A SHED RESOURCE: A LOOK AT WOOD RECYCLING IN THE UK

Marlene Cramer and Daniel Ridley-Ellis

Edinburgh Napier University

SUMMARY

The secondary timber value chain was explored by interviewing companies involved in wood recycling. The interviewees include community wood recyclers, chip producers and board-making companies. This paper is a perspective of the wood recycling industry in the UK and gives an insight on how it could become even more circular.

What does typical waste wood look like? What kind of wood is used for different products? In which condition is it and is it suitable for higher cascading steps? How is it sorted and by whom? What are the processes used when manufacturing products from secondary timber? Which challenges and barriers are related to the material or the structure of the industry? And how much does the public know about the second life of wood waste?

Our paper looks at all these questions while accompanying your hypothetical garden shed on the way to its uncertain future.

KEYWORDS: wood recycling, waste wood, circular economy

INTRODUCTION

On our way to a more circular, bio-based, economy, we will need to start treating recycled timber as a more valuable resource. The apparent consumption of wood in the UK is almost 1 m^3 per person (UNECE 2018; Office for National Statistics 2019), but not all of the wood we use vanishes in a puff of smoke. What exactly did happen to that garden shed that you took down last spring? Has it found a new life with a new family?

Our paper is a vignette of UK's wood recycling industry. It describes typical paths and uses for secondary timber, investigates the state of the wood recycling industry, and wonders how the system would be different in a perfect world; where the value of products reflects environmental and social worth.

The work is part of the Forest Value cofund InFutUReWood project which aims to enable the structural reuse of timber. Important parts of the project are to survey the condition of secondary timber, to estimate the volumes of secondary timber that arise in different quality classes and to identify barriers in the reuse and recycling of wood waste. The report contributes to answering these questions and identifies which gaps in the timber cascade could be filled without disturbing existing recycling paths.

When you ask people why they are not separating their waste, the answer will often be: "Because it will be burnt anyway!" For your garden shed this is most likely true, but the excuse is flawed nonetheless. Incineration for energy is an inevitable step for cascading wood, even in the most circular economy we can imagine, but it is the lowest and final cascading step and can be preceded by various uses such as sawn timber, engineered wood products, particle board and chemical use (Höglmeier, Weber-Blaschke, and Richter 2013).

In a perfect world, your garden shed might serve as a dinner table, before it gets chipped and lives again as a kitchen top, possibly again as a flooring board, and finally provides heat for

your grandchildren's home, when it is incinerated at the end of its life. But what happens in reality?

To answer this question, we interviewed seven wood recycling companies in Scotland and Northern England. Two of the enterprises are community wood recyclers, three are wood waste chipping companies and two are board-making companies.

MATERIALS AND METHODS

The goal of the study was to follow your hypothetical garden shed on its possible ways through different wood recycling paths. On this journey we gained insight on the following research questions:

1. What are the sources of the wood waste?
2. What size and condition is typical for secondary timber?
3. According to which criteria, and where in the value chain, is wood waste sorted?
4. How is secondary timber processed by recycling companies?
5. What advantages and disadvantages does secondary timber have compared to virgin timber?
6. How are circular economy and environment protection principles affecting the wood recycling sector?

We interviewed seven wood recycling companies between January and March 2020. The interview was always accompanied by a site visit so that the condition of the wood waste, the processes and machinery, as well as resulting products could be observed first-hand. The companies are three chipping companies in Scotland, two board manufacturers, one of which in Scotland and one in England, and two community wood recyclers in Scotland. An overview of all companies is given below.

Companies

ENVA is one of the largest recycling and resource recovery companies operating in the UK , covering a range of different materials. Recovered wood is processed into animal bedding and chips for biomass and chipboard production on seven sites across the UK. Part of the study was the production plant in Linwood, Scotland.

Hamilton Waste and Recycling receives waste from construction and demolition sites and commercial and industrial waste, mostly from the broader Edinburgh area. All material is sorted, and the vast majority of it is recycled. Everything from mattresses, through plasterboard to wood waste is prepared for a second life using separate approaches for each material stream. Wood waste is chipped and the higher grades are sold to particleboard manufacturers while the lower grades terminate their life in energy recovery plants.

Timberpak is the recycling division of EGGER, one of the largest chipboard manufacturers in Europe. Timberpak supplies around 85% of the recovered wood used in EGGER products. Four production sites in the UK are constantly collecting, sorting and chipping waste wood. The interview was conducted at the site in Bellshill, Scotland.

EGGER manufactures chipboard on a large scale in two locations in the UK and several more across Europe. The EGGER group combines all activities around wood-based products: From forestry through saw-milling to board production and recycling. The production plant in Hexham, England was included in the survey, even though only a fraction of the questions could be answered as part of a guided site tour.

Norbord is a chipboard, OSB and MDF manufacturer based in the UK and Belgium. With three production sites in the UK, the company is one of the biggest local producers of particleboards and was the first one to produce MDF locally. Part of the study is the production plant in Cowie, where around half of the production comprises of particleboard and the other half of MDF.

Glasgow Wood Recycling is a community wood recycling company. The company collects and receives material from construction and demolition sites, private households and commercial waste. Volunteers sort the wood to either resell it or produce unique furniture and decorative items. The company also offers training and workshops to help people with employability and tackle social isolation.

Move On Wood Recycling follows the same approach as Glasgow Wood recycling. The company in Edinburgh has a workshop to reprocess recovered timber. Move On offers a collection service and sells used wood and furniture items made from secondary timber. Ecological and social aspects are equally important company values.

From the company descriptions above, it is obvious that your garden shed will have a very different future if you decide to give it to community recycling, compared to a chipping company (via the wood skip at the local recycling centre). In the former scenario your shed would be used for high-value products while in the latter scenario it would be degraded to lower cascading levels or biomass. The higher importance and volume by far, is taken by the second approach but the community recycling concept uses the cascading potential of the timber more efficiently. Both recycling paths are of relevance for the InFutUReWood project. Chipping, as the main industrial approach, is investigated to understand which other cascading steps before chipping might be relevant in the future, which factors might motivate the industry to exhaust the full potential of secondary timber and which cascading steps are already state-of-the-art. Companies who were interviewed as case studies for this approach are ENVA, Hamilton Waste and Recycling, Timberpak, EGGER and Norbord. The community wood recycling approach is closer to the project goal of enabling structural reuse of timber. The interest when interviewing these companies lies in the understanding of the condition and type of secondary timber members, as well as potential challenges or benefits when reusing or reprocessing salvaged wood. At the same time, the approach of community wood recycling, which is both ecologically and socially valuable, should not be disturbed by any of our project outcomes. To ensure this, the market situation regarding sources of secondary timber as well as demand for recycled products need to be understood. Glasgow Wood Recycling and Move On Wood Recycling served as case studies for this approach.

RESULTS AND DISCUSSION

The source

Wood waste arises in all shapes and sizes. Your garden shed could be in good structural condition or close to complete decay, it could be oiled or painted or pressure treated for a higher durability, it could be littered with nails or relatively clean and it could be pine, spruce or fir or even made from hardwood or fancier softwoods. We don't know, but since not only you, but also your neighbour, your golf partner and thousands of other people had the idea to renovate their garden last spring, it is fair to assume that a wood skip at the civic amenity contains material from all of these garden sheds; plus terrace boards, dining tables, IKEA cupboards, structural beams, pallets, battens, MDF and most likely even products that look like wood but don't really belong in this skip, like wood plastic composite or laminate flooring. The chipping companies receive mixed wood skips like this, while community wood recyclers mostly pick out the bigger pieces of solid wood. Civic amenities and municipal collections are a big source of wood waste for all recycling companies, but they also receive similar amounts of wood from

construction and demolition sites and industrial wood waste. Construction wood waste often includes scaffolding boards and oversupply of virgin timber. Wood from demolition projects includes different sizes of solid timber as well as engineered wood and board products. It is often broken and contaminated with other building materials. Industrial wood waste contains a high amount of packaging materials, sawmill rejects and (these days, thanks to the popularity of gin requiring bigger production volumes) whisky barrels.

Chipping companies

The three chipping companies process between 300 and 1000+ tons of non-dry timber per week. The moisture content of the source is variable, since the wood waste is usually stored outside and is unprotected from the weather. It is estimated that the moisture content when processing is between 12 and 25%. Depending on its origin, as described above, wood waste as it arrives on site might be of only one type or in mixed skips. One company even accepts mixed skips with all sorts of materials including timber, concrete, plasterboard, plastic, insulation and other materials. But even the relatively sorted wood waste normally contains impurities. A lot of the timber is painted or affixed to other materials like plastics, cardboard or glass. The wood waste mix also includes products ranging from furniture to plywood, chipboard and MDF. Most of the timber that arrives at the chipping plants is already broken for easier transport or it has been damaged in its previous life. A typical pile of timber before processing is shown in

.

All interviewed chipping companies use their own sorting system that is mostly resembling the system of the Wood Recyclers Association (WRA). In this system, grade A includes only clean solid wood, grade B also includes construction and demolition waste wood, grade C also includes civic amenity and municipal wood waste and grade D contains hazardous waste.

For easier understanding the following statements regarding sorting of waste wood have been translated to the WRA waste wood grades. According to one company, approximately 20% of the material is grade A, and the rest is a mix of solid wood and board products of grade B and C. One company estimates that 50% of the resource is grade A wood, another company estimates that 30% is grade A. None of the recycling facilities accepts hazardous wood waste of grade D, but none of them tests for hazardous contaminations of the resource (presently this is permitted based on previous work that confirms an acceptably low level of hazardous contamination). Companies do not accept railway sleepers or telegraph poles since they know these are preservative treated to a high level with the most problematic chemicals. For all other wood waste, they trust their suppliers to not deliver hazardous material.

One of the companies puts a lot of emphasis on sorting the wood and provides training for waste collectors, so the delivered material is sorted carefully and fewer impurities are drawn into the

system. If they receive low grade, unsorted material, they try to manually separate as much high-quality timber as possible, for animal bedding production.

The company that receives all construction waste unsorted, separates the wood from other materials during processing. Similarly, one company receives all kinds of wood waste, including impurities, and processes everything collectively. In this company the sorting system is only used for determining the price that they pay to the waste provider, but is irrelevant for the recycled product. It is voiced that demolition companies often do not sort the timber but instead sell it all as the lowest waste grade (C), since the price incentive is not big enough. For one of the companies, the most important aspect when sorting the waste wood is determining the share of packaging waste, to receive packaging recovery notes. This government scheme offers monetary incentives to recyclers of packaging material.
During the recycling process, often all material is collectively shredded and impurities removed afterwards. For this purpose, the shredded parts run through the factory on conveyor belts while impurities are removed manually or using machines (Figure 2). Magnets separate ferrous metals, eddy currents non-ferrous metals, plastic is separated by hand and using air classification, sand and stones are separated using sieves or float classification. MDF is separated manually by two of the companies, who sell it for energy production. The third company includes MDF in the chip production. A high degree of MDF in the resource can cause problems for some processes due to the tiny fibres. The cleaned material is then chipped, and most purifying steps are run again. Fines are separated as well and sold for energy production.

Figure 1: Unsorted waste wood

Figure 2: Removing Impurities

The cleaned chips are sold for further processing, for energy production or as a final product (animal bedding). In the company where the timber is sorted before shredding and processed in different classes, only the highest quality (grade A) is used for animal bedding. Lower grades and all material in the two other companies are processed into medium-class chips (Figure 3) that can be used for board production, and low-class chips (Figure 4) for biomass energy. In the lower chip classes, considerable contamination with plastics and other material is visible, but this is within the regulations.

If products and by-products are sold externally, employees constantly perform quality control on-site. By-products are mostly metals, sand and stones, plastic and cardboard, that were separated from the wood waste. By-products are sold to external recycling companies and only a small share of materials is sent to landfill. In one of the companies, tablets are used to track wood waste batches over the whole process and pictures are automatically taken to detect inadmissible contaminations. In an on-site lab the chips are controlled for mechanical contamination weekly. In the company where animal bedding is produced, every batch of bedding is controlled and tested for bacterial and heavy-metal contamination. One company

mentions that the chips for energy production are controlled very strictly, since the incineration equipment is expensive, but this is done by the energy producers.

None of the companies sees particular problems in processing recovered material, since existing contaminations are manageable. For these companies it is business as usual to remove all the nails, paint and concrete that is adjacent to the parts of your garden shed and most of these processes are automated. On the other hand, none of the companies sees a potential for higher-value products made from the material they receive. The timber is mostly damaged and mixed with other materials from the demolition process or earlier use. Only a small share of large dimension timber is found, and chipping/crushing early on in the chain is a common processes to reduce transport costs. Two companies mention that sometimes, if they receive a larger batch of intact timber, they inform the local community wood recycling or charity and sell it for reprocessing or reuse. For animal bedding, recovered timber poses the advantage of not absorbing as much moisture as new timber. In all other applications, recovered timber only has an advantage regarding the price, compared to virgin timber.

The big companies for wood recycling are not receiving any government support for their circular material use. Two companies even see a threat in the government's support of the biomass energy sector that increases the prices for recovered wood due to higher demand. One company states, that the packaging recovery note scheme is the only factor that makes panel production in the UK financially viable. The varying prices for the recovery notes are therefore problematic. All companies are members of the WRA.

Figure 3:Medium class chips

Figure 4: Low class chips

Board making companies

If your garden shed was among the waste wood that was chipped, and then delivered from the chipping companies to one of our two board makers, it will be combined with a varying amount of virgin timber that is delivered in the form of roundwood or chips from sawmill residues. The recovered chips are randomly checked for chemical contamination using a spray and colour change technique. Samples of the chips are also given to an on-site lab to check for physical contamination. If necessary, a batch that exceeds the threshold for chemical contamination is "watered down" using clean chips. According to one company, it does not happen often that a batch exceeds contamination levels and needs to be sent back to the provider.

A maximum of 10% secondary wood products (laminated products, MDF, particle board) can be used in the production of MDF, according to one of the companies. The other states that all MDF in the waste stream is sorted out and used for heat production on site.

The recovered chips are cleaned again in many purifying steps using magnets, sieves and air classification. In one of the companies all chips are separated into a bigger and a smaller fraction for use in the different board layers. The other company uses recycled timber only for the core layer and virgin wood for the outer layers (for aesthetic reasons). One of the companies uses 70-100% recycled material but virgin wood from UK spruce is usually added to ensure consistency of material properties. The other company uses around 40% recovered wood, 40% sawmill residues and 20% roundwood. One of the companies does not use any recycled material for the furniture grade MDF (kitchen tops etc.) since contaminations could disturb the appearance.

Depending on the future use, the chips are either refined for fibreboard production or chipped to the correct size for chipboard production. The particles are then dried using excess heat from the press. Afterwards glue is added, and the chips are blown onto conveyor belts to form sheets with two surface layers and a core layer. The process for fibreboard production could not be observed in either of the factories, but sheet production with fibres instead of chips is commonly done by spreading the fibres mechanically and homogenising the sheets using rollers. For both fibre- and chipboard, the sheets are fed into a continuous press and the resin cures at elevated temperature. The endless sheet is then cut into panels and they are cooled in a star cooler. Afterwards they are sanded and cut to size. Depending on the further use, they can be surface coated with impregnated paper or melanin layers and edge sealers. Your garden shed now has a completely new appearance and it is most likely distributed in hundreds of products. In the form of chipboard, it is most likely used for flooring, while in MDF it could be in a kitchen top or other furniture.

By-products like metal or glass that were separated from the chips are recycled by external companies. Wood residues (dust from sanding, dust from sawmills, secondary MDF) are used as fuel and for heat production for the press. Production offcuts are fed back into the input material stream. One of the companies mentions that the chip sheets are monitored, and the feed can be stopped directly before the pressing step, if anything looks amiss. In that case the unused, glued chips are fed back into the material stream after removing contaminations. Products are tested in an on-site lab for strength properties, abrasion resistance, staining and chemical resistance.

One of the companies names cost savings as the main driver for the use of recovered material, but also mentions that there are no downsides to it. The use of secondary timber, the use of by-products for heat and closed loop material streams are beneficial both environmentally and economically. One company perceives the increasing biomass use of wood as a threat since this leads to rising material prices. At the same time, they are receiving government funding for their own renewable heat generation on-site. The other company says that no government support is available for their business. One of the companies is a member of the WRA.

Even though the price incentive rather than the environmental benefits of using recovered timber is what mostly drives the big chip producing and board making companies, two of them are making small efforts for the environment. One company is planting trees on and around the processing site and one company is keeping bees.

Community wood recycling

If your garden shed was among the wood that was selected by the community wood recyclers, or if you called them to collect it directly from your garden, the future of your shed might look quite different. The two community wood recycling companies, and similarly over 30

enterprises across the country, are using salvaged timber to manufacture furniture or to resell it for DIY projects. The companies included in this report receive between 100 and 500 tons of timber per year from private households, construction centres, sawmills, construction and demolition sites and other industries. They collect the timber for a fee.

The material can contain anything from furniture to solid wood and board products (Figure 3-Figure 5). Hazardous waste is not accepted, but this concerns only telegraph poles and railway sleepers, since no testing is done for contamination. Fencing material and other members that are visibly treated, are sold for reuse as the same product. This way, if your garden shed is in good condition, it might well end up in the garden of your neighbour. Scaffold boards and other timber is explicitly sold to not be reused for structural purposes, since the resistance of the material cannot be guaranteed (despite what the stamp may say).
One of the largest timber sources for one of the companies are whisky barrels, that are resold or processed into plant pots and decoration. One of the companies receives big batches of construction leftovers and sawmill rejects that have never been used but may have been exposed to weather. Whether material is accepted or not depends on the opinion of the volunteer who collects it. Usually no lengths shorter than 1 m are accepted, but if the material is "special" regarding its species, age or shape, an exception might be made. Material contaminations like metal fasteners, if not too intensively used, are not a restricting factor for accepting the material. Painted members are accepted as long as one surface is clear.

During the collection, wood is sorted into grades to determine the price, but this classification is not used for any other purpose. Upon arrival in the workshop, the timber is sorted by volunteers in an informal way, usually just into "useful" and "not useful" for producing furniture. According to one of the companies around 85% of the resource can be used for furniture production. The sorting strongly depends on the subjective opinion and experience of the volunteer and on the type of products they want to make. If the volunteer is able to identify the timber species, or if the customer specified what kind of timber is in the batch, it will be sorted and advertised correspondingly. Painted members, board products and intact furniture are usually resold. Some of the members have strength classes stamped on them, but no attention is paid to any marking from the original manufacturer.

Figure 3: Timber with nails

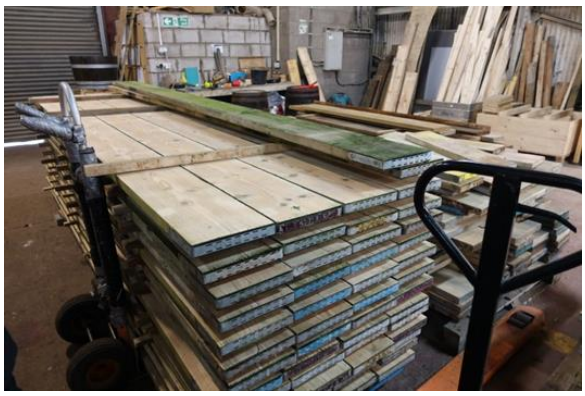

Figure 4: Scaffold boards

Figure 5: Diverse boards

Before processing, all metal parts like nails and fixings as well as other impurities are removed and sent for recycling with an external company. In the workshop volunteers process the wood with hand tools and larger woodworking machinery. Manufactured items vary, including tables, benches, plant pots, shelves, candleholders and wall cladding. Every piece is unique and dependent on the available material as well as the creativity of the volunteers, so the future of your garden shed in this scenario is quite uncertain, yet beautiful and "up-cycled". Timber for resale is not processed at all, since some customers are specifically looking for "scrappy" parts, and defects can be seen as features. Material that is too small to be used and offcuts are either sold as firewood or chipped and sold to biomass energy plants. One of the companies says that the space to store all timber they receive is not sufficient, so they are chipping some of the useful wood too.

Problems due to the nature of the resource are not perceived. Unless there was excessive use of nails and screws, existing material contaminations can be removed and are handled as part of the process. Defects are seen as features rather than nuisances. Limitations to the production are only set by the space and number of volunteers, since the demand for the products and supply of used wood are high. Customers value the good prices as well as the ecological and social approach of the business model. Both companies received funding with Zero Waste Scotland and are members of the WRA. Grants and business support are available from the government for the relatively small community projects.

CONCLUSIONS AND THE BIGGER PICTURE

The interviews and accompanying visits gave a good overview of the wood recycling sector in the UK. Since only seven companies took part in the study and most of them are located in Scotland, it is natural to wonder how well these companies represent the whole UK wood recycling industry. We came to the conclusion that they are representing it well indeed, since most companies have other branches in the UK that are likely to operate in the same way. In addition, the observations and responses to the interview were very similar in all companies of the same type. Below, our findings are summarised, and it is shown how the path of your garden shed fits into "the big picture" of the UK wood recycling industry.

Wood waste in the UK

Apparently, your garden shed is not the only wood that is given to recycling, because the UK is among the top five producers of wood waste in the EU (BioReg, 2018). According to WRA figures, summarised in an Article by Doherty (2019), 4.5 million tons of waste wood arose in the UK in 2018. Of course, this is not only garden sheds, but demolished buildings, construction leftovers, furniture, pallets, barrels and all other wooden items you can imagine. Around 26%

of wood waste originated from construction, 25% from demolition, 26% from packaging, 13% from municipal waste and 10% from industrial waste in 2009 (Pöyry Forest Industry Consulting Ltd and Oxford Economics Ltd, 2009). Most likely the proportions are still similar today and the companies we visited receive material from all these sources, although the shares from each source are unknown to the companies.

The waste wood is a mix of solid timber, board products and pre-used products like furniture and whisky barrels. Even unused solid timber in form of sawmill rejects and construction oversupply are among the resource. The size of timber members cannot be generalised, since such a large variety of members is accepted.

Before recycling the waste wood, it seems natural that it needs to be sorted. The WRA introduced a classification system for wood waste in 2009 that sorts recovered wood into four grades: Grade A includes only clean, non-contaminated timber, mostly from packaging material; grade B includes timber from construction and demolition waste that can be coated and treated to some extent; grade C includes municipal wood waste and adhesive-bonded products; grade D is used for all hazardous wood waste (Greenhalf and Brown, 2012). This classification system is similar to others used in the EU, like the German one with the grades AI to AIV (Meinlschmidt et al., 2016) and the Finnish one with the grades A, B, C and D (Alakangas et al., 2015) that are essentially the same as in the UK. The WRA sorting system was developed to allow a more efficient recycling of the wood waste, but its use is not mandatory. The interviews suggest that the system is not widely used by waste providers and waste handlers, but chipping companies often use similar systems, although with certain customisations. But the sorting plays only a minor role in the processing of the material and mostly determines the price to pay to the waste providers, where chips are not used for animal bedding. If waste providers want to achieve a higher price, they sort the wood before sale but often it sold unsorted as grade C. For the production of animal bedding, only clean, solid wood can be used and is separated either by the waste provider or by the chipping company before processing. Packaging waste might be separated by the recycling companies to receive packaging recovery notes. MDF is usually sorted out manually and incinerated.

In community wood recycling facilities, the WRA system is not used. Wood waste is sorted upon collection to determine the price. A simple sorting system into a high grade and a low grade is usually used. In the workshop the volunteers are sorting the timber using a subjective system with the categories “useful” and “not useful” for furniture production.

The quality of the wood waste decides its cascading potential. Statistically 31% of wood waste fall into grade A while less than one percent of wood waste is classified as grade D and has to be incinerated in certified facilities (Pöyry Forest Industry Consulting Ltd and Oxford Economics Ltd, 2009; Turner, 2020). The interviewed chipping companies confirm the statistics and estimate a share of 20-50% of solid, clean wood in grade A. None of the companies accepts hazardous waste, which means that the rest of the wood they process is grade B and C. The WRA is currently investigating the true share of grade D in the UK´s wood waste, but their numbers seem to confirm the low estimate from above, with less than 0.1% of municipal wood waste and around 8.5% of demolition wood waste being hazardous (WRA, 2020). Following this, a large share of wood waste has a good quality and potential for reuse or cascading. For timber possible cascading steps include solid wood products, particle-based products, fibre-based products and chemical raw materials, according to Höglmeier et al. (2013).

However, the timber is often damaged and contains a large share of impurities (metal, plastic, stones, concrete, glass). The damage either results from the previous life of the product, the demolition process or is done by the waste handlers to facilitate transport. In reuse and remanufacturing facilities, the timber arrives in a better condition. Since these enterprises need high quality material, it is handled more carefully and not deliberately broken down by the waste providers. This shows that if the price incentive is high enough, wood waste can be obtained in sufficient quality for reuse or reprocessing. Around 85% of the timber given to community recycling are fit for furniture production, according to the interviews.

Even though a large amount of all wood waste could evidently be reused or reprocessed, statistically only around 2.5% of secondary timber are used for these high cascading steps. The National Community Wood Recycling Project, a network of wood recycling enterprises across the UK, recovered 21,000 tons of wood in 2017 and 44% of this was reused (Community Wood Recycling, 2018). Another important way of reuse is architectural salvage, where companies collect and resell items from demolition sites or municipal waste. As part of this, the Furniture Reuse Network salvages an estimate of 90,000 tons of wooden furniture per year (DEFRA, 2012). Structural products from secondary timber are not currently available, and their recovery is not compatible with much of modern demolition practice for reasons of safety and cost, but grading of recovered timber or manufacturing secondary CLT and glulam could allow structural reuse.

The largest share of wood waste in the current system, however, is chipped and used for biomass energy or lower cascading applications. This happens to more than 76% of wood waste (Doherty, 2019). The share of secondary timber that is used for energy recovery has increased largely over the past ten years, gaining nearly 30% in share between 2008 and 2018 (2008 numbers from WRAP (2011) and 2018 numbers from Doherty (2019)). It is foreseeable that in 2020 the demand for woody biomass will rise again (WRA, 2019) and following that, it is likely that more than 50% of recovered wood will be used for biomass energy this year. The remaining part of wood chips, around 30% of all wood waste by mass, is mainly used for chipboard production including particleboard (15.4%) and medium density fibreboard (4.2%). Small shares of chips are used as animal bedding (6.9%) or mulch and compost (3.3%).

For either chipping or remanufacturing, the removal of impurities is the biggest challenge in processing recovered timber. The chipping companies are shredding the waste before most of the cleaning happens. Impurities are then removed either manually or using magnets, sieves and classification systems. The output material is then chipped and purified with the same systems again. If you want to preserve the structural integrity of the timber however, removing impurities can only be done manually. The best way to facilitate the reuse is therefore the design of timber members, so that little effort is needed to separate materials.

Other damage to the timber is not usually a problem for the existing recycling paths. The “scrappy” look of secondary timber can even be seen as a feature. Another advantage of secondary timber is the reduced moisture absorption in the production of animal bedding. Ecologic benefits are of minor importance for big companies but valued by community wood recyclers. Nonetheless, big companies try to reduce the environmental impact of their products since usually the same measures that are ecological are also economically beneficial. The low price is what drives the choice of secondary timber in the first place. But the growing biomass energy sector, supported by the government, is putting the waste wood sector under high demand and increases the price for secondary timber. This poses a threat to other businesses that use recovered wood, like board manufacturers. A more sustainable use of secondary timber

would be possible, if the UK government placed more importance on circular material use instead of quick, seemingly green energy solutions.

Community wood recyclers are not affected by the material shortage however, since their market share is comparatively small. Their demand for secondary timber is more than covered, since their processing capacity is limited by the number of employees and available space. The companies are funded by the government and initiatives like Zero Waste Scotland and rely on volunteers. This means that their productivity is directly linked to the value that is placed on ecological and social merits by the government and society.

Impacts of the InFutUReWood project

Structural reuse of timber is not currently of relevance in the UK. The InFutUReWood project aims to make this technically feasible by developing structural secondary timber products, rules for structural grading of used timber, and designs for demountable buildings. It is foreseeable that the reuse of timber in the construction industry will have a slow uptake, since reuse and recycling chains that target structural products are a novelty and trust in these products has to be built. Nonetheless, developing this part of the timber value chain seems promising, given the monetary and ecological benefits. The project includes the development of engineered wood products from secondary timber, which is hoped to spur the industry to make use of the full potential of the material. The existing industries will not be impacted negatively, since initially the volumes that are reprocessed and reused will be small. As the industry hopefully grows, it will only add a further cascading step before the wood can be used for board products and finally for energy recovery. The competition with community wood recyclers will be small because most resources used by these companies are of little interest for structural reuse.

The impact of the project will be dependent on government policies and the importance of circular economy values both in the society and for government decisions. That is why one of the most important project outcomes is raising awareness, not only for the importance of circular and material efficient resource use, but also for other topics that are connected to the project aims. The biggest problem in the wood recycling sector is the growing biomass energy industry and its high demand for wood waste, but also virgin timber, as a result. This is not only related to the UK, but to the EU in general. The EU's approach to increasing the renewable energy share lead to a rather wasteful and unsustainable use of virgin and secondary timber. It is not within the project scope to address this problem or provide possible solutions, but it will be included in communication activities with the public and the industry.

It is not likely that our efforts will turn the wood recycling sector by 180°. But we can most certainly influence the future of your garden shed. You can give it a new life and contribute to a circular material use with your decisions in its first and second life. Choose a building system that is designed for disassembly, maintain the quality of the wood by repainting the shed every now and then; and when you are removing it, give it to your neighbour or the local community wood recycling. This way you are already contributing to the change towards a circular economy.

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