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Recovering and minimising waste wood

Wood and wood-based products are used in a wide range of applications, some with service lives of many decades before they enter the waste stream. However, it is only since the mid-1990s that an industry has emerged to recycle waste wood, where qualities such as a low moisture content compared with virgin wood have made recycled wood fibre popular for a variety of applications.

This Wood Information Sheet (WIS) is an overview of the subject with signposts to more detailed sources that are listed at the end.

Contents

Figure 1: Grade C wood chips for use in an IED Chapter IV compliant biomass installation

Key points

- The Wood Recyclers Association (WRA) estimates that current annual UK waste wood arisings are in the order of 4.5 million tonnes.
- Of the wood recycled annually in the UK, the major applications are for biomass as a fuel for energy production, followed by wood-based panel manufacture.
- The market for biomass fuels is expanding rapidly, to such an extent that waste wood will be increasingly demanded as a fuel. This may have a wider impact on current recycling and reuse options.
- The WRA has classified waste wood in a system that enables most of it to be streamed to an appropriate application.
- The waste hierarchy, which ranks prevention as the ideal and disposal as the least desired outcome, is now embodied in Waste Regulations and governs how all those involved with waste must behave.
- According to Environment Agency data, less than 1% of waste wood now ends up in landfill.
- It is self evident that the UK needs to rely less on landfill for disposal, due to both lack of space and the release of greenhouse gas (GHG) emissions associated with biodegradable materials. However, recent research suggests that wood in landfill may not produce greenhouse gases to the extent previously thought.
- The UK wood recycling sector is recycling an ever increasing proportion of waste wood and moving towards a situation where all wood ‘waste’ is becoming a ‘resource’.

Waste wood arisings

Total waste wood arisings

Determining the quantity of waste wood generated in the UK has proved difficult over the years, with surveys offering a wide range of figures. However, more recently results have tended to consolidate around the range of four to five million tonnes per year.

The Wood Recyclers Association (WRA) suggests that the main sources of waste wood in the UK are:

- Household Waste Recycling Centres (HWRC) 20%–25%
- Commercial and industrial 35%–40%
- Construction and demolition 40%

Recycled waste wood

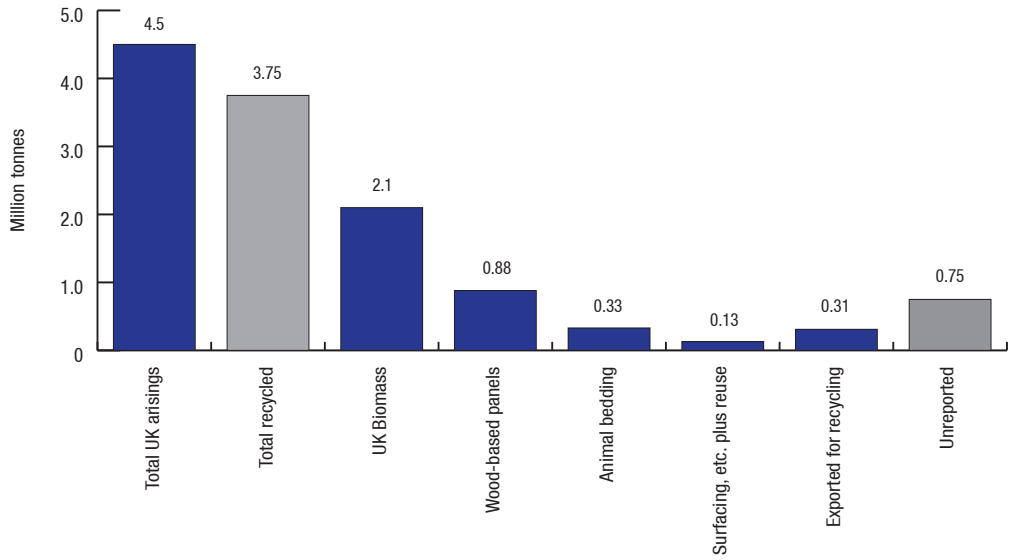
The WRA estimates that in 2018 the UK produced approximately 4.5 million tonnes of waste wood *(Figure 2)*. The WRA results presented in *Figure 2* indicate that 83.4% of waste wood (3.75 million tonnes) was recycled into new products or used as a biomass fuel for energy production. Of this figure, 56% was exploited as biomass, which can substitute fossil fuels for electricity and heating, 23.4% was recovered for wood-based panel manufacture (which represents 60% of the feedstock used in UK chipboard production). Just over 12% found applications in high value recycled products such as animal bedding, surfacing materials and reuse. The remainder, at just over 8% was exported (mainly for biomass).

The findings suggest that 16.6% (750,000 tonnes) of UK-generated waste wood was not recycled. However, data from the Environment Agency's Waste Interrogator 2018 suggests that less than 1% of waste wood ends up in landfill [2]. This leaves approximately 700,000 tonnes unaccounted for, although it potentially includes unreported and informal routes of disposal which may involve further processing, as well as the 'refuse-derived fuel' element of waste from materials recovery facilities that is either used in the UK or exported for use as a fuel in energy production.

These figures demonstrate that much progress has been made since the mid-1990s when less than 4% of waste wood was recycled (Wood Panel Industries Federation, 2014 [3]).

In the early days of the wood recycling sector, by far the biggest market was for wood-based panel manufacture. As the industry developed, additional markets were identified for high value products such as animal bedding and surfacing materials. Today, the demand for biomass has grown to become the largest single market, and the direction of travel seems to be for this to increase. New biomass plants coming on stream are likely to see a demand for 3.1 million tonnes of feedstock, a figure considerably higher than the current 2.1 million tonnes. It is estimated that this will provide the UK with approximately 2.9 TW of annual domestic power, a figure that is equivalent to 1% of the UK energy requirement. A key outcome is that the increased demand for fuel is likely to leave a shortfall in the domestic waste wood supply, which could see the UK importing over a million tonnes of waste wood per year beyond 2019 (WRA, 2019 [4]).

Figure 2: Estimated UK waste wood arisings and recycling applications 2018
Data: WRA 2019 [1]



Forms of waste wood

Waste wood is a diverse material that can arise in numerous forms and may be associated with various contaminating materials. In 2009 the WRA published a grading system that provided a simple and common understanding of the quality of wood that was suitable for various applications (Letsrecycle.com, 2009 [5]). *Table 1* summarises the main applications for waste wood of various grades, as updated in 2020.

The Waste Wood Classification Project

A key element to a regulatory framework is to ensure that waste wood is correctly classified so there is no risk of using an inappropriate feedstock, and any potentially hazardous items are identified. Ideally classification should occur at the front end of the recycling operation so that the wood can be processed appropriately for the required end-use. In 2017 the Waste Wood Classification Project was instigated at the request of the Environment Agency (EA). This has been led by the WRA with support from other trade bodies. In addition, the project investigated the scale of hazardous material in the UK waste wood stream (Turner, 2018 [7]).

The investigation has determined materials of potential concern as:

- decking and fencing
- structural timbers, tiling battens and external joinery from buildings constructed between 1950 and 2007.

The project has involved a testing programme to gather evidence on the safety of these materials, which at the time of writing remains ongoing. In the meantime the EA has issued Regulatory Position Statement (RPS) 207 [8] which provides conditions for handling wood that may have been preserved, varnished, coated, painted or exposed to chemicals, so that it can be classified as non-hazardous. It states that mixed-waste wood must only be used for wood-based panel feedstock or as biomass for boilers with appropriate abatement capacity.

The RPS remains valid until 31 July 2020. If the project has not been completed at that point, the system will revert back to a Duty of Care regulation. In this situation, responsibility will lie with the producer to provide evidence that their waste wood is non-hazardous before leaving site. The project has, however, secured agreement that the current WRA grading system (*Table 1*) can still

Table 1: Waste grades and applications
Source: WRA (2020) [6]

Grade	Description	Application
Grade A Clean untreated	Solid softwood and hardwood. Packaging materials, including pallets, packing cases and cable drums. Untreated manufacturing offcuts. May contain nails, metal fixings and minor amounts of paint or surface coatings.	Animal bedding Equine and landscaping surfacing Fuel in domestic and non-IED Chapter IV biomass installations
Grade B Industrial waste wood	May contain up to 60% Grade A material, plus construction and demolition materials, as well as solid wood domestic furniture. May contain nails and metal fixings, plus some paints, plastics, glass, grit, coatings and glues. The limits will depend on end user requirements and the Industrial Emissions Directive (IED).	Manufacture of wood-based panels
Grade C Municipal waste wood	All Grade A and Grade B materials plus fencing, flat pack furniture, board products and DIY materials. May contain nails and metal fixings, plus paints, plastics, paper, rubber, glass, grit, coatings and glues. Also includes non-copper chrome arsenic (CCA) and non-creosote treated timber.	Biomass fuel in IED Chapter IV compliant installations Manufacture of wood-based panels in small and controlled quantities
Grade D Hazardous waste wood	All Grade A, Grade B and Grade C materials plus agricultural fencing, transmission poles, railway sleepers and cooling towers. Timbers treated with CCA and creosote are classified as hazardous waste.[1]	Requires specialist disposal at sites licenced to accept hazardous waste

1. Although the preservatives of creosote and CCA have been withdrawn from mainstream use, the volume of CCA-treated wood entering the UK waste stream will grow and reach its peak in the middle of this century. This is because much of the wood treated during the second half of the twentieth century will have a service life of 60 years or more.

be used, as long as additional information is provided on how the grades relate to the categories of:

- clean
- untreated
- treated
- non-hazardous and treated
- hazardous.

There is also a requirement to give clear guidance on the classification and provide any relevant European Waste Catalogue codes (Turner, 2020 [9]).

Although this project will continue where possible, the arrival of the Covid-19 pandemic will inevitably prove disruptive. The EA have therefore agreed in principle to an extension beyond July 2020, however at the time of writing, further details have yet to be announced.

Options for recovered waste wood

There are various options available for wood and wood-based products at the end of service life.

In the interest of resource efficiency and reducing the environmental impacts of disposal, it is desirable to maximize the service life and then look at reclaim options before it becomes a waste product or material. The EU Waste Framework Directive [10] identifies the five steps for managing waste in descending order of environmental desirability (shown in *Figure 3* and explained in *Table 2*). This waste hierarchy has been adopted by the Waste (England and Wales) Regulations 2011 [11], the Waste (Scotland) Regulations 2011 [12] and the Waste (Northern Ireland) Regulations 2011 [13].

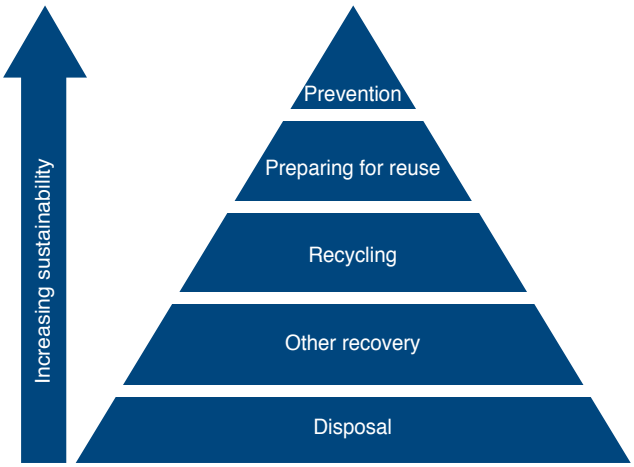


Figure 3: Various levels of the waste hierarchy
Source: Department for Environment, Food and Rural Affairs (DEFRA), 2011

Table 2: Definition of levels in waste hierarchy

Action level	Meaning
Prevention	Design and manufacture to reduce the volume of material required. Extend product life, reuse and reduce the use of hazardous materials.
Prepare for reuse	Includes checking, cleaning and repairing items so that they can be reused in their entirety or as spare parts.
Recycling	Converting waste into a new raw material or product, and can include composting where the appropriate standards have been met.
Other recovery	Includes a range of activities such as anaerobic digestion, combustion with energy recovery in the form of heat or electricity, advanced thermal processes such as gasification and pyrolysis (these emerging technologies can involve the heat degradation of wood to produce energy and useful products and may make a greater contribution in the future). Cellulosics including wood can also be used as raw material for the production of liquid biofuels.
Disposal	Landfill and incineration with no energy recovery.

Businesses that import or produce, collect, transport, recover or dispose of waste, or who operate as dealers and brokers, must take all reasonable measures to apply the waste hierarchy when the waste is transferred.

The wood recycling industry has made enormous strides in the last 25 years to drive wood up the waste hierarchy, considering that traditionally almost all waste wood would have been consigned to landfill. The recycling process typically involves chipping the wood to meet the specification of the target market. Wood that is prepared for wood-based panels, animal bedding, horticultural mulch etc., would sit at the recycling level on the waste hierarchy, whereas wood destined for biomass would be a tier lower at the recovery level. An example of an initiative to drive wood further up the hierarchy where possible, albeit at a relatively small scale, is provided by the National Community Wood Recycling Project, trading as Community Wood Recycling (CWR). As a not-for-profit business, CWR describes itself as a network of social enterprises which collects and reuses waste wood in the most environmentally beneficial way. In addition, CWR sees its role as creating jobs and providing training for disadvantaged people. Of the 21,500 tonnes of wood collected around the UK in 2018, CWR managed to reuse 20%, recycle 46% and assign 34% for use as firewood [14]. Most of the CWR enterprises stock a range of reusable wood for sale that is suitable for DIY and building needs.

Developing a resources and waste strategy

In December 2018, the UK Government launched the policy paper 'Resources and waste strategy for England' [15]. The strategy presents a direction of policy which is in alignment with the government's 25 year Environment Plan, and proposes an approach to:

- preserve resources by minimising waste and promoting resource efficiency, by moving towards a more circular economy which encourages re-use, remanufacture, repair and recycling to optimise resource use
- minimise damage to the environment by careful management and reduction of waste
- deal with waste crime.

This approach would place an obligation on businesses to first look at re-using before considering recycling of their products at the end of their service life. Supporting this end will see the introduction of extended producer responsibility (EPR) for packaging waste, including wood packaging, which could be expected by 2023. Currently under the Producer Responsibility Obligations (Packaging Waste) Regulations 2007 [16], companies are obligated if they: are UK registered, handle over 50 tonnes of packaging, and achieve a turnover of over £2 million per year. Those obligated demonstrate their compliance by the purchase of Packaging Recovery Notes (PRNs) or Packaging Export Recovery Notes (PERNs) where packaging is exported for recycling. These may be purchased directly from accredited waste processors or via a compliance scheme where they are purchased on behalf of the membership. Currently this system sees 10%–15% of recycling costs covered by the packaging producers. It is anticipated that introducing an EPR system will result in a contribution from producers as high as 90%, and generate up to £1 billion per year for investment into recycling and disposal [17]. The WRA estimate that as much as 1.4 million tonnes (over 30%) of the UK waste wood stream is produced as a result of wooden packaging materials.

Having a financial incentive to maximise the recycling of packaging waste wood will make more clean wood available for recycling. This is higher up the waste hierarchy than producing biomass for combustion, for which lower grade material is often acceptable.

The need to reduce landfill

Historically, significant volumes of waste wood would have entered landfill in the UK. However, although very much reduced today, it is desirable that this trend continues. There are several reasons for reducing the volume of waste wood going to landfill in the UK.

- In many areas the availability of approved void space is limited and only able to accommodate waste arisings for a few more years. Although more space is likely to be approved in the future, it is important to remember that landfill is a limited resource.
- As wood potentially biodegrades under anaerobic conditions in capped landfill, it has the possibility of releasing methane, a potent greenhouse gas that became restricted under the Kyoto Protocol. The Intergovernmental Panel on Climate Change (IPCC) assumes a decay factor for organic materials of 50%, however, Ximenes et al (2015 [18]) have determined a relatively low carbon loss in wood samples recovered after 16–44 years from landfill sites in Sidney and Cairns. In addition, microscopic analysis indicated that most degradation was as a result of aerobic fungal decay, suggesting that for the cases studied, the release of methane from wood in landfill may be greatly overestimated. This is supported by O'Dwyer et al (2018 [19]) who determined that a range of landfilled wood samples from the Republic of Ireland over several decades would have released up to 56 times less methane than would be determined by applying the IPCC default factor. This is an area where more work needs to be done, especially within the context of the UK.
- Although some research work has suggested that wood may produce much less methane than assumed in landfill, pressure is likely to build for the exclusion of biodegradable material in general. The Climate Change Committee (CCC) which is the independent statutory advisory body to the UK Government on climate change, has called for a commitment to ban biodegradable waste from landfill by 2025 [20]. This recommendation was made as part of a call for a national policy package to meet the UK Government's net-zero emissions target for 2050 [21].

To discourage dependence on landfill, the government introduced a landfill tax in 1996 with a standard rate of £7 per tonne. This has increased steadily since, and from 1 April 2020 stands at £94.15 per tonne for the standard rate [22].

Disposal considerations

Re-use, recycling and energy recovery from waste wood depends on being able to segregate wood of appropriate quality and transport this in various forms to end users. Effective disposal depends on:

- having sufficient volumes of suitable waste wood for efficient collection
- methods for segregating different qualities of waste wood
- networks of wood reusers, recyclers and energy generators that use wood for fuel.

Present and future markets for waste wood

When the wood recycling industry became established in the 1990s, chipboard manufacture accounted for approximately 95% of production. This dominance has fallen greatly with the advent of a rapidly expanding biomass sector, as well as the emergence of many smaller markets such as animal bedding, surfacing materials and horticultural mulch.

Much waste wood includes panel products as well as materials that have been coated or treated, and would typically be classified as Grade B and C in the WRA grading system. Such wood is suitable as a feedstock for energy production in Industrial Emissions Directive (IED) Chapter IV compliant boilers, which hold the combustion gasses at a temperature of 850°C for two seconds [23].

Some products, typically railway sleepers, transmission poles and wood treated with creosote are classified as Grade D and should be segregated and consigned as hazardous waste for which specialist disposal is required.

The development of the biomass market

Trees absorb carbon dioxide (CO_2) from the atmosphere as they grow in order to form wood. This carbon remains captured (sequestered) until the wood is burned or decays, when CO_2 will be released. Therefore the longer the wood can remain in service, the longer the carbon will remain sequestered, which will potentially help to mitigate climate change. Even where wood is combusted to generate electricity or heat, it is likely that it will be substituting fossil fuels which release carbon locked up for millions of years. Providing wood biomass is sourced from sustainable forests (those where harvesting is carefully managed to allow for regeneration), biomass generation, excluding transport and processing, is effectively a 'carbon neutral' renewable source of energy. The wood chips shown in *Figure 1* are an example.

Under the EU Renewable Energy Directive (RED) (2009 [24]), the UK was obliged to generate 30% of its electricity, 12% of its heat and 10% of its transport fuel from renewable sources by 2020; this equates to 15% of energy use overall. By 2018, the levels achieved were: electricity (31%), heat (7.3%), transport (6.2%); overall: 11% [25]. A contribution to this effort has been provided by the biomass energy sector which has produced a market for the lower quailty Grade C wood as a fuel source, for which post-consumer options were previously very limited.

In 2002 the UK Government introduced the Renewables Obligation (RO) as a supporting mechanism for renewable electricity projects. Operators who produce renewable electricity are accredited with tradeable Renewable Obligation Certificates (ROCs), based on their output. Energy suppliers need ROCs to demonstrate that they have met their obligation to provide the market with renewable energy. The RO is designed to ensure that 20 years of support is offered to a registered project. However, the scheme closed to new applicants in 2017, therefore financial support will cease by 2037.

Despite the closure of the RO to new entrants, government support remains under the Contracts for Difference (CfD) regulations, which were introduced in August 2014. CfDs are awarded competitively and work by establishing a 'strike price', which reflects the cost of investment in the project, and a 'reference price', which is a measure of the average market price for electricity. The generator can expect to receive the difference between the strike price and the reference price as subsidy. However, should the reference price exceed the strike price, the generator has to pay the difference. One fundamental difference between CfD and the RO is that while biomass Combined Heat and Power (CHP) and energy from waste (excluding those fuelled by bioliquids) are eligible for CfD support, biomass and energy from waste-only projects are not.

It is anticipated that the UK will have approximately 30 large-scale biomass power stations in place when they are all operational. This will increase demand for fuel significantly and may leave a shortfall in the domestic supply, requiring waste wood to be imported.

The Renewable Heat Incentive is a response to help the UK Government to meet its target for producing 12% of its heat from renewable sources by 2020 under the Renewable Energy Directive, and was introduced under the Energy Act 2008. It provides a subsidy to encourage the use of heat generation that, unlike electricity, cannot be transferred via a grid. It was

initially introduced in 2011 for non-domestic applications such as businesses, hospitals, schools, and district heating schemes. In 2014 it was finally extended to domestic buildings. Although open to a range of renewable technologies, biomass has been a major contributor to the scheme. Government support for the Domestic RHI has been confirmed until 31 March 2022 and may be replaced with a Clean Heat Grant Scheme from April 2022. Funding in the current form has been pledged for the non-domestic RHI until 31 March 2021.

The future of wood recycling

The wood recycling sector has grown dramatically over recent years towards a position where an ever-increasing proportion of the waste wood stream is recycled, and an increasingly mature recycling industry operates within a regulatory framework. The WRA is actively engaged with the EA on waste wood classification and with the HSE to improve standards such as reducing workplace exposure limits for wood dust.

It is anticipated that an increasing proportion of the waste wood stream will continue to be recycled, and established markets for recycled wood will continue to be serviced. Demand for biomass, however, is expected to rise significantly requiring the importing of waste wood to meet demand.

Further reading

Classifying waste wood from mixed wood sources: RPS 207, at www.gov.uk/government/publications/classifying-waste-wood-from-mixed-waste-wood-sources-rps-207/classifying-waste-wood-from-mixed-waste-wood-sources-rps-207

Combined Heat and Power Incentives, at www.gov.uk/guidance/combined-heat-and-power-incentives#renewables-obligation-rocs-are-closed-for-new-chp-schemes

Community Wood Recycling, at www.communitywoodrecycling.org.uk

EU Waste Framework Directive (Directive 2008/98/EC), at www.defra.gov.uk

The Producer Responsibility Obligations (Packaging Waste) Regulations 2007, at www.legislation.gov.uk/uksi /2007/871/contents/made

The Waste (England and Wales) Regulations 2011, at www.legislation.gov.uk/uksi/2011/988/contents

The Waste (Northern Ireland) Regulations 2011, at www.legislation gov.uk/nisr/2011/127/contents/made

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About TRADA

The Timber Research and Development Association (TRADA) is an internationally recognised centre of excellence on the specification and use of timber and wood products.

TRADA is a company limited by guarantee and not-for-profit membership-based organisation. TRADA's origins go back over 80 years and its name is synonymous with independence and authority. Its position in the industry is unique with a diverse membership encompassing companies and individuals from around the world and across the entire wood supply chain, from producers, merchants and manufacturers, to architects, engineers and end users.

Our aim

To provide members with the highest quality information on timber and wood products to enable them to maximise the benefits that timber can provide.

What we do

We seek to achieve this aim through active and on-going programmes of information and research. Information is provided through our website, an extensive collection of printed materials and our training courses.

Research is largely driven by the desire to update and improve our information so that it continues to meet our members' needs in the future.

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