materials available for reuse, recycling and recovery could significantly be improved. By introducing source separation of wood waste on-site can help the best value to be obtained from the material.

Case Study: The Brighton and Hove Wood Recycling Project is an excellent example of where education and source separation has significantly increased the quantity and quality of material recovered. They work closely with local builders to implement source separation where possible. This project has been very effective where the builders involved now create two separate woodpiles for recycling, with higher value timbers being reused by the contractor.

Projects where source separation has been successful have proved that with the right education, considerable volumes of wood residues can be pulled from the waste stream.

Wood waste arising from demolition activities are usually contaminated with other materials such as rubble, glass and steel. During demolition, the customer will generally require the site to be cleared in a short time frame which usually involves the use of heavy-duty equipment which is not labour intensive. This means reclaiming wood waste from these activities can prove both expensive and time consuming.

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[1] Timber Recycling Information Centre: Timber Utilisation (2001)
[2] Timber Trades Journal Online, UK Construction Will Rise, Says CFR, 14th Nov 02, www.ttjonline.com
[3] Waste Watch Wood Information Sheet, www.wastewatch.org.uk
[4] SEPA, Construction & Demolition Priority Waste Stream Report, August 2002, work undertaken by EnviroCentre

The practice of deconstruction rather than demolition would increase the recovery of quality timber from old buildings, renovations or alterations in a good condition; however at present this is not common practice. Fashion trends have also helped increase demand for good quality recovered wood products. At present barriers to increasing the use of recovered timber are strict building regulations, sourcing a consistent supply of quality recovered materials, and education / awareness.

Although there is considerable scope to recover more wood residue from C&D sources, without the implementation of sustainable waste management practices, large volumes of recyclable wood and other materials will continue to be sent to landfill.

Wood Packaging

Wood packaging was included in the Packaging Waste Regulations from January 2000. This has led to a considerable impetus to recover wood packaging from the waste stream, with it having the potential to generate Packaging Recovery Note (PRN) revenue. Under these regulations, wood currently only has a recovery obligation and therefore obligated companies are not required to obtain wood material specific PRNs to comply.

The Timber Packaging and Pallet Confederation (Timcon) estimated that 670,000 tonnes of packaging waste entered the waste stream during 2000, of which 296,557 tonnes were recycled, which compares to only 94,000 in 1999, indicating the positive impact the packaging regulations have had in increasing the recovery of wood packaging waste in the UK[1].

During 2000 there were approximately 2.2M m^3 of softwood used in the manufacturing of packaging in the UK. Overall 75% of pallet / packaging wood are sourced in the UK[2].

The current Scottish Executive consultation paper on the proposed packaging recovery targets does not include a material specific recycling target for wood; however it states the recycling of wood may contribute towards the achieving of the overall recovery target. The proposal allows energy from waste to account for only 5% of total recovery[3].

Wood re-processors in Scotland currently supply most of their woodchip to the board manufacturing industry. However the re-processors are currently only accredited to issue PRNs where the material has been supplied into alternative end markets such as mulch, animal bedding and composting. The board manufacturers raise PRNs for all the packaging wood waste they utilise in their products.

In Scotland there are currently four accredited wood re-processors and two wood composting re-processors accredited under the voluntary accreditation of re-processors, with the Scottish Environmental Protection Agency (SEPA).

Pallets

The Brighton & Hove Wood Recycling Project estimate that there are up to 2 billion pallets currently in circulation worldwide with approximately 90M in the UK alone.

At present the majority of the UK's pallets are manufactured from softwood. Alternative materials account for only a minor share of the market, although this is set to rise with materials such as plastic beginning to create competition within the market place.

Most pallets are designed for reuse and can usually be repaired or are broken down into their component parts for remanufacture. Refurbished pallets can then be sold for around half the price of new ones, with the added advantage to the user that as reused items they carry no obligation under the packaging regulations[14].

Because repaired pallets will not be considered to have been reprocessed, repairers will not be able to issue PRNs for them[4].

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[1] DETR (2000) Increasing Recovery & Recycling of Packaging Waste in the UK: A Forward Look for Planning Purposes (2nd Edition)
[2] Timber Recycling Information Centre: Timber Utilisation (2001)
[3] Scottish Executive, Directive 94/62/EC on Packaging and Packaging Waste, Consultation paper on proposed Directive targets from 2006, April 2002
[4] Wood and the Packaging Regulations: The Timber Packaging & Pallet Confederation for the ACP Taskforce and DEFRA, Revised Version 07/11/2001

Many companies offer a free collection for pallets depending on the quantity and quality, and will either repair them or process them for use in other markets such as decorative mulches etc.

Pallets which have been repaired have an advantage over new pallets in that since they are reused, they carry no obligation under the packaging regulations. The regulations promote re-use by excluding packaging which is being reused from a company's obligation. It also allows companies switching to reuse systems to spread the cost of their first obligation over 4 years.

With the introduction of new international Phytosanitary rules governing the import of wood packaging material into the European Communities from Canada, China, Japan and the USA, wood will require treatment to prevent contamination from the Pine Wood Nematode. This may well increase the volume of pallets and packaging entering the waste stream in the near future, since at present the majority of wood packaging in the UK is made from unseasoned /untreated wood, and therefore does not conform to these new rules.

The Timber Recycling Information Centre estimate that if approximately 2.2M m^3 of softwood is utilised by the pallet and packaging industry each year, and assuming a 20% wastage rate, approximately 400,000 tonnes of relatively 'clean' wood residue may arise each year.

Figure 3: Pallets

Additionally, if ~1M tonnes also arise from wooden pallets and packaging waste each year, then there may be up to 1.4M tonnes of wood residue entering the UK waste stream from this source alone[5].

On this basis it is suggested that there may be between 80,000 and 140,000 tonnes of wood packaging waste arising in Scotland per annum.

Fencing

TRADA estimate that the UK fencing market accounts for approximately 6% of the softwood consumption, which in 1999 equated to approximately 550,000m^3 of softwood. This was predominantly utilised for industrial, domestic and motorway fencing.

There is no nationally specific data currently being collated for residue volumes in this sector. However assuming that approximately 20% of this material ends up as waste, through either the production stage or simply being discarded, this would indicate that potentially 60,000 tonnes of wood residue arises from this source in the UK, with approximately 6,000 tonnes arising in Scotland.

With the fencing sector being largely influenced by the construction market, the demand for timber fencing is likely to increase. A large percentage of post consumer waste from the fencing sector will end up in either the municipal or construction waste streams.

Furniture Manufacturing

Timber constitutes a large percentage of the furniture market. Wood wastes can arise during manufacturing and through end of life items being discarded from offices, households and other facilities.

The Furniture Industry Environment Trust (FIET) have identified that waste costs the furniture industry approximately 3.55% of turnover.

When converting sawn timber into furniture products a high proportion of the input timber will often end up as waste. This wastage can often account for up to 60% of timber and 25% of board products. Secondary processing can often result in a further loss with 5% to off-cuts. Product assembly an extra 2% and packaging / returns up to 15%[1].

With such high volumes of wood residue / waste being produced companies must seek to limit disposal costs and where possible obtain the highest value from the residue material. There appears to be considerable potential to recover significant volumes of wood residue from this sector. Some companies currently utilise this material for generating heat and power on-site.

The Furniture Industry Research Association (FIRA) estimate that residues arising from the furniture sector in the UK are:

- 55,000 tonnes of softwood
- 50,000 tonnes of hardwood
- 230,000 tonnes of board residues

This equates to potentially 335,000 tonnes of wood residue being generated by the furniture industry in the UK each year, indicating that in Scotland there may be up to 33,500 tonnes of wood residue available from this source.

At present wood residue / waste is either utilised for either heat / power, board manufacturing, sold to wood recyclers or consigned to landfill / incineration. However for the industry to remain competitive it should seek to reduce waste and find highest value markets for all residue materials. FIRA indicates that up to 50% of the cost of waste in the industry could be saved by implementing relatively simple measures.

In the UK during 1999 / 2000, 3.9% of the annual Municipal Solid Waste arisings were identified as furniture-based (UEA ref. 612)[2].

With many items of furniture arising being recoverable, this has lead to the development of the Furniture Recycling Network in the UK, which consists of over 360 re-use schemes for household furniture.

Municipal Solid Waste

In Scotland the most common disposal route for Municipal Solid Waste (MSW) is to landfill, with currently over 90% of waste being consigned to this fate every year.

The latest figures estimate that Scotland produces approximately 3M tonnes of MSW per annum. Of which it is estimated that 385,728 tonnes arises from civic amenity sites [3].

A recent study produced by WRAP indicates that between 18.5% and 26.5% of CA waste may be wood-based. It indicates there are between 74,000 and 106,000 tonnes of wood waste being deposited at CA sites throughout Scotland every year. The cost of segregating and processing waste from CA sites is estimated to be between £18.95/tonne and £47.00/tonne.

The report also estimates that wood waste accounts for approximately 0.2% to 3.0% of the household waste stream, changing due to seasonal variances. However on average it accounts for 1.2% of collected household waste.

WRAP estimates there may be up to 121,000 tonnes of wood waste arising in Scotland's municipal waste stream every year[4].

The majority of wood which arises in the MSW stream is predominantly in the form of furniture, packaging, fencing and DIY waste. The quality of material can vary significantly, which has historically led to it being disposed of to landfill or incineration. However as the WRAP report shows, tapping into this resource may significantly help expand wood recycling in the UK.

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[1] Envirowise: Savings From Waste Minimisation in Furniture Manufacturing, GG290
[2] Timber Recycling Information Centre: Timber Utilisation (2001)
[3] Scottish Environmental Protection Agency (SEPA): Waste Data Digest (2001)
[4] WRAP – Wood Market Study– Municipal Wood Waste Arisings, written by Excelar Ltd, August 2002, www.wrap.org.uk

2.2. Scottish Wood Waste Arisings Overview

Table 3 below shows the volume of wood residues which arise in Scotland from the major waste streams every year and some of the contaminants which may be present.

Table 3 Scottish Wood Waste Arisings

Source of Residue	Volume (T)	Possible Contaminants
Forestry	675,000	Grit, Soil, Moisture
Sawmills	793,500	Grit, Soil, Moisture
Construction / Demolition	1,570,000	Rubble, Asbestos, Creosote, Laminates, Carpet, Gypsum, Adhesives, Glass, Metals
Packaging	140,000	Plastics, Metals
Furniture	33,500	Preservatives, Adhesives, Metals, Fire Retardants
Fencing	6,000	Preservatives
Municipal Solid Waste	121,000	Preservatives, Plastics, Metals, Adhesives

It can be seen from Table 3 that the majority of wood residues are produced by forestry and sawmill operations. These residues and other pre-treated residues from secondary processing operations are considered 'clean'. Other than forestry residue which is principally left in-situ, these residues will principally be utilised by board manufacturers or for used on-site heating and power.

Urban wood waste which includes packaging, MSW and construction/demolition wastes will in comparison often have some degree of contamination. These sources of wood waste are largely considered post-consumer and will normally have gone though several processing stages before disposal. These waste streams will normally be collected and processed by specialist wood re-processors. In Scotland these waste streams account for approximately 1,831,000 tonnes of wood waste per annum. However there may be a significant proportion of wood waste which largely remains unaccounted for simply due to the diverse nature of the industry and lack of accurate data. Therefore it is estimated there may be up to 2M tonnes of urban wood waste arising in Scotland every year. Due to current practices and economic reasons very little wood waste from the construction and demolition waste streams are recycled.

It is estimated that Scottish wood re-processors recycle approximately 150,000 tonnes of wood waste per year.

3. Wood Flow

Resources usually enter the economy as 'raw materials', in this case round-wood. The primary processing stages will add value by converting it from a raw material into a product. These products will then often go on to a secondary processing stage where they may be converted into more sophisticated products.

By mapping the material flow of wood through its life-cycle, and targeting appropriate sources of material it is hoped that not only will increased volumes of material may be recovered, but also that greater value may be obtained.

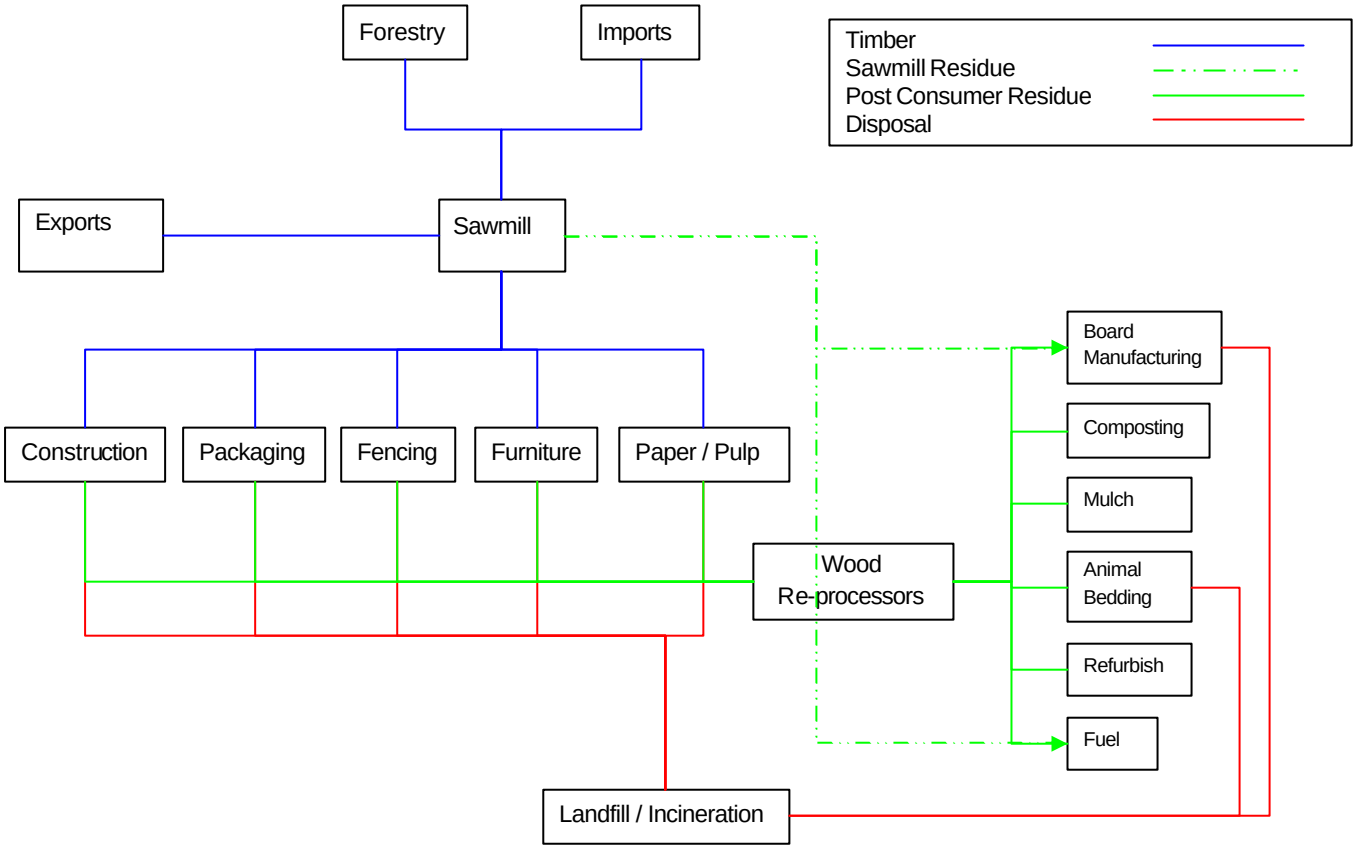

Figure 4 Wood Flow Map

As Figure 4 shows there are many industries which utilise wood at some point in their operations. The flow of material through each of these stages will often generate a high proportion of wood residue and or waste.

As detailed previously, wood waste arises from variety of sources, each having their own characteristics and associated contaminants. Post-consumer wood waste for example, which is often present in each of the major waste streams, will often have several contaminants present.

Contaminants may range from rubble and glass to adhesives or preservatives. It is this wide variety of contaminants which can prevent greater volumes of wood waste being recovered. In some cases even a small degree of contamination can be sufficient to deem a whole batch un-acceptable to an end user resulting it being either refused or downgraded.

The problem for wood re-processors is the difficulty in identifying particular contaminants. However if wood re-processors can trace their supplies of material back to the source they can potentially identify which contaminants may be present.

As shown in figure 5, during some primary and secondary processing operations large quantities of pre-treated and treated residue may be produced in addition to waste product. The difference in quality from each of these wastes makes it important for re-processors to identify which sources of material which are best suited to their particular requirements.

Wood residues initially arise through forestry and are generated in varying quantity and quality from then on by many processing operations. It should be noted that where timber is imported, residues generated by primary processing operations will remain in the country of origin.

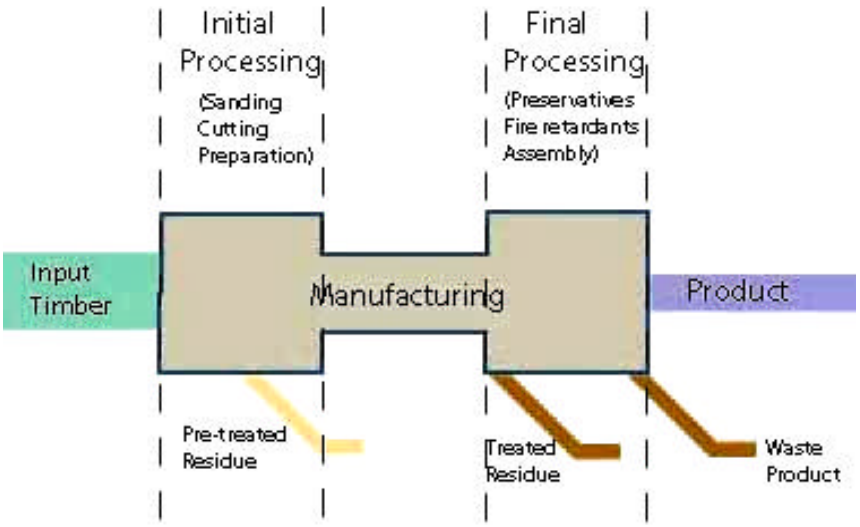

Figure 5: Processing Residue Production

Sawmill waste which is considered 'clean' will often be sourced directly by end users rather than from re-processors. This helps minimise contact with other more heavily contaminated wood wastes.

Wood recyclers must try to source wood waste by targeting sources in the material life-cycle chain which are suited to their particular needs. The general rule appears to be that the cleaner the material the higher its value.

Once timber leaves the sawmill stage it is sold on to secondary processing industries where it is converted into a product. These processes will again tend to generate considerable quantities of residues. Secondary industries include paper/pulp, construction, fencing, furniture and packaging.

It should be noted that moisture can also be considered a contaminant by some end users; therefore re-processors should ensure that where necessary they should source material which is not only considered 'clean' but also has low moisture content.

Figure 6: Clean Wood Residue

Advances in technology are making it easier to remove increasing volumes and types of contaminants from wood waste. However it should be noted that the greater degree of processing required, the greater the

processing costs; therefore it is important for re-processors to source material which requires the least amount of processing.

At present many small to medium sized companies tend to dispose of their wood waste along with the rest of their waste, rather than separating it at source; however some companies have invested in wood combustion boilers, although more as a solution to their rising costs of disposal as opposed to concerns for the environment.

With new markets for wood wastes slowly developing in the UK, attitudes towards this material are likely to change with wood waste being regarded as a resource rather than a waste material.

There are many things which can ultimately push or pull wood from the waste stream such as disposal cost avoidance. Fiscal drivers and legislation have begun to increase the desirability of wood waste making re-processors increasingly look at the potential to recycle alternative sources of wood waste.

4. Utilising Wood Waste

4.1. Factors Influencing the Utilisation of Wood Waste

The introduction of fiscal and regulatory drivers such as the Packaging Regulations and the Climate Change Levy are of increasing interest in recycling wood waste.

The majority of wood wastes have the potential to be recovered, reused or recycled; however this potential depends largely on the quality and composition of the wood waste arisings. Where there is a large degree of contamination which can often be the case with post-consumer waste, the material will often require some degree of sorting and or processing. The degree of contamination and condition of material can greatly influence processing costs.

Care must be taken to identify and remove potential contaminants where possible before the material is processed. If a contaminant is identified before processing then it can simply be removed from a load, however if this is discovered after processing it can lead to the whole load being rejected or downgraded.

Many sources of wood waste can prove uneconomical to collect at present due to high transportation costs or there simply not being enough material; however this may be overcome where stockpiling or backhauling material is feasible.

Large commercial users of recycled woodchip will generally demand the material to be supplied at a consistent quantity and quality. Therefore wood recyclers require a comprehensive quality control system.

Wood can be treated with a wide variety of performance enhancing treatments such as Creosote and Chromate Copper Arsenate (CCA) etc. With increasing use of performance enhancing treatments, the volume of treated wood waste arising in the UK is likely to rise[1]. The European Union has determined that organo-treated timber waste is a hazardous material. It has subsequently classified preservative treated wood waste as a hazardous waste, which will require special treatment of the residues produced[21].

The industry has generally accepted that the burning of chemically treated wood at temperatures above 800^{o}C is likely to produce emissions similar to untreated wood. However Directive 2000/76/EC of the European Parliament on the incineration of waste, requires that hazardous wastes such as those which contain halogenated organic substances expressed as chlorine must be incinerated at least for 2 seconds at temperatures of 1100^{o}C[2].

The principal problem associated with treated wood waste is in identifying the chemicals / preservatives present in the load. There is no way to easily identify the composition or quantity of any chemicals present. Board manufacturers in the UK identify chemically treated wood as material they will not accept for use in their products, due to concerns with health and safety, product quality and processing.

Unless these barriers can be overcome or alternative markets developed which can handle treated wood, it will continue to be consigned to landfill as a hazardous waste.

There is considerable research currently being undertaken looking at the use and disposal of treated timber, which include particleboard, energy recovery, wood composites, dilution, biodegradation and bio-processing. One such study is the work WRAP and the Timber Research and Development Association (TRADA) who are currently investigating the rapid identification and sorting of preservative treated timber[3].

As competition for wood waste increases processors may have to develop ways to utilise more heavily contaminated material in order to increase their throughput of wood waste.

New markets are slowly emerging for waste wood. Each market requires a consistent supply of high quality material which is cost competitive with virgin material. The markets vary considerably in the quality of material they can utilise, however advances in technology and greater awareness are producing greater volumes of good quality recycled woodchip.

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[1] Timber Recycling Information Centre: Timber Utilisation (2001)
[2] Directive 2000/76/EC of the European Parliament and of the Council of 4th December 2000 on the Incineration of Waste
[3] Waste and Resources Action Programme (WRAP) Web-site, www.wrap.org.uk

4.2. Markets

Historically wood waste has been processed as feedstock for the board manufacturing industry, however in recent years alternative markets have slowly been developing. End markets now range from animal bedding to specialist composite materials.

The end markets available to each source of material will ultimately depend on the quality of the material. Depending on the level of contamination, varying degrees of processing may be required which can influence the cost-effectiveness of the process. The recycled fibre will often have to compete with virgin materials and as such should be produced to the highest specification possible.

Drivers such as the Climate Change Levy (CCL) have encouraged greater utilisation of wood waste. The CCL which came into effect on 1st April 2001 encourages energy intensive industries to improve energy efficiency and reduce emissions of greenhouse gasses by offering an 80% levy discount to industries if they meet their agreed targets. This has resulted in companies utilising wood waste instead of virgin material, where energy savings can be gained by using feedstock's which have a low moisture content. It has also encouraged interest in bio-fuels such as wood-fuel.

Board Manufacturing

Board production is been increasing its share of the UK furnishings / building market in recent years, slowly replacing the use of solid timber. Recycled woodchip and sawdust are increasingly being utilised by the industry in the manufacturing of some wood board products.

In 1999 the UK consumed approximately 4M m^3 of particleboard, oriented strand board (OSB) and medium density fibre board (MDF), with almost 3M m^3 of these products being produced in the UK[1].

At present the volume of recycled wood included in board manufacturing is increasing, however the percentage mix of recycled wood fibre included in board product will vary depending on the product; however it can potentially it can be up to 100%.

In recent years the industry has increased specifications regarding the use of recycled woodchip in its products. These include low contamination of metals, paint and chemicals etc.

During 1999 the UK particleboard industry used approximately 3.6 M tonnes of woodchips, of which approximately 400,000 tonnes (11%) was recycled (not including sawmill residues). It is estimated that packaging waste accounted for 75% of this material. The recycled material content is an increasing proportion of the mix due to regulatory / fiscal drivers influencing the market[2].

TIMCON estimated that in 2001, the board manufacturing industry in the UK consumed approximately 770,000 tonnes of recycled wood, of which approximately 400,000 tonnes was wood packaging waste[25].

Since wood packaging became a material covered by the Packaging Waste Regulations in 2000, subsequently generating revenue from the PRN value, it can be seen that the volume of recycled material utilised by this industry has increased considerably.

Where recycled wood is used in this industry it will normally require some kind of re-processing normally carried out by specialist wood re-processors. Specifications will normally be agreed between the two parties in order to minimise the risk of material being rejected.

The advantages of recycled compared to virgin are:

- The moisture content can be up to 70% less than virgin wood, therefore saving energy when reducing the moisture content down to the levels required by board manufacturers
- Wood packaging waste has the potential to generate PRN revenue
- With energy savings to be gained by using recycled material, the industry can use this to contribute towards their CCL targets, and ultimately receive the 80% discount available

[1] Dr Georgina Magin, Fauna & Flora International (UK): An Introduction to Wood Waste in the UK (2001)
[2] Wood & the Packaging Regulations, by The Timber Packaging & Pallet Confederation for the ACP Task Force & DEFRA (Revised Version 07/11/2001)

The problem with using recycled wood in this industry is where a sample contains board material; the residual resins can stick to the wood fibre reducing the bonding quality of the 'clean' woodchip. Therefore only loads with none or minimal amounts of particleboard wood waste will be accepted.

Another barrier to increasing the percentage of recycled wood in particleboard products has been the need for manufacturers to attain the Forestry Stewardship Council (FSC) label, which is important when accessing end markets. However the FSC are now reviewing their criteria with a view to awarding certification to products containing recycled wood.

However revenue generated from PRNs has enabled particleboard manufacturers to invest in new cleaning lines, increasing their capacity to utilise recycled wood. This market for wood waste looks set to grow for the foreseeable future.

Biofuels

In the UK wood has traditionally been used as a fuel in both commercial and domestic applications. However when compared to most northern European countries, Scotland is perhaps 15 years behind in terms of the development of a biomass industry[1].

Advances in technology are increasing the potential to utilise wood waste as a source of both a source of heat and energy. The recycling of wood waste by thermal conversion offers the opportunity to utilise the calorific value of wood whilst diverting considerable volumes of wood waste which might have otherwise been consigned to landfill.

Figure 7: Wood Burning Boiler

In some cases where treated wood is present, waste to energy plants may offer the Best Practicable Environmental Option (BPEO), particularly where the plants have facilities for the removal of dioxins.

In the UK it was estimated that the volume of wood waste available as a fuel in the UK in 1998 was approximately 1.1M oven dried tonnes (odt), with this figure potentially rising to approximately 1.7M odt by 2013[2].

Wood waste can be utilised as a fuel in a variety of forms such as solid wood, woodchip and sawdust, fuel pellets and charcoal.

Wood waste can be treated by Carbonization which involves burning the material in the absence of air, breaking it down into liquids, gases and charcoal[3]. This option offers a high volume high value market particularly for hardwood waste.

In order for the bio-fuels market to successfully utilise recycled wood, there must be a ready supply of fuel available locally. There must also be demand for the heat and or energy produced.

At present the market largely consists of producers of waste wood utilising wood-burning boilers to generate heat and or power to their premises. However, discussions with timber processors indicated these boilers were

[1] Steve Luker, Scottish Enterprise Lanarkshire, Bioenergy for Scotland article in Wood-web Newsletter, Issue 3, Spring 2002
[2] Energy Technology Support Unit (ETSU) - UK Industry Wood Fuel Resource Study for DTI (1997)
[3] The Regional Wood Energy Development Programme (RWEDP) web-site: www.rwedp.org

installed primarily as a waste management solution, with the heat and energy generated only being an additional benefit. This pattern has been largely influenced by the increasing cost of landfill in the UK.

Pilot biomass power stations are currently being developed in the UK, which could utilise vast quantities of wood waste as fuel. Wood waste can also be burnt in general waste-to-energy incinerators. Operators of large incineration plants will often require vast quantities of waste to feed the incineration plants which can in some cases hinder recycling schemes. Wood also has a high calorific value which is attractive to these operations.

A UK wood fuel resource study is currently being undertaken by the Scottish Enterprise which will map on a GIS system the available wood fuel resource in the UK, which should aid strategic planning and the development of bio-energy schemes[1].

Also Lanarkshire Biomass, a project funded by the Scottish Clean Energy Demonstration Scheme, is currently progressing with technical evaluations of 12 locations in the Lanarkshire region, including schools, hospitals and visitor centres, which could potentially be used to demonstrate to potential of these technologies.

There is considerable potential for this market to utilise large volumes of wood waste; however there must be considerable expansion of the supply infrastructure.

Animal Bedding

Good quality 'clean' sawdust and shavings are widely used as animal bedding / flooring applications in the UK. This material is primarily sourced from sawmills and other primary / secondary wood processing industries.

The National Association of Wood Shaving and Sawdust Merchants and Contractors (NAWSMEC) estimate that the market volume for animal bedding in the UK at present is approximately 450,000 tonnes per annum.

Fresh virgin wood can contain up to 90% moisture, which can greatly reduce its absorption capability. Therefore it is required to have a moisture content of >10%. Also, where there the moisture content is high the material can be susceptible to mould.

This is a relatively new market for waste wood. Although recycled fibre can generally have a relatively low moisture content, the industry expresses concerns regarding quality and consistency. Contaminants such as metals, plastics, or chemicals are prohibited for quality assurance purposes and also for the protection of the animals. Poultry have been reported to consume up to 4% of their feed from eating their bedding material[2].

Processors must work closely with end users to develop standards. Quality control measures should be implemented to ensure the recycled material complies fully with the specifications required by the end users.

The PRN revenue associated with wood packaging has greatly contributed to this market utilising recycled wood.

Composting & Mulches

It is estimated that approximately 1M tonnes of bark from the sawmilling industry, and unknown quantity of post consumer shredded wood (including 15,000 tonnes per year from packaging), are used for mulch, horticultural products and agricultural uses[3].

Mulches serve as physical barriers to prevent soil erosion, soil structure and permeability, reduces loss of moisture through evaporation, enriches soils, moderates soil temperature and also acts as a weed suppressant.

A wide range of wood residues can be used for composting. Composting is the process of aerobic biodegradation, which converts organic material into a valuable stable nutrient rich material.

The Composting Association estimated that 'green waste' from local authority parks and gardens and household garden waste arising at civic amenity sites accounted for approximately 90% of all municipal waste composted in 1998.

- Wood can add value to compost by:

[1] Woodweb – The newsletter of the Scottish Forest Industries Cluster, Issue 4, Summer 2002
[2] Timber Recycling Information Centre: Timber Utilisation (2001)
[3] Dr Georgina Magin, Fauna & Flora International (UK): An Introduction to Wood Waste in the UK (2001)

- Acting as a bulking agent improving structure improving airflow
- Adding carbon to the material

Adding compost to soil increases the nutrient content, improves the water holding capacity and texture of soil. It is utilised by the agriculture, landscaping and gardening markets. Lower quality materials can be used for land remediation and landfill cover.

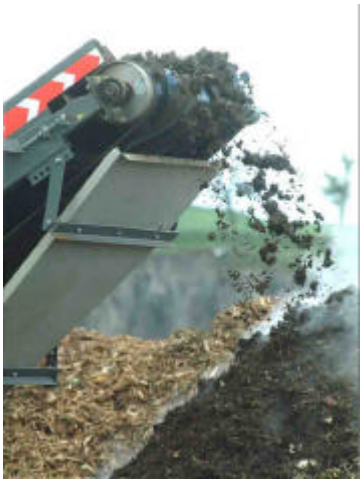

Figure 8: Compost

The final end market will dictate the type of wood waste which can be utilised in these markets. The recipe` of compost utilised by each of the markets will also determine both the quality and quantity of wood waste it can use. It should be noted that contamination from treated wood can be a problem, and further research is required in this area.

Implementation of Scotland's National Waste Strategy and the EU Landfill Directive are encouraging local authorities to considerably reduce the amount biodegradable household waste going to landfill. This has created a considerable impetus towards composting in the UK. This market will have the capacity to consume vast quantities of wood waste.

Figure 9: Coloured Decorative Woodchip

Composite Materials

Wood / plastic composites are materials which consist principally of plastic with wood fibre utilised as a reinforcement filler, and can be manufactured using traditional plastic processing / extrusion equipment.

Wood / plastic composites can be produced from 100% recycled products, diverting both plastic and wood from the waste stream.

Composite materials offer a way to produce products to a specific shape without producing much waste. These materials can be used for fencing, signs, aquatic and construction applications. At present the wood/plastic composite market is in its infancy stage and is yet to be fully developed.

The benefits of using wood as filler are:

- **Durability** – this can be improved with the addition of wood to the matrix, however the wood fibres should be fully encapsulated within the individual plastic matrix to protect the wood fibres from the environment. This prevents moisture absorption, fungal attack and swelling.
- **Linear Expansion** – plastic expands/contracts with variations in temperature whereas wood expands/contracts with changes in humidity. Therefore adding wood to the plastic matrix can significantly decrease the susceptibility to thermal expansion. This is important when wood/plastic composites are used alongside materials with lower thermal expansion rates, such as solid wood.
- **Stiffness** – the addition of wood to plastics improves stiffness enabling the material to be utilised in building applications. The addition of wood fibre can sometimes triple the stiffness of a plastic matrix. However, it should be noted that even with this increase in stiffness most wood/plastic composites still have a modulus of elasticity (MOE) less than half that of solid wood.

Typically materials used for plastic reinforcement include fibreglass and minerals which can be both heavy and expensive. Wood fibre can provide reinforcement to plastic with little or no weight gain. This market is well suited for wood residues such as sawdust, shavings and conventional scrap wood.

The use of recycled wood can be restricted by its moisture content with plastic processing systems typically having zero tolerance to moisture, requiring typically less than 0.1% moisture.

Another problem is the variation in burning point between wood and plastic. Wood will often burn at temperatures where many plastics are processed. Therefore the inclusion of wood is limited to plastics which melt at lower temperatures, such as polyethylene, polystyrene, and polyvinyl chloride (PVC).

The development of wood/plastic composite materials in building applications may provide an opportunity to introduce a variety of innovative products with new performance characteristics opening exciting new opportunities in design.

As these materials become more accepted, specifications must be developed for a variety of new and exciting composite materials.

Liquid absorbent

Historically sawdust has been used as a liquid and chemical absorbent extensively in both domestic and industrial applications. Recycled wood fibre is ideal for this market with it generally having a lower moisture than virgin material. The absorbent qualities of wood also make it ideal for soaking up spills making them easier to handle.

This market is a low volume market for recycled fibre; however it has the capacity to utilise small fibres which can often be undesirable in other applications.

5. Conclusion

Wood recycling in Scotland is increasing principally through the rising cost of landfill, and with this set to increase in coming years the trend is likely to continue. Also with the EC Landfill Directive requiring the amount of municipal (household) biodegradable waste sent to landfill to be considerably reduced, other outlets for materials such as wood waste will need to be developed.

The inclusion of wood to the Packaging Regulations in January 2000, has also significantly encouraged wood packaging to be increasingly recovered from the waste stream, with revenue from PRNs making wood packaging a priority material for many wood re-processors.

Although there are many drivers increasing wood recycling in Scotland, there are still some barriers which need to be addressed. Wood re-processors identify lack of local markets as one of the main obstacles to further expanding wood recycling capacity and would welcome competition within the marketplace for recycled wood, particularly those who are currently dependent on one particular end market.

With wood recycling likely to increase, greater penetration of waste streams will likely generate wood waste which is increasingly contaminated. Therefore greater effort must be made to implement source separation schemes and also to source material which is best suited to the desired end use.

Re-processors must work closely with their sources to help recover wood waste in the best possible condition. Education of both the public and private sectors is important in order raise awareness of the issues concerning wood recycling.

Stability in the price of woodchip is another key factor in developing the wood recycling market; however this is inevitably problematic to control since it can be influenced by factors such as imports/exports, the price of virgin material and general market conditions.

Large areas of forestry are expected to come into season over the coming years, increasing the volume of virgin material entering the marketplace, which may drive down the value of virgin material making it increasingly difficult for recycled material to compete.

The sporadic nature of wood waste arisings in many instances can also have an adverse effect on wood recycling, making collection cost-prohibitive. This is due to the non-uniform nature in which wood waste arises, particularly if there has not been any size reduction. However greater effort must be made to overcome these barriers and to further develop the collection infrastructure to expand collection to include alternative sources of material, and also to accommodate a collection system whereby several segregated grades of wood waste are collected from each source. This is necessary to significantly expand wood recycling in Scotland and particularly so if the alternative markets are to be fully developed.

Although there are many markets for wood waste slowly being developed, material which is heavily contaminated will continue to be landfilled. There must be further research done to identify opportunities where this material can be utilized, with definitive guidelines made available to end users.

Where wood waste which has been chemically treated the difficulty is in identifying the type of chemicals present. Re-processors will either have to trace the material back to source in order to identify potential contaminants present or will have to develop markets which can utilise this material. Another option is to develop alternative treatments for timber which are more environmentally benign.

There are many barriers to increasing wood recycling, which include:

- Contamination
- Lack of end markets
- Building regulations / material specifications
- Consistency of supply
- Sporadic arisings
- Demolition rather than deconstruction
- Lack of quality data

- Capital costs
- Volatility of market
- Education
- Product labelling
- Chemical / Preservative treated wood

With careful planning and greater awareness many of these barriers can be overcome. In order to further increase wood waste recovery in Scotland, re-processors need to understand both the requirements of the end markets and as well as the quality of wood waste they accept through the gate.

In most cases recycled wood in the marketplace will compete directly with virgin fibre, therefore the material produced by the re-processor must be to the best specification possible.

With greater volumes of wood waste arising from increasing number of sources, further development of alternative markets is required which can utilise a variety of wood wastes. Also by increasing demand for recycled wood it should help increase confidence in the marketplace to expand the present collection infrastructure. As demand increases for wood waste, preferred sources of material will be targeted by re-processors.

Further research will be needed to accurately identify all sources of wood wastes and the types of contaminants they may contain. By developing a greater understanding of the quantities and types of wood wastes arising in Scotland, greater measures can be implemented to help attain not only increased recovery of wood waste but also the highest possible technical and economical value from this valuable material.