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UTILISATION OPTIONS FOR WOOD WASTE:

A REVIEW OF EUROPEAN TECHNOLOGIES AND PRACTICES

MATTHEW WARNKEN

2001 GOTTSTEIN FELLOWSHIP REPORT

Matthew Warnken is the Projects Director for Australian Wood Waste Management.

He began his research activities within the Waste Management Industry as the research officer for a joint project between Blacktown City Council and the Western Sydney Waste Board that concentrated on small timber related manufacturers. This was followed by developing and managing the New South Wales Waste Boards' Wood Waste Project.

Matthew has a Bachelor of Arts and a Bachelor of Science majoring in Resource Management, Statistics and Philosophy. At the time of publication Matthew was studying part time for a Masters research degree in Chemical Engineering at the University of Sydney focusing on the optimal utilisation of wood waste materials within the context of Ecologically Sustainable Development. He has also completed one-third of the requirements for a Masters in Business Administration.

Matthew was a participant in the ACT Youth Business Initiative, won the inaugural NSW Enterprise Workshop Chairman's Award for Most Promising New Business and was a founding member on the steering committee for the Energy from Waste Division of the Waste Management Association of Australia.

As a CSIRO Gottstein Fellow, Matthew's objective was to review wood waste processing and recycling technologies and research commercial operations that utilise wood waste for a beneficial use.

In previous work lives Matthew has been a labourer, carpenter and small business owner, salvaging and recycling Australian hardwoods into custom designed furniture pieces.

I) JOSEPH WILLIAM GOTTSTEIN MEMORIAL TRUST FUND

The Joseph William Gottstein Memorial Trust Fund was established in 1971 as a national educational Trust for the benefit of Australia's forest products industries. The purpose of the fund is *"to create opportunities for selected persons to acquire knowledge which will promote the interests of Australian industries which use forest products for the production of sawn timber, plywood, composite wood, pulp and paper and similar derived products."*

Bill Gottstein was an outstanding forest products research scientist working with the Division of Forest Products of the Commonwealth Scientific Industrial Research Organisation (CSIRO) when tragically he was killed in 1971 photographing a tree-felling operation in New Guinea. He was held in such high esteem by the industry that he had assisted for many years that substantial financial support to establish an Educational Trust Fund to perpetuate his name was promptly forthcoming.

The Trust's major forms of activity are;

1. Fellowships and Awards - each year applications are invited from eligible candidates to submit a study programme in an area considered of benefit to the Australian forestry and forest industries. Study tours undertaken by Fellows have usually been to overseas countries but several have been within Australia. Fellows are obliged to submit reports on completion of their programme. These are then distributed to industry if appropriate. Skill Advancement Awards recognise the potential of persons working in the industry to improve their work skills and so advance their career prospects. It takes the form of a monetary grant.
2. Seminars - the information gained by Fellows is often best disseminated by seminars as well as through the written reports.
3. Wood Science Courses - at approximately two yearly intervals, the Trust organises a week-long intensive course in wood science for executives and consultants in the Australian forest industries.
4. Study Tours - industry group study tours are arranged periodically and have been well supported.

Further information may be obtained by writing to,

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II) ACKNOWLEDGEMENTS

This report is the result of an overseas study tour, sponsored primarily by the Gottstein Memorial Trust Fund. My sincere gratitude goes to this organisation and especially to the Trustees and the Secretary, Dr Adrian Wallis, for their ongoing administration that serves to perpetuate the opportunity of overseas research into forest product issues.

The New South Wales Waste Boards and Australian Wood Waste Management were also sponsors of this research and I am very appreciative of this additional support.

I have been fortunate enough to have had significant involvement with wood waste issues, from making furniture from recycled to hardwood to project managing a wood waste project with the NSW Waste Boards and to my current work as Projects Director with Australian Wood Waste Management. Wood waste, and more specifically, the recovery of resource value from this “waste” has been and remains a passion of mine.

The information contained within this report, except where otherwise cited, was derived from interviews with over 30 organisations visited in the United Kingdom, Germany, the Netherlands and Austria during May and June of 2001. I would like to thank all of these overseas contributors for their assistance and generosity in providing contacts and making time to arrange and accompany me on site visits – often going far beyond the normal call of duty.

It is hoped that this information will benefit the timber products industry in Australia and provide some of the impetus for environmental beneficiation while reducing unnecessary cost for wood waste generators. The research tour provided first hand experience of wood waste management, and hopefully this report will assist in putting some of these examples into practice in Australia.

I would like to thank former NSW Waste Board colleagues especially Einion Thomas and Jane Pretty for their encouragement and support for the wood waste tour. Mark Glover (EcoWaste), Stephen Shuck (Bioenergy Australia), David Gardner (NSW State Forests), Andrew Burnard (SEDA), David Brown (Otterson and Associates) and Ron Wainberg (Biomass Energy Services and Technology) also provided valuable contacts and advice on organisations to visit.

I would also like to thank Angelika Zidek for assistance in organising the trip and David Robson (CSIRO Forestry and Forest Products) who provided valuable comments on the report.

And finally on a personal note, I would like to thank my wife Gabrielle for her support, encouragement and for being a wonderful travelling companion without whom I would most likely still be lost; driving around Europe looking for a pile of wood waste!

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1. EXECUTIVE SUMMARY

Waste management has been an unrecognised but essential participant in the wood products industry within Australia. It is needed to "remove" from the economy timber products that are no longer needed and/or wanted.

To date, the primary wood waste management system has been the disposal of materials to landfill. Landfill, however, is not a sustainable option for wood waste management both from an economic and ecological viewpoint

In order to protect the profitability of the wood products industry new methods, technologies and approaches to wood waste management are required. Forcing this change is the increasing cost of landfill disposal and Government initiatives such as the Renewable Energy (Electricity) Act. At the same time there remains a lack of options for the beneficial utilisation of waste from engineered timber products (e.g. particleboard and medium density fibreboard). There is a need for industry development in wood waste management and for information and technology transfer.

The purpose of the Gottstein Fellowship was to support a study tour of wood waste processing and recycling centres in Germany, Austria, the Netherlands and the United Kingdom.

This report presents the information collected on the technology options and different strategy and policy approaches to wood waste utilisation. It is broken into two halves. The first half presents sections on:

- Wood waste materials handling,
- Manufacture of particleboard from wood waste,
- Thermal utilisation of wood waste for heat and electricity generation,
- Reclamation of wood fibre from waste panel products,
- Other utilisation options for wood waste,
- Optimal utilisation of wood waste, and
- Specific applications for Australia.

The second half contains 25 case studies from which the main information presented in the first half was derived. The case studies cover a range of industries involved in wood waste recycling, utilisation and machinery manufacture.

The Cost of Disposing Wood Waste to Landfill

Wood waste is not an ideal material to landfill, as there is a poor return on a landfill asset owing to the low density of the wood waste. The gate fee charges associated with landfill in the countries visited are also very high, ranging from approximately $63 to $185 AUD per tonne. Landfill taxes comprise over half of these costs and in most cases are set to increase.

The high cost of landfill acts as an incentive for wood waste generators to separate their waste material into loads of wood waste only.

In the countries visited, there was a three-tiered A-B-C classification system for separated loads of wood waste. A-wood waste is derived from untreated timber products, B-wood waste is derived from painted and engineered timber panel products and C-wood waste is derived from preservative treated timber products.

A-wood and B-wood wastes are processed in order to manufacture a usable product. Process stages include size reduction, separation of contamination, screening to desired particle sizes and storage. A variety of transport modes are used to deliver product to market and in some cases, are transported in excess of one thousand kilometres.

Each processing stage adds an additional cost. These costs need to be covered by a combination of gate fees for separated loads of wood waste and the sale of product.

Using Wood Waste to Manufacture Particleboard

Particleboard manufacture is a mature market; hence there are large drivers for the industry to reduce costs. Using a recycled wood chip overcomes the high cost of virgin wood chip often meets legislated extended producer responsibilities.

It is mainly A-wood waste that is utilised to manufacture particleboard. Potential issues include contamination in the recycled chip that may detrimentally affect the panel product's performance and might also introduce a safety hazard for workers using the recycled panel product. There is also a large amount of energy required to process, clean and screen the wood waste material in order to reduce the impact of contamination. Thus the process of recycling has environmental impacts.

Thermal Utilisation - Heat

There are a wide range of applications where wood is utilised as fuel for heating. Different sources of wood waste have different moisture contents and thus have varying calorific values. Some facilities have a pre-heating process stage that enables them to utilise wood residues with high moisture contents of up to 60%.

In all countries visited, A-wood was acceptable as a fuel source while C-wood waste was not allowed to be combusted. There were some restrictions to the use of B-wood as a fuel depending on local regulations and the combustion technology.

There are many issues that impact the viability of using wood waste as a fuel product, the major one being pollution to air and to land (contaminated ash). From a social perspective community fears tend to be focused around pollution issues. These fears need to be addressed in order for facilities to gain a community operating licence.

Underlying the utilisation of wood waste for heating purposes is the assumption that there is a need for heating. This may not be the case for Australian conditions.

Thermal Utilisation – Electricity Generation

Electricity generation requires a fuel source either to power generators directly or to create heat that can be used to produce steam. Wood waste can be used as a solid fuel for combustion. It can also be used in gasification technologies. Gasification involves the manufacture of a flammable gas, called syngas. Other technologies that can use wood waste include pyrolysis. The process of pyrolysis produces a char, a liquid fuel and a combustible gas.

Some of the advantages of generating electricity over "heating" are that electricity is more easily transportable, has a wider range of applications and utilises an existing infrastructure to "plug into" without the need for extensive development.

The generation of electricity from wood waste raises many of the same issues as does the generation of heat. To overcome some of these issues, the future of electricity generation from wood waste should concentrate on improving the efficiency of conversion into electricity and also improving the environmental performance of technologies. It is anticipated that a series of decentralised power stations may be developed, obviating the need for large infrastructure intensive, electrical grids.

Reclamation of Wood Fibre from Waste Panel Products

There are increasing amounts of panel products such as medium density fibreboard entering the economy. Waste from panel products are normally used as a fuel. Two processes are being developed, however, to reclaim this fibre for use in new panel products. Both processes take batches of waste panel products and use heat, steam and additives to break apart resin bonds. A clean wood chip is recovered suitable for substitution into the manufacture of new particleboard

The ability to reclaim fibre and chip from waste particleboard and medium density fibreboard greatly increases the alternatives for resource recovery from waste panel products. It decreases the potential for contamination because panel products are readily identifiable and their component ingredients are known. Added benefits are realised when combination recycling and electricity generation activities are run in tandem, with the waste heat from electricity generation being made available as the process heat for the panel product recycling.

Optimal Utilisation of Wood Waste

It is readily agreed that disposal of wood waste to landfill is not the best use of wood waste. However the diversion of wood waste from landfill does not in and of itself establish the environmental credentials of any project. Life Cycle Assessment is often used as an environmental decision making tool to differentiate between alternate uses for materials. It is also necessary to incorporate community and NGO perspectives into any decision making process. Furthermore the economics and technical aspects of any options must be taken into account. Thus the highest resource value of the wood waste must be determined on the basis of techno-economic, socio-political and environmental criteria.

To facilitate this analysis there is a need to compare the wood waste product alternative against a reference product. For example, in the case of electricity generation, will the wood waste be used to replace fossil fuels and what fossil fuel is it replacing? The highest resource value of wood waste depends on the quality of wood and the efficiency of the chosen type of technology. Negative factors such as emissions are important when comparing technologies.

Regardless of preferences for optimising resource recovery from wood waste the issue remains that even if all landfill diversion targets are met, increases in population will present the same net amounts of waste requiring management. Inaction on the basis that we do not have enough information to determine the best use of the wood waste material is therefore not an option.

Applications for Australia

Australia is uniquely placed to leapfrog to the front of the world's best practice through technology and methodology transfer. The agenda for Australia to follow comprises overcoming materials handling and logistic issues, increasing wood waste product options available on the market, taking advantage of emerging technologies and developing a strong industry that adds value to the entire wood products industry.

The future for Australian wood waste management lies in developing value added products and realising that a "one size fits all" approach to wood waste management will not work; hence the opportunity to apply homegrown research and development. Overall wood waste presents a significant business opportunity for early entrants into the market.

2. BACKGROUND

2.1. Waste Management in the Wood Products Industry

Waste management has always been an integral, even if unrecognised, part of the wood product industry. There is a finite "consumer space" for wood products to be "sold into". Wood waste management is needed to "remove" from the economy products that are no longer needed and/or wanted. This in effect creates the consumer space that new wood products can fill.

With landfill space decreasing and cost of disposal increasing the reliance on landfill as the primary mechanism for waste management is not sustainable. Historically, wood waste has been disposed at landfill. However current political, social and environmental goals are acting to remove that option for the management of wood waste.

This creates the need for alternate technologies and practices for wood waste management in order to maintain the retail space required by the wood products industry. The whole of life cycle for wood products needs to be managed – whether value is recovered by re-use, recycling or energy generation.

2.2. Wood Waste in Australia

Australia has only recently begun to address the issue of wood waste disposed to landfill. EcoRecycle Victoria and Resource NSW are supporting investigative research and development work to form a secondary resource industry in wood waste. What has already been identified is the lack of options for the beneficial utilisation of the waste from engineered timber products (e.g. particleboard and medium density fibreboard) and from treated timber (predominately Copper Chrome Arsenate (CCA)).

Other forest products organisations are also becoming involved in research around wood waste management. For example, NSW State Forests and their life cycle research project on the service life and decomposition rates of wood waste in landfill. This work is being undertaken as part of the Cooperative Research Centre for Carbon Accounting. The Forest and Forest Products section of the Commonwealth Scientific and Investigative Research Organisation (CSIRO) has also started to become more involved with the issues of wood waste as is evidenced by the preliminary work undertaken to form a Cooperative Research Centre (CRC) for wood waste management and also by the "Waste Wood Workshop" that was held in 2000 as part of the 26th Forest Products Research Conference in Melbourne.

In spite of these initiatives however, it is clear that the Australian wood waste industry is in its infancy.

2.3. Purpose of the Gottstein Fellowship

The purpose of the fellowship was to support a technology review study tour of wood waste processing and recycling centres in and around Germany, the Netherlands and the United Kingdom (see Section 12 for a detailed itinerary).

Australia is very much behind when compared to Europe, both in information and technology resources. Information on the technology options and different strategy and policy approaches to wood waste utilisation is not available in Australia in a form that can be easily disseminated to wood waste related stakeholders. With the emerging focus on wood waste management as an issue, this information is vital to a successful wood waste industry.

Not only would this information be of benefit to the forest products industry at large, it would also provide the impetus for environmental beneficiation while reducing unnecessary cost.

The primary advantage of such a research tour is the first hand experience of learning directly from the researcher as well as having the opportunity to see the theory put into practice in a commercial setting.

This report presents the information gathered as part of the study tour.

3. WOOD WASTE MATERIALS HANDLING

3.1. The Challenge of Handling Wood Waste

A number of challenges are presented when handling wood waste, such as volume, geometry and processing hazards.

Wood waste is a light-weight material. For instance the bulk density of solid pine is approximately 450 kg per cubic metre. Unprocessed wood waste comprises mainly air, making it a very light-weight and bulky material. Even when processed, a range of bulk densities between 200 kg and 300 kg per cubic metre of processed wood waste material are reported. This creates inefficiencies in transport as legal load weight limits are not achieved even when cubic metre carrying capacity is exceeded.

Another related challenge is the geometry of wood waste. Unprocessed off-cuts come in all shapes and sizes as do end-of-life items. For example, cable ends are circular and often have heavy nuts and bolts still attached. Window frames come in all shapes and sizes, are often painted and may still have glass attached to the frame. This makes it difficult to achieve high rates of wood waste throughput when processing.

There is also a tendency for wood chips to bridge. For example, processed wood chip has a tendency to “stick” together as is evidenced by the near vertical wall of this wood chip pile (Figure 1). As a result of the low bulk density, geometry and tendency to bridge, wood waste does not flow and is hard to convey.

Figure 1: Wood chip pile at Van Werven Recycling, Biddinghuizen the Netherlands.

Further materials handling challenges arise from non-wood contamination. This includes materials such as metals, glass, plastic and paper. Contamination in wood waste varies between 3% and 5%. Lower rates of contamination are produced from customers who have been educated regarding recycling. By the same token, higher rates of contamination can occur, usually with "one-off" customers.

There are also several occupational health and safety problems inherent in wood waste materials handling. The processing of wood waste is a very dusty activity (Figure 2). The sander dust from panel products like medium density fibreboard is very fine. There are processing dangers that relate to large heavy duty grinding machinery. This is especially the case with tub grinders.

There are also the normal hazards associated with any heavy manufacturing industry combined with the additional hazards related to waste, such as increased potential for infection from tetanus and hepatitis. Furthermore, there is an added risk of fire resulting from large stockpiles of wood waste.

Figure 2: The dust hazards when processing indoors at V&V Recycling, Vianen the Netherlands. Here a slow-speed shredder and a high-speed hammermill are used in tandem to process wood waste.

3.2. Avoiding Cost of Landfill Disposal

In spite of these disadvantages, however, there are many positive aspects to using the wood waste material as a resource. When disposed of to landfill wood waste takes up more space per tonne than other "denser" materials. This results in a poor per cubic metre "return" on landfill space and decreases the potential life of the landfill. There are also concerns with methane and leachate generation from the decomposition of the wood waste. For these reasons many landfill operators do not want wood waste as part of their incoming waste stream.

From the wood waste generator's perspective the major advantage comes from avoiding the cost of landfill.

For example there are approximately 12 million tonnes of wood waste disposed of to landfill in the United Kingdom (Riddough and Abbott 2000). Each tonne of this waste attracts a landfill levy of £12 ($36 AUD) per tonne. (This levy is set to increase at the rate of one pound each year to £15 ($45 AUD) per tonne by 2004 with further increase likely). The cost of landfilling the wood waste material is in addition to the landfill tax. These costs vary according to the value of the land and the length of time until closure of the landfill. They average around £21 - £22 ($63 - $66 AUD) per tonne.

Wile in Germany there are approximately 15 million cubic metres of wood waste generated each year in Germany. Of that amount, approximately four million cubic metres of particleboard and medium density fibreboard are disposed of to landfill (Erbreich 2000). The cost of disposal to landfill is approximately 150 DM ($135 AUD) per tonne.

Even more expensive are the costs of landfill disposal in the Netherlands. There are approximately 800,000 tonnes of wood waste generated each year in the Netherlands. The average cost of landfill is 240 guilders ($185 AUD) per tonne. This includes a landfill tax of 140 guilders ($108 AUD) per tonne. The landfill tax is set to increase at regular yearly increases to a level of 350 guilders ($270 AUD) per year in 2006.

The high costs of landfill disposal in combination with several initiatives looking at banning the disposal of organic material to landfill are large drivers for the recovery of wood waste materials.

3.3. Categorisation of Wood Waste

Wood waste is not simply clean pieces of untreated pine offcuts. A system of classification is required to differentiate between different grades of wood waste material. In Europe there is a classification system that relates to the type of wood product from which the waste originated and what (if any) treatment had been applied to the original wood product. This approach results in a three-tiered A-B-C (or variations thereof) categorisation of wood waste.

A-wood waste is derived from untreated solid wood materials.

B-wood waste is derived from engineered panel products such as particleboard, medium density fibreboard, and plywood.

C-wood waste is derived from preservative treated timber products.

The grade of input wood waste used in recycling directly impacts on the potential end product that can be manufactured and also the gate fee associated with separated loads of wood waste for recycling.

3.4. Cost of Wood Waste Recycling

Recycling alternatives for wood waste materials still have gate fee costs for the generator of wood waste, but are cheaper than disposal to landfill. This improves the economics of recycling opportunities. For instance in the UK loads of A-wood waste a fee of between £5 and £10 ($15 - $30 AUD) per tonne is paid to the recycler at some facilities (Figure 3). This is comparable to prices in Germany where A-wood costs can be as low as 20 DM ($18 AUD) and the Netherlands with gate fees of 40 guilders ($31 AUD) for A-wood.

B-wood waste attracted higher gate fees, ranging from 80 guilders ($62 AUD) per tonne in the Netherlands up to 125 DM ($115 AUD) per tonne in Germany.

C-wood waste was always disposed of to landfill.

Figure 3: Hadfield Wood Recyclers near Manchester UK offer a cheaper waste management solution for generators of wood waste than sending the material to landfill.

3.5. Size Reduction

There are three main size reduction stages; primary, secondary and tertiary size reduction. Primary size reduction is normally undertaken with slow-speed (can be as low as 40 rpm) high torque shredding equipment. These units can be either stationary or mobile.

Figure 4: Slow-speed shredder at Rethmann Lippewerk, Germany.

The main focus is for size reduction to be able to better handle the material in subsequent processing and separation stages.

At Rethmann Lippewerk, Germany, a slow-speed Hammel shredder is used in the primary shredding stage (Figure 4). It has a throughput of approximately 40 tonnes per hour. The slow-speed operation of these shredders usually results in less damage from large metal contamination.

Secondary size reduction is undertaken with a hammer mill that operates at high-speed, normally in excess of 1000 rpm.

Sometimes a high-speed hammermill is used for a one-step processing solution. EBK in Berlin, Germany use a high-speed Doppstadt hammermill to produce a minus 45 mm and a minus 150 mm product size (Figure 5). The size of the end product is varied by changing the screen sizes on the hammermill.

Figure 5: Doppstadt mobile high-speed hammer mill used here by Rethmann Berlin.

There are often slow-speed/high-speed combinations of mobile units that are used in tandem like V&V Recycling near Vianen in the Netherlands.

Tertiary size reduction is a product-specific processing stage. For instance in particleboard manufacture flaking rings are used to process larger sized wood chips into a flake of desired thickness and length, suitable for particleboard manufacture.

3.6. Separation of Contamination

There are a variety of approaches related to the separation of contamination ranging from mechanical assisted (excavator with grab) to hand sorting in sorting cabins.

Magnets are used to separate out ferrous metal contamination from wood waste. Metal contamination contributes to excessive general wear on processing machinery. Large metal pieces, like railway ties, have the potential to damage components within size reduction equipment.

Metal separation can be achieved with an overhead belt magnet or a magnetised drum in the out feed of a wood waste grinder (Figure 6). However, if the magnet is too strong it will pull out pieces of wood that have fastenings still attached.

A two staged magnetic separation process can be used to overcome this. The first magnet is used to remove large pieces of tramp iron after primary size reduction. A second magnet can be used at a higher power setting to remove smaller pieces of metal after secondary size reduction produces a smaller chip with few fastenings like nails or screws still attached to the wood.

Figure 6: Metal separated at Hadfield Wood Recyclers, Manchester UK. The large piece of steel caused the plant to shut down.

Eddy current separation is used to remove of non-ferrous metal. In this process powerful magnets are spun at revolutions greater than 3000 rpm to produce an “eddy current”. The eddy current reacts with non-ferrous metals creating a repelling force on the non-ferrous metal. Some grades of stainless steel can also be separated with this machine.

Wind sifting is used to remove the lighter contamination such as paper and plastic. During wind sifting a steady pressure of air lifts the light- weight contamination, leaving heavier wood particles behind (Figure 7).

Figure 7: Example of the lightweight plastic, paper and foils that a wind sifting unit it removes at Hadfield Recyclers, Manchester UK.

3.7. Screening Different Product Sizes

Different end uses for wood waste require different sized particles. For example a grate-fired boiler may require a 20 mm chip, with low tolerances for oversized particles (overs) and also for under sized particles (fines). There are a variety of machines to screen wood waste particles into homogenous sized factions. These include fractionators, disk screens and vibrating screens.

A fractionator is able to screen multiple product sizes, depending on the number of internal screens that are fitted. Overs are usually returned for reprocessing. Fines from a primary and/or secondary grind, especially those below 5 mm, are often used as a low-grade product owing to a higher concentration of contamination within this faction.

3.8. Receival, Conveying, Loading and Storage

Special consideration must be given to the receival of processed and unprocessed wood waste. Unprocessed wood waste is invariably delivered in self tipping trailers and unloaded onto hard stand and/or compacted dirt floor. Hard stand can be either concrete, pavers or bitumen. Bitumen, however, does have a tendency to break up under continuous use from heavy machinery. This can add contamination to wood waste processing.

Self-tipping trailers are also used to unload processed wood waste. Whole of truck lift mechanisms are also becoming quite common. They have the advantage of not requiring a self-tipping mechanism or walking floor for wood waste chip discharge from truck trailers or rail. This increases the carrying capacity of the truck or carriage. A whole of carriage rail unloader is used by SAPPI, a paper maker near Graz, Austria (Figure 8).

Figure 8: Unloading mechanism at SAPPI near Graz, Austria.

Bunkers are used to accept processed wood waste and act as temporary storage (Figure 9).

Figure 9: Processed wood waste receival at Pfleiderer, Güttersloh, Germany.

In other situations the wood waste is unloaded onto walking floors (Figure 10). A walking floor is often covered by a storage shed in which case it acts to receive, store and convey the wood chips.

Figure 10: Walking floor storage and conveyance, Bad Arolsen near Kassel, Germany.

Other methods for conveying processed wood waste material include screw feeds, conveyor belts and pneumatic systems. There are limitations to each method of conveyance. For instance, pneumatic systems are unable to move large chips, screw feeds are also limited by the size of the screw as to the range of material transportable and conveyor belts have problems with high dust products.

Storage of processed material can be undertaken on covered or uncovered hard stand (Figure 11).

Figure 11: Approximately 2,500 cubic metres of storage undercover at Rethmann Lipperwerk, Germany.

Other methods such as bunker and silos can also be used in more automated handling systems.

The loading of wood waste product for transport can be accomplished simply by means of a front-end loader or excavator with modified bucket. More automated systems use conveyors or overhead loading bins.

3.9. Transportation to Market

The transport used for wood waste products in Europe comprise road, rail and barge systems.

Road haulage is dominated by semi-trailers. In some instances long distances are travelled, for example from the Netherlands to Germany.

At Houtbank in the Netherlands, rail is used to transport in excess of 250,000 tonnes of unprocessed wood waste each year to Italy (Figure 12). Each train contains 34 wagons with a carrying capacity of 3,400 cubic metres. Loading takes between six and eight hours.

Figure 12: At Houtbank Roosedhaal, the Netherlands, rail is used to transport high volumes of unprocessed wood waste to Italy.

Afvalzorg, also in the Netherlands uses barges to transport wood derived fuel to Sweden (Figure 13). One barge can hold 1,200 cubic metres of product and takes approximately six hours to load.

Whatever transport system is utilised the primary issue to contend with is the reduced transport efficiencies through the low bulk density of the wood waste material

Figure 13: The loading dock for barges that transport to Sweden, at Afvalzorg in Halfweg, the Netherlands,

3.10. Product Testing

One of the key aspects to changing a “waste” into a “resource” is in making the differentiation between waste management and product manufacture. With a product manufacturing approach, the key issue is the quality of the product.

This approach is achieved with wood waste through quality assurance management and processing systems and also through product testing.

Van Werven in Biddinghuizen, the Netherlands, perform tests on wood derived fuel products they manufacture for percentage water, percentage fines and percentage oversized pieces. The number of samples taken relates to the homogeneity of the infeed source material.

In undertaking this regime of product testing, Van Werven is able to assure the quality of their product and generate an auditable inventory of product sales and quality levels.

4. MANUFACTURE OF PARTICLEBOARD FROM WOOD WASTE

4.1. Using Wood Waste to Manufacture Particleboard

The manufacture of particleboard is a large industry in Europe. For instance, Pfleiderer Industrie, a particleboard manufacturer located in Güttersloh, Germany, has two operations that produce approximately 3,500 cubic metres of particleboard each day (Figure 14). This is almost equivalent to the total production capacity in Australia of 978,000 cubic metres (ABARE 2000 in NAFI 2001).

The worldwide production of particleboard is static. Being such a mature industry there are strong drivers to reduce the costs associated with particleboard production. One of the major cost centres in particleboard manufacture is the cost of the raw materials, that is, the wood chip. The cost for virgin wood chip in Germany is approximately 100 DM per green tonne ($91 AUD), while in England the cost is approximately £40 per green tonne ($120 AUD).

Figure 14: Pfleiderer Industire Güttersloh Germany.

This presents a large incentive to particleboard manufacturers to utilise recycled wood chip as a feed stock material. As the wood waste would otherwise be going landfill, the recovery of a resource is a strong value added proposition. Also it is more efficient to transport recycled wood chip as opposed to virgin chip. This is because of the high moisture content in the virgin chip that can be up to 50% by total weight. This results in moisture primarily being transported.

The moisture content in virgin chip adds a significant energy cost as the chip needs to be dried before being used. The use of a recycled chip with low moisture content thus also reduces the overall drying costs.

There are also strong drivers for the generator of wood waste to recycle the material as well. For instance, in England it can cost between £5 and £10 per tonne to recycle loads of A-wood waste ($15 - $30 AUD) compared to £30 per tonne ($90 AUD) to landfill the material.

In addition to the economic drivers, there are also other drivers related to the sustainability of corporations that motivate the utilisation of wood waste. Many companies see that they have an environmental responsibility to contribute to activities that are ecologically sustainable. This is enforced by legislated extended producer responsibility, where the manufacturer of a product is responsible for the end-of-life management of the product, and landfill is not a management option.

For instance in the United Kingdom a Packaging Recovery Notes system was recently introduced under the EC Packaging and Packaging Waste Directive (94/62/EC). Under this scheme all participants in the life cycle of wooden packaging materials are required to collectively act to recover 56% of the packaging waste material.

By using wood waste used to manufacture particleboard it is possible not only to overcome the high cost of virgin wood chip material, but also to decrease wood waste going to landfill and produce a value added product.

4.2. Wood Waste Feedstock

A-wood waste is primarily utilised to manufacture particleboard. This is owing to the fact that an A-wood chip is closest to the virgin wood chip (i.e. desired fibre thickness and length for particleboard manufacture). B-wood waste material, derived from processed panel products, tends to create a shorter fibre chip and results in increased amounts of sawdust or fines compared with A-wood waste (Figure 15). Increased sawdust corresponds to increased resin usage and hence increased cost in particleboard manufacture.

Figure 15: Difference between processed A-wood (left hand side) and B-wood (right hand side) waste from EBK Recycling, Berlin Germany.

Waste from treated timber products or C-wood waste is not used. This is because of difficulties with resin bonding with treated fibre. There is also the potential for chemical mobilisation during processing, especially during the chip drying and the hot pressing stages of particleboard manufacture. Furthermore there are restrictions on the use of treated timber products for internal applications where particleboard materials are most likely to be used. Additionally, there would be the issue of identification of particleboard made from treated timber and of managing this product at the end of its lifecycle.

To ensure that this material is not included in the feedstock, some particleboard manufacturers request a signed affidavit that the load of wood waste contains no treated timber. Loads are tracked so that if any problems arise, the source of problematic loads can be backtracked. However this remains a difficult problem to test for and enforce.

4.3. Process Requirements

There are three levels of size reduction required to produce a usable recycled wood chip. Primary size reduction reduces unprocessed materials to a minus 150 mm chip (usually slow speed shredding) and secondary size reduction produces a minus 40 mm chip (usually high speed hammer milling). It is this sized material that is then put through the tertiary processing stage of flaking to produce a wood chip ready for use in particleboard. Here the use of recycled wood fibre involves an extra expense in that flaking knives have to be re-sharpened more often than with virgin wood chip.

Figure 16: Contamination still requiring further separation at Pfleiderer Güttersloh, Germany

Great care and attention must be paid to the removal of contamination especially metals (ferrous and non-ferrous), sand, grit and, to a lesser extent, plastics and paper.

The removal of contamination is a difficult process requiring many cleaning and screening stages. Even after intensive screening and cleaning, some contamination can still remain requiring further separation (Figure 17).

Figure 17: Contamination remaining even after intensive cleaning and screening Pfleiderer Güttersloh, Germany.

Wood waste materials may be received unprocessed, processed or as shavings or sawdust, depending on the processing capabilities of the particleboard manufacturer.

4.4. Different Approaches to Manufacture of Particleboard from Wood Waste

Sonae in Merseyside, UK, is reliant on wood waste as the principal feedstock material for manufacture. The plant was designed to run on 100% recycled wood fibre. It was built at a cost of £110 million ($330 million AUD) and has to compete to find sources of wood fibre.

Initially, Sonae were accepting unprocessed wood waste to process themselves (Figure 18). There were issues with stockpiling sizes and also restrictions on processing times due to their proximity to a residential belt. Now they are accepting only pre-processed recycled wood chips. The initial quality of the material is not an issue as they clean, screen and tertiary process themselves. Owing to the economics of regaining their capital investment in processing machinery, there is a preference for paying less for a low quality chip, as opposed to purchasing a recycled chip ready for use.

Another factor necessitating the owning and operation of cleaning, screening and separation equipment is the unreliability inherent in a wide range of suppliers. There is a requirement to accept the lowest common denominator of wood chip available. This is a rough processed chip with little or no contamination removal. Otherwise all suppliers would be required to have high grade processing machinery set up and this would severely limit the supply base.

Figure 18: Stockpiled materials at Sonae (Merseyside UK) awaiting processing.

The newer of Pleiderer's two plants in Güttersloh, Germany uses wood waste as a supplement to feedstock (Figure 19). It is set up to receive all forms of wood waste, that is unprocessed materials, wood chips and sawdust and shavings. Gisiger equipment is used to handle the size reduction, cleaning and screening.

Figure 19: Pfleiderer Güttersloh, Germany receiving bay for wood waste chips.

Houtbank at Roosendaal, the Netherlands, sends mixed A-wood and B-wood waste to SIA, a particleboard manufacturer in Italy. SIA has developed its own proprietary process for separating out usable A-wood from mixed wood waste and undertaking the necessary size reduction, cleaning and screening to produce a recycled wood chip.

4.5. Issues in the Manufacture of Particleboard from Wood Waste

It is essential that the recycled wood chip be free from contamination. This is both from a product liability and from a process control perspective. Contamination in the end product may detrimentally affect the product's performance and may introduce a safety hazard for workers manufacturing the product. Contamination in the process has the potential to damage equipment and result in increased rates of wear. Further potential for pollution is also created.

There is a large amount of energy required to process, clean and screen the wood waste material in order to reduce the impact of contamination. The process of recycling causes environmental impact. This has to be taken into account when comparing the benefits of recycling as opposed to utilisation of plantation chip. There are also increased costs with resin usage as the recycled chip tends to have higher amounts of dust and fine particles than the competing plantation chip.

Against this must be measured the positive nature of completing a higher value "re-use" of the wood waste. It is generally accepted by the community that reusing wood fibre to make particleboard is a good thing. Most waste management hierarchies rank direct recycling, that is recycling a wood product into another wood product, at the top of the tree just under avoid waste generation and re-use.

Furthermore if a usable recycled wood chip could be reclaimed from waste particleboard (B-wood), then the materials loop would be completed. Wood chip could be perpetually recycled, albeit with some system losses that could be used for other purposes. Here the versatility of panel products is an added advantage in that the recycled product has a multitude of applications (see section 7 for further discussion).

5. THERMAL UTILISATION - HEAT

5.1. Age-Old Use for Wood

Human beings have a long history of reliance on wood as a fuel product for heating. From a simplistic perspective this is because the combustion of wood produces heat as a by-product. It is only recently that modern civilisation has changed to coal, gas, oil and electricity as "fuel" products to procure heating services. There is, however, a trend swinging back to wood.

There are a wide range of different technologies for combustion and varying applications where the heat is utilised. These range from the simple fireplace technology, used to heat individual domestic residences, to fully automated pellet fired boilers, again used for individual domestic heating and also for multi-unit-dwellings. At the bigger end of the spectrum there are large-scale boilers that burn wood chips for district heating. The heat is usually transported via a medium such as water. Large-scale boilers are also used to provide process heat in industrial applications such as particleboard manufacture. Wood waste is also used as an alternate fuel to supplement heating requirements, such as in cement making kilns.

5.2. Technology for the Combustion of Wood Waste

The most common type of combustion unit in use for industrial heating purposes is a grate-fired boiler. The grate is the burning platform for the wood waste material. The system can be low-tech, with fuel being hand loaded into the boiler, or high-tech like the automated Talbott's boiler used at the Elvendon Priory, Oxfordshire UK (Figure 20).

Wood waste is unloaded into a hopper and is automatically fed by a screw auger to the boiler. The wood waste is preheated prior to entry into the combustion chamber, improving the efficiency of the process.

A Programmable Computer Controller allows the manufacturer to measure and troubleshoot remotely via modem. This sized unit has a heating output of 300 kW.

There are other configurations of grate fired boilers including reciprocating grate, stepped grate and rotary grate systems. For more information on other grated fired technologies please refer to the case study sections in Part B of this report.

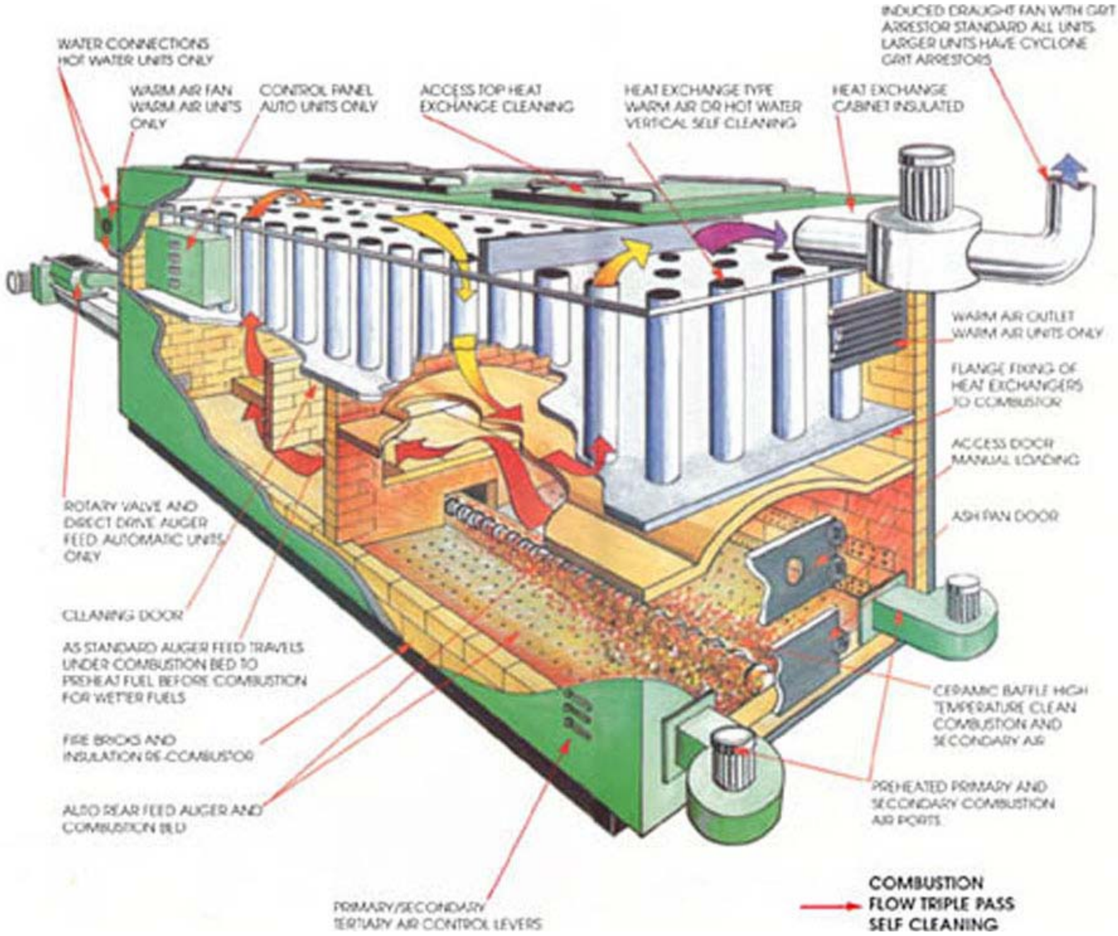

Figure 20 Cross section of Talbott's C1 – C7 range of combustion units. The Elvendon Priory used a 300 kW C4 unit (source: Talbotts).

Fluidised Bed Combustion (FBC) is another form of combustion technology that relies on a circulating medium, usually quartz (sand) to provide a bubbling bed that provides many burning advantages. One such advantage is the ability to combust low calorific fuels. An example of this technology is used by Sappi near Graz, Austria, use to provide process heat to their paper making activities.

Sappi utilise a mixture of bark and paper slurry, both of which have a low calorific value of between 6 – 7 MJ/kg (depending on moisture content). The circulating medium needs to be pre-heated by two natural gas burners to a temperature of 450 degrees Celsius before either of the fuel materials can be burnt. The FBC requires 60 tonnes of quartz that is replaced every three months. The Sappi unit has a heating output rated at 23 MW.

Small-scale speciality micro-combustors use a standard grate firing combination, but are designed to replace an oil fired or gas fired domestic heating system. In this case the fuel is a pelletised wood waste (A-wood and also forestry residues). Pellets are able to be handled in a similar manner to liquids, hence the operation is completely automated and a pellet tanker is used to pump the fuel material into a storage tank, again of a similar size to a domestic oil reservoir.

5.3. Wood Waste Feedstock

In all countries visited, A-wood was acceptable as a fuel source (Figure 21). Some countries make the distinction between forest residues and A-wood waste. The different sources impact the calorific value of the material, which is directly related to moisture content. Some boilers have a pre-heating process stage that enables them to utilise wood residues with high moisture contents of up to 60%.

Many countries like Germany allow the utilisation of B-wood waste as a fuel product, while others like the Netherlands do not allow it. This has led to the interesting situation in the Netherlands where virtually all B-wood waste is exported to other countries like Germany and Sweden to be used as a fuel source.

C-wood waste (treated) is not allowed to be combusted in any of the countries visited. This is mainly owing to the deleterious effect that the treatment chemicals have on the quality of air emissions.

Figure 21: This swimming pool and district heating plant near Kassel, Germany, accepts only untreated wood waste from nearby factories.

5.4. Process Heat

Particleboard manufacture requires heat to dry the moisture content of the wood fibre to as near as bone dry as possible, prior to pressing. During the pressing stage heat is also required to activate the thermoset resins.

Sonae (Merseyside UK) requires 40,000 tonnes of boiler fuel for their process heat requirements. They accept all types of wood waste, except treated timber. They also accept garden trimmings from local Council activities. The variability in moisture content means they have to ensure a mix of material for the smooth operation of the boiler.

Sonae receive boiler fuel either at no cost or are paid up to £10 ($30 AUD) per tonne. Pfeliderer (Güttersloh, Germany) also utilise wood waste as a fuel to supply their heat requirements. They get paid approximately 25 DM ($23 AUD) for B-wood that they utilise as fuel for process heat.

Figure 22: B-wood fuel stockpile for process heat at Sonea, Merseyside UK.

The process of cement manufacture requires heat for the calcination of carbonates, key oxide ingredients in cement powder. Cement kilns are also an ideal burning environment, with high temperatures, extended residence times in burning zones and no ash creation (all of the ash ends up in the clinker which is ground up to make cement). They are such an ideal burning environment that in some countries they are used to destroy hazardous waste materials.

Wood waste operations like Afavalzorg (Amsterdam, the Netherlands), send the fine fraction (minus 5 mm) to cement kilns. They pay 10 guilders ($7.50 AUD) per tonne to the cement kiln plus the cost of transport. In this case the transport component is the most significant cost.

Rethmann Lippewerk (Germany) also pays a cement kiln to take their B-wood waste derived fuel. This is in spite of the fact that coal prices are relatively high at between 80 – 120 DM ($73 - $109) per tonne.

5.5. District Heating

District heating ranges in size from individual stand alone dwellings to larger scale multi-unit-dwelling and then even larger to entire villages or townships. At the smaller scale there have been developments in manufacturing compressed briquettes that have been extruded and partially pyrolysed to remove volatiles. These higher density logs are able to burn longer and produce fewer emissions than straight fuel logs. Wood pellets about the size of the end of a little finger are transported similarly to oil tankers, stored in domestic tanks and fed into the micro-boiler with an automated system requiring no manual involvement.

Figure 23: Elvendon Priory Country Estate, Oxfordshire, UK.

There are medium sized operations for apartment blocks and large estates. For example, Elvendon Priory Country Estate (Figure 23) is a residential, farming and sporting estate that lies within the rural location of Oxfordshire, UK. A wood waste heating system manufactured by Talbotts was installed that utilised forest residues and sawmill waste. Approximately 700 cubic metres of wood waste are used to provide yearlong heating to the estate.

The boiler provides a continuous supply of low-pressure flow hot water at between 80-85 degrees Celsius and 1.5 bar. Heat loss is restricted to 1% through the heating system.

A similar sized boiler is used by Weitzer Parkett, a parquetry floor manufacturer located near Graz, Austria. Approximately 18,000 cubic metres of waste sawdust and 10,000 cubic metres of waste shavings are used to fuel three grate-fired boilers that provide heat to the factory buildings during the autumn, winter and spring months. Some of the heat is also used to assist the timber drying process.

An example of a district heating scheme is the Bad Arolsen biomass project, located approximately 10 kilometres to the west of Kassel, Germany.

This heating system warms a public swimming pool and has the capacity to provide 100 local apartments with heating services.

There are two grate fired biomass boilers that consume between 3,000 and 4,000 tonnes of wood waste each year. The first, a 1.1 MW thermal unit, uses up to 0.4 tonnes of wood waste an hour. The second, a 400 kW unit, uses up to 0.15 tonnes of wood waste an hour. Water is heated up to 90 °C via a heat exchanger. Heating is provided to local residents by means of specialised 25kWh residential heating units (Figure 24). These units were designed to take up minimal space in an apartment.

Figure 24: Individual domestic heating unit for the district heating scheme near Kassel, Germany.

5.6. Issues for the Combustion of Wood Waste

Contamination is a major issue for the combustion of wood waste. For instance, metal and grit cause slagging in the boiler and reduce efficiency of burning. This in turns results in increased ash from the burning process. Chlorine reduces the pressure that heat exchangers can operate at, again reducing the efficiency of operation.

Contamination also causes deleterious impacts on environment. Dioxin formation in emissions to air is of great community concern. Air pollution issues are such that the cost of gas clean up is estimated as two-thirds that of the entire capital expenditure.

There are requirements to have the emissions tested on every boiler facility, regardless of the fuel. The results from using wood waste are often good. Tests undertaken at Bad Arolsen (Kassel, Germany) show a reduction by over 50% of SO_2, slightly lower NO_x and almost net neutral CO_2 emission when compared to the emissions from a hot oil boiler. A hot oil boiler, however, does emit lower fine particulate matter.

Contamination can also create problems with ash management. Approximately 30 tonnes of ash are produced each year from Bad Arolsen. This compares with approximately 2.5 tonnes of ash from the Elvendon Priory and approximately 10,000 tonnes of ash per year from the fluidised bed combustor at Sappi (near Graz, Austria). If there is heavy metal contamination in the ash it will most likely need to be disposed of to landfill. Without contamination the ash can be utilised as a compost additive or as a feedstock into cement manufacture.

Community acceptance is also a critical issue for any energy from waste facility. Acceptance levels for energy recovery from wood waste materials are for the main part high in countries visited. For instance at Bad Arolsen (Kassel, Germany) there is an overall positive community acceptance of the heating plan, especially as it displaces the need for 230 kilolitres of heating oil and also reduces CO_2 emissions by 1,100 tonnes per year. Whereas unsightly steam plumes cause much community concern and are a visual focal point for opposition.

There are also issues with the concept of incineration as opposed to energy from waste. Community attitudes are also not consistent. Some communities oppose what others accept, even when the communities may only be twenty kilometres apart and are dealing with similar technologies. For instance, there are two energy from waste (EfW) plants in London – Edmonton and Lewisham. Edmonton has been the subject of much protest and controversy. Lewisham, while being smaller and newer, has virtually the same emissions profile and has received little or no protest.

Underlying the utilisation of wood waste for heating purposes is the assumption that there is a need for heating. The colder climates in Europe have greater requirements for heating for a greater part of the year than does Australia. The increased scope for utilisation drives the efficacy of heating projects.

The economics of such heating installations rely on maximised periods of use. Not only this, but there is also a reliance on a negative cost component somewhere in the handling chain to cover the costs of materials handling (processing etc). The end user may also require a negative or neutral cost at the gate. This can drive down the quality of the material. As more plants start coming on line, greater levels of competition for resource will occur. This may result in paying per giga-joule of material, as opposed to being paid to accept materials.

The source of the wood waste material also raises issues of fuel composition from a contamination profile perspective against the issues of fuel cropping and impact on the environment. Moisture content results in decreasing value as a fuel product. This is a positive for wood waste as it has very low moisture levels.

The issue of guaranteed supply for project proponents also impacts the viability of using wood waste as a fuel product. No business is in business to generate waste, making it difficult to guarantee the availability of a wood waste fuel product.

6. THERMAL UTILISATION - ELECTRICITY

6.1. Potential for Electricity Generation

In the preceding chapter it was seen that wood waste has an energy content and that when combusted produces heat. It is this same property that creates the potential to utilise wood waste as a fuel for electricity generation.

The recovery of "electrical" resource value from wood waste is advantageous for many reasons. Electricity is more easily transportable than heat and there are a wider range of applications that electricity can be used in, as compared to heat. There is also an existing infrastructure to "plug into", without the need for extensive infrastructure development as is the case with large-scale district heating projects.

6.2. Technology Options for Electricity Generation

Electricity is generated by a number of ways. To generate electricity using a steam turbine, any of the technologies used to generate heat can be used. This process relies on the manufacture of steam through a heat exchanger that takes the heat from a combustion unit, (for example, a grate fired boiler or a fluidised bed combustor) and turns waste into steam. The steam travels under pressure through a turbine, causing it to turn an attached generator and thus generate electricity.

Gasification is a technology that was widespread in the middle of the twentieth century, particularly during the war years, when it was not uncommon to have wood powered trucks and cars. It involves the manufacture of a flammable gas, called syngas, from the wood waste. The syngas can then be used to power an internal combustion engine or a gas turbine (similar to a jet engine). The syngas is created by heating wood waste in the absence of oxygen. This causes combustible volatile gases (syngas) to be given off from the wood waste. The syngas is then combusted in either an engine or turbine after going through a cleaning process. Other by-products include char, ash and some liquids, all of which have the potential to be utilised beneficially. Although the technology is not new, the process of commercialising a stand-alone large-scale wood waste power station is still being proved.

The process of pyrolysis also involves the heating of wood in the absence of oxygen. This time the focus is on extracting a liquid faction that is released, along with char and gas. The liquid fuel can be used to power an engine or turbine attached to a generator. An example of this technology is under commercialisation by Dynamotive Europe Limited (See Case Study 19). Although at this stage the input materials are limited to forestry residues, the capacity to accept a wider range of materials is under development.

6.3. Efficiency of Electrical Conversion

Different technologies for electricity generation have different electrical efficiencies. This is a measure of how efficiently the conversion of the energy content (joules) in the wood waste fuel to electrical energy (watt hours) occurs. The higher the electrical efficiency the better, as this maximises the value of the input fuel material.

Typically a modern coal fired power station will have an electrical efficiency of approximately 35%. This compares to a large-scale (approximately 300,000 tonnes per annum) wood fired steam turbine system, which would have an electrical efficiency of approximately 25%.

The larger the capacity of the plant, the greater the efficiency of electrical conversion. Furthermore, large-scale installations are the most economic operating with larger economies of scale.

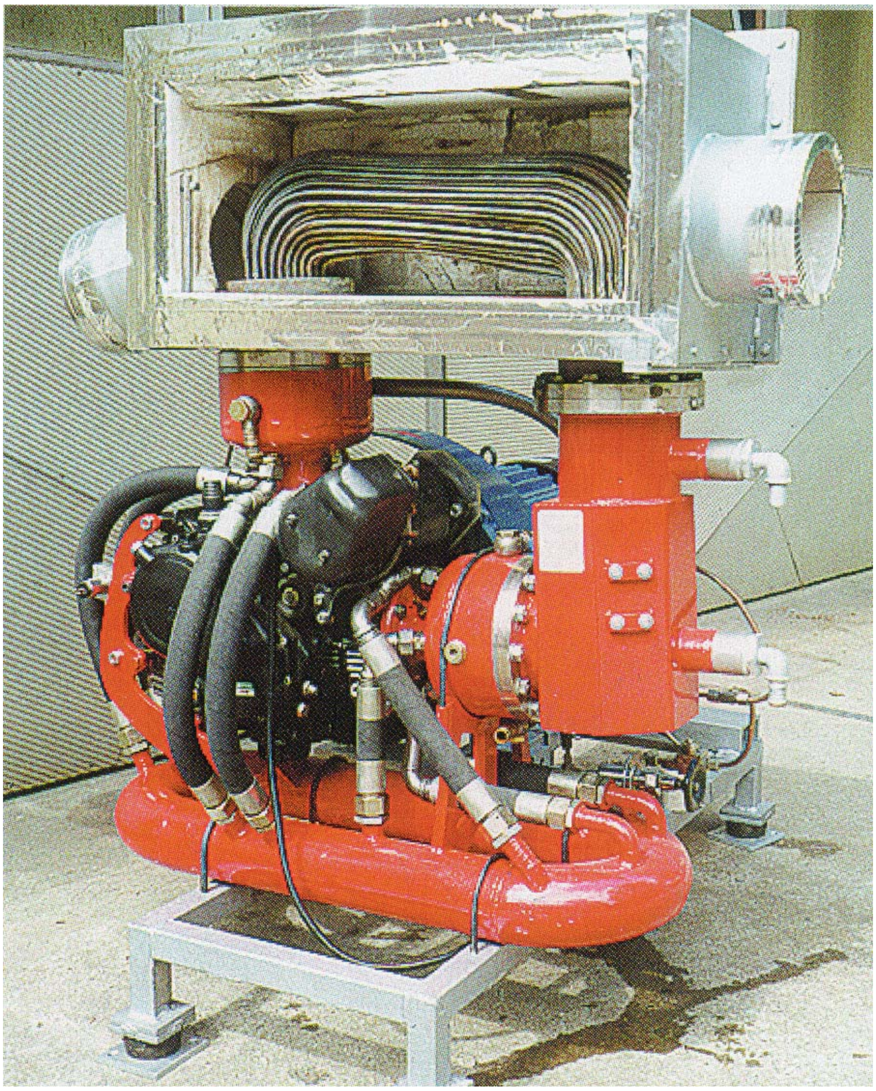

Figure 25: Micro scale electricity generation developed by Joanneum Research, Graz, Austria (source Joanneum Research).

Joanneum Research, a state owned research company in Graz, Austria, has undertaken the design, construction and operation of a Stirling engine to generate electricity from small-scale biomass facilities (Figure 26).

Flue gas at 1000 degrees Celsius was used to drive a 3kW alpha-type Stirling engine with a heat exchanger that required no flue gas cleaning. When the primary purpose of the biomass plant is the production of heat, the electricity generated is between 6% and 8% of the total fuel input.

However, there are also applications for small-scale electricity generation as the primary focus of a biomass facility, especially in rural locations that have no connection to an electricity grid. For these cases, Joanneum Research is developing a Stirling engine between 5kW and 100kW electric capacity. In such a configuration it is possible to achieve an electrical efficiency of 20%.

6.4. Community and NGO Support and Opposition

The generation of electricity from wood waste raises many of the same issues as does the generation of heat from wood waste. There are similar restrictions on the use of wood waste materials, with C-wood (treated timber) unable to be utilised. The issue of incineration is often raised as are the formation of dioxins and other forms of pollution and the potential loss of local amenity.

Also of issue is the potential subsidising of unsustainable energy use patterns with cheaper more available electricity and the subsidising of a “disposal” approach to waste rather than avoidance. There are also concerns that wood waste resources will be locked into a technology option that may not be sustainable in the long term. This derives from the size of capital expenditure for a wood waste power station and the length of supply commitment required to payback the original investment.

6.5. Future Issues for the Generation of Electricity from Wood Waste

The issue of increasing efficiency is not only related to maximising the calorific value of the input fuel material. Another critical issue that relates to the use of wood waste is the amount of chlorine present in the fuel source. Chlorine limits the steam conditions within which the boiler operates it corrodes tubes in heat exchangers. Because of this only low pressure steam can be tolerated or more expensive materials must be used in heat exchangers. Hence improving the sorting and separation of chlorinated plastics from wood waste materials is just as important as advancing combustion technologies.

It is anticipated by Alstom Power that in the next 6-10 years there will be Biomass Integrated Gasification Combined Cycle (B-IGCC) plants commercially available that will achieve electrical efficiency rates of between 45% and 50%.

In the UK, as in most European countries, there are obligations to generate a certain percentage of electricity from renewable sources. It is not clear whether wood waste derived fuel products fit into the category of “renewable”. A positive resolution of this issue will provide added market support to the use of wood waste as a fuel.

Other future potentials include decentralised power stations, obviating the need for large, infrastructure intensive, electrical grids. Decentralisation has the potential to improve environmental performance and provide a growth market for commercially available gasification and pyrolysis technologies.

7. RECLAMATION OF WOOD FIBRE FROM WASTE PANEL PRODUCTS

7.1. Increasing Options for the Utilisation of Waste Particleboard and Medium Density Fibreboard

There are large amounts of panel products such as particleboard and medium density fibreboard entering the economy. Reasons for this include the versatility of such products for use across differing industries and an increased reliance on fast growth plantation timber, unsuitable for saw logs, as the major feedstock for wood products.

The present issue with these types of panel products is their limited recycling potential. There are many challenges to overcome in order to reclaim a usable wood fibre or chip for use in the remanufacture of panel products. Size reduction (grinding) shortens the length of individual fibres and chips, often creating high levels of dust, which increases resin use. Additionally, laminate flecks can create aesthetic blemishes in “raw” board, limiting market potential. There is also the challenge of breaking down glue bonds between wood fibres and chips. Hence, at present in Europe, these materials are primarily used as a fuel source.

There are however, potential benefits from a recycling system that is able to reclaim usable wood fibre and chips from particleboard and medium density fibreboard. The primary benefit is in producing a wood fibre resource that is available for use in a wide range of applications, including the manufacture of new panel products.

7.2. Commercial Development from WKI

The Fraunhofer Gesellschaft is a German organisation of applied research, undertaking contract research for a varied client base and on a wide range of subject matter. The Wihelm-Klauditz-Institut Holzforschung is a member institute within the Fraunhofer group and has developed what is termed as a “chemo-thermo-mechanical” batch process to recycle waste particleboard and recover a clean wood chip that is suitable for substitution into the manufacture of new particleboard.

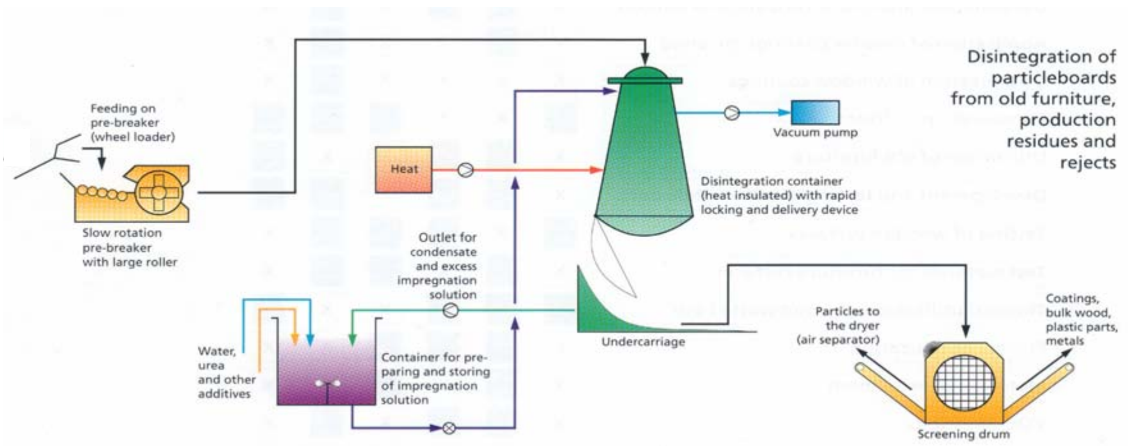

Figure 26: Process of recovering wood fibre from waste panel products (Source: WKI Holzforschung)

The process of recovering wood fibre from waste particleboard is illustrated in Figure 26. The particleboard is broken down into large pieces of approximately 200 mm through a slow-speed shredder. It is then conveyed into a pressure vessel where a solution of water with small amounts of urea and sulfuric acid are added under a slight vacuum, effectively impregnating the particleboard pieces with solution.

After removal of excess solution the mix is heated to 110°C for approximately 20 minutes. This breaks down the bonds of the resins, disintegrating the particleboard pieces into wood chips, pieces of laminate and metal contaminants like hinges, handles and screws. The batch is removed and conveyed to a screening drum where the laminates and contaminants are removed and the wood chips are taken for drying and utilisation.

The commercial scale units (Figure 27) have a holding capacity of 25 cubic metres, which is approximately 6.5 tonnes of broken down particleboard. The batch cycle varies between 90 and 120 minutes. Annual throughputs of up to 25,000 tonnes per annum are available per unit (with 24 hour operation – one person per shift).

The process recovers approximately 95% of wood fibre from the waste particleboard. It is also possible to utilise some of the wood fibre and the laminates for energy generation to provide part of the process heat required to recycle the particleboard material.

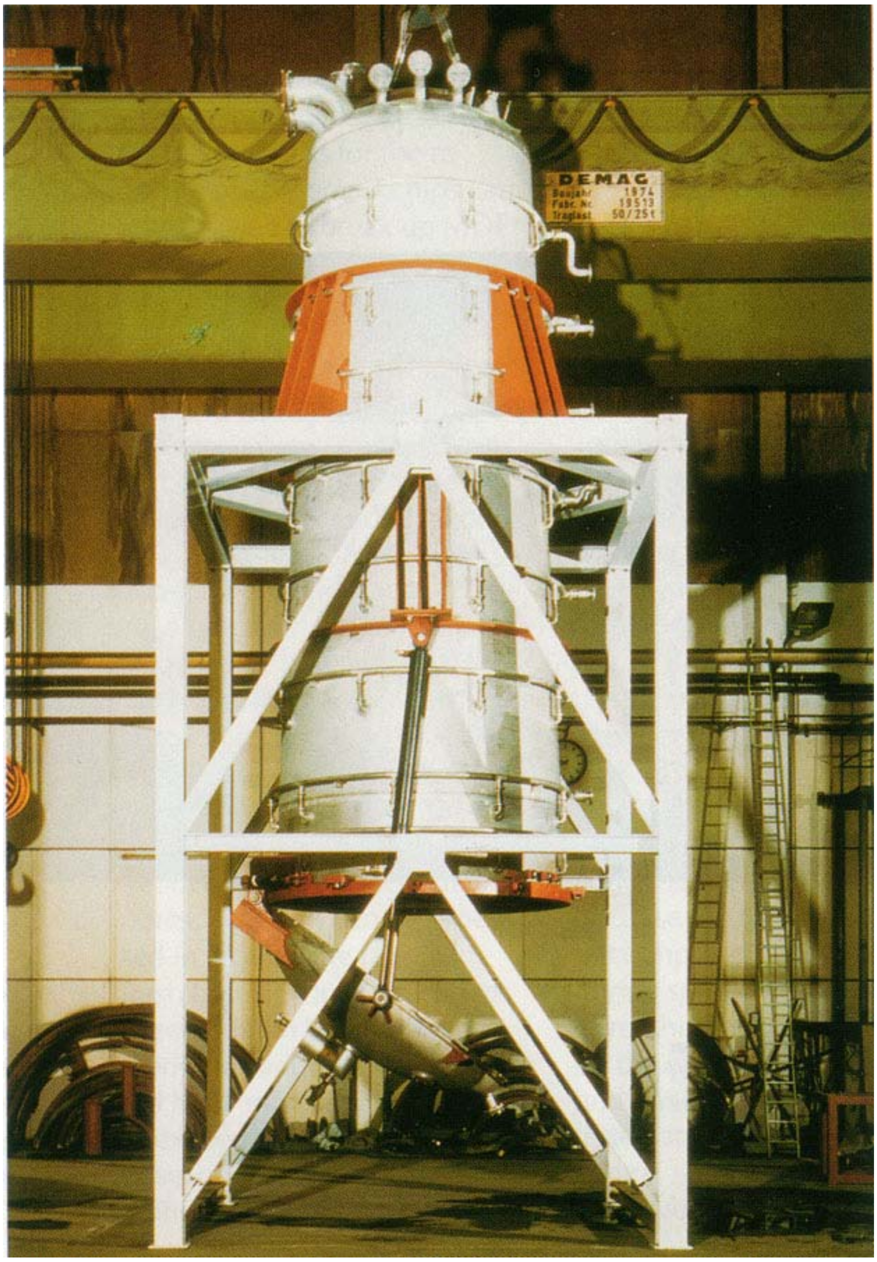

Figure 27: Commercial sized batch vessel as developed by the WKI Holzforschung (Source WKI Holzforschung).

7.3. Fibresolve – an Initiative from TRADA

TRADA Technology in the United Kingdom is also developing a process to recover fibre from waste panel products. The wood panel recycling initiative has two components, recycling and panel manufacture.

The recycling stage is to demonstrate the viability of wood fibre recovery using the "Fibresolve" process. This process has been developed to a laboratory stage. It is similar to that developed by the WKI Holzforschung in that it uses an in-vessel batch system and a combination of heat and mechanical break down. Unlike the former process, however, Fibresolve uses no chemical additives.

The project aims to construct a semi-commercial unit to ascertain the economic effectiveness of the process.

The second stage to the project is to take the recycled wood fibre and manufacture new panel products. These recycled boards will then be tested for strength and durability, in comparison to panel products made from virgin chip sources.

7.4. Potential for Fibre Reclamation

The ability to reclaim fibre and chip from waste particleboard and medium density fibreboard greatly increases the alternatives for resource recovery from waste panel products.

In some instances this will reduce contamination or decrease the potential for contamination because panel products are readily identifiable and their constituent materials are relatively known. This is especially the case when viewed against construction and demolition material which could contain unknown treatment applications.

Added benefits are realised when combination recycling and electricity generation activities are run in tandem, with the waste heat from electricity generation being made available as the process heat for the panel product recycling. Haas, a manufacturer of wood waste processing machinery, has a commercial unit under development that incorporates gasification technology for electricity generation with a batch thermo-mechanical recycling process for waste panel products. It is anticipated that this combination technology will be commercially available mid 2003.

8. OPTIMAL UTILISATION OF WOOD WASTE

8.1. What is the Best Use of Wood Waste?

For corporations with a commitment to ecological sustainable development, the question is not just a simple matter of wood waste utilisation, it is also an issue of using wood waste at its highest resource value.

Further to a commitment to higher principles, it is increasingly becoming a non-negotiable fact of business that companies of today must be environmentally friendly and not adversely impact the environment.

It is generally agreed that the landfill of wood waste materials is not the best option both from a socio-political and environmental viewpoint. This is the primary reasoning behind countries introducing a landfill tax to discourage this option. Other initiatives to increase recovery of wood waste materials away from landfill have also been implemented.

For example, the Packaging Waste Regulations of the United Kingdom. These were introduced under the EC Packaging and Packaging Waste Directive (94/62/EC). If a business handles more than 50 tonnes of packaging material per year or has a turnover in excess of £12 million ($36 million AUD), then they are responsible for meeting a 56% recovery obligation. This obligation is tracked by the issuing of Packaging Recovery Notes that can only be issued from approved wood recyclers (TRADA 2001).

Other examples include Extended Producer Responsibility (EPR) legislation introduced in Germany and other members of the European Union.

In looking at alternatives other than landfill the issue of optimal utilisation must be considered. Usually this is done on the basis of techno-economic, environmental and socio-political criteria to ensure that a holistic approach is taken. Life Cycle Assessment is often used as an environmental decision making tool to differentiate between alternate uses of materials. Life Cycle Assessment looks at the impacts of a product throughout the entirety of its life cycle. In the Netherlands, life cycle thinking is used as the basis of all waste decision making and management.

Additionally to the “objective” science basis of life cycle approaches to this problem, it is equally true that community and NGO perspectives are just as important in determining uses for wood waste. These “softer” issues can be critical to the success of a wood waste utilisation project as they have the potential to projects from proceeding.

8.2. Assessment of Wood Waste Utilisation Options

According to CE, an independent research and consultancy organisation specialising in environmental problems, the highest resource value of wood waste depends on the quality of wood and the efficiency of the chosen type of technology. Debates on CO_2 and greenhouse gases have had a large impact on waste management and planning. Emissions are an important factor when considering the optimal utilisation option for wood waste, such as whether extra flue gas cleaning will be required for a given type of technology or type of wood waste.

In a study conduced by Bergsma and de Weerd for CE in 1999 for the Netherlands Agency for Energy and the Environment (Novem), it was identified that the recycling of Dutch wood waste to particleboard in Italy would lead to at least the same savings in CO_2 emissions as using the waste as a supplementary fuel in a coal-fired power station. This result was further refined to include the case study of Houtbank at Roosendaal, the Netherlands, who transport large amounts of wood to be recycled in Italy. Despite methodological uncertainties, it was concluded that recycling wood waste via rail transport to Italy and processing in a modern particleboard plant for materials feedstock and energy resulted in a greater reduction in CO_2 emissions than using that wood waste to co-fire a power station.

However it should also be kept in mind that when comparing wood waste utilisation technologies, co-combustion, as with a power station, gives up to ten times less emissions than an incinerator.

From this study the recommendation was that manufacture of particleboard, even though the materials needed to be transported in excess of 1,000 kilometres, was a higher order use than co-firing for electricity generation. In turn, co-firing was more preferable to straight incineration.

Joanneum Research, a state owned research company located in Graz, Austria is also involved with a study that looks to assess wood waste utilisation options. This project compares energy recovery, recycling and landfilling of wood waste in order to identify the most environmentally beneficial practices. A final report is expected early 2002. Preliminary findings indicate that the use of wood waste as a fuel product results in an approximate reduction of 80% of greenhouse gases (as opposed to a widely held view of a 100% reduction). In order to accurately quantify this amount there is a need to compare the reference use for wood waste, namely is it being used to replace fossil fuels and if so, what fossil fuel is it replacing.

8.3. Differing Industry Attitudes

Some of the industry viewpoints canvassed during the study tour on the subject of optimal utilisation include:

- Use round wood for framing and the like, then recycle into particleboard – more than once if commercially possible and then energy recovery. This maximises the effective service life and usefulness of the wood fibre resource.
- There are inconsistencies within the definition of sustainable use of wood resources. The Forest Steward Council, an accrediting agency for sustainable utilisation of wood products, does not allow the production of wood products from recycled fibre as production from sustainable sources.

- Find an economic niche where one can realise a premium return on the wood waste product. For example a bagged animal bedding product that has been "de-dusted". Monetary value is the best indicator to determine highest resource value.
- The best use is energy recovery in a Combined Heat and Power system for all the wood waste that is not readily recyclable. It is an inescapable fact that if landfill directive targets are to be achieved there needs to be energy recovery from wood waste.
- Materials should go to their most suitable use. For example, high moisture content wood waste materials should be used for compost. Dry wood waste is better suited as a fuel product. If there is wood waste that can be re-used or recycled, eg, soft wood for particleboard, then it should go to that use.
- Composting wood waste material is a process that creates it own waste in that large amounts of water are "wasted" to manufacture compost.
- Tax credits for energy generation from waste materials discourage the re-use of those materials.

8.4. Maximising Alternatives and Product Outputs

There are some first order principles that can be applied to develop a wood waste management strategy without having a high level of detailed information.

The first principle is that of increasing product output and thereby decreasing environmental impact per unit of output. For example, creating heat, electricity and a material product from the one process. This could be achieved through a form of gasification where there is a charcoal residue that can be used as a reduction agent in metallurgical industries.

The second principle is that inaction is not acceptable. There will never be a complete and total answer, but there is a need to make a start. Positive advance and development can occur by using technologies that have a flexibility of product output and that can use a variety of wood waste inputs. Further benefits result from facilities that are modular and scalable.

We are faced with the fact that increasing population size will present the same net amounts of waste requiring a waste management solution, even if all of the landfill diversion targets are met. This situation requires that the range of wood waste utilisation options be constantly developed and enlarged.

9. APPLICATIONS FOR AUSTRALIA

9.1. Australian Context – Emerging Industry of Wood Waste Management

The small size of the wood waste market in Australia is such that there have not been the same drivers and pressures that formed the wood waste industry in Europe. However this is changing and Australia is moving from an ad-hoc approach to wood waste management to a organised and developed industry. Furthermore, Australia is uniquely placed to leapfrog to the front of world's best practice through technology and methodology transfer.

The agenda for Australia is as follows:

- Overcome materials handling and logistics issues,
- Increase the range of wood waste product options with viable and sustainable markets,
- Take advantage of emerging technologies, and
- Develop a strong industry that adds value to the wood products industry at large.

9.2. Materials Handling and Logistics – Australia's Tyranny of Space

The main issues for wood waste management in Australia are cheap land with cheap disposal rates at landfill and long distances between suppliers of wood waste material and potential end-users of wood waste products.

In order to overcome transport distance and cost barriers that would otherwise make utilisation of wood waste uneconomic, significant development of reverse distribution networks is required. Innovative intermodal containers are needed that can transform any semi-trailer into a bulk wood waste carrier.

To overcome processing barriers there is a need for specialist processing operations that move away from small-scale mobile processing machinery to dedicated plant and equipment configured to manufacture to strict end-user specifications.

Additionally there is the special challenge of high density Australian hardwoods with their destructive potential for processing machinery. A possible way of managing this is to separate hard wood waste and process with different machinery.

9.3. Increasing Product Options

Australia has historically only produced a landscape mulch from wood waste materials, in addition to popular but relatively small-scale recycling of timber into furniture and floor boards.

As a result of the federal Renewable Energy (Electricity) Act a new market for wood waste as a power station fuel product has emerged.

There is a need to continue to increase the number of commercial market opportunities for wood waste to include cement kilns and particleboard manufacture.

9.4. Emerging Technologies

Emerging technologies with particular application to the Australian market include:

- Fast pyrolysis to produce a biofuel. This technology has great potential when the fuel input is able to be expanded to include wood waste. Especially when used in a semi-portable modular format there is the opportunity to process in districts or regions and transport value added material, rather than transporting low value wood waste material.
- Combination wood fibre reclamation and electricity generation. This technology not only presents wood panel products as an ideal recyclable product, it also has the potential to create a stream of contaminant free wood fibre/chip that could be used in a variety of markets.
- Using heat for air conditioning systems. Australia does not have a high demand for heating services, but does have a large demand for air-conditioning. Such a technology could be used in tandem with electricity generation to lay the foundation of an industrial eco-park, supplying its own electricity and air-conditioning for factory units and offices, in addition to heating in winter; all from wood waste.

9.5. The Need for Industry Development

There is a need for the following industry development activities to occur:

- Categories of wood waste. A standard national code similar to the three-tiered A-B-C level definition that classifies untreated, engineered panel products and treated timber is required. This will assist consistency of approach and consistency of wood waste products.
- Operational procedures to assist the movement away from waste management and into product manufacture.
- Testing protocols for creating and maintaining product quality assurance.
- Specialist wood waste operations with expertise for streamlining and optimising wood waste activities.
- Information sharing through associations, wood based forums and inclusion in forestry courses and TAFE curricula.
- National wood waste association.

9.6. Future Opportunities

Wood waste in Australia presents an as yet untapped resource that entails a significant business opportunity for early entrants into the market. Overseas experience, technology and practices present a valuable learning opportunity for organisations to rapidly achieve worlds best practice. The future for Australian wood waste management lies in developing value added products and realising that no one solution will fit all circumstances. Hence there is a need to maintain a variety of product options to ensure that environmental and social outcomes are also realised.

Finally there is the challenge is to take worlds best practice and apply home-grown research and development to expand and develop novel techniques and applications for the Australian environment and economy.

10. REFERENCES

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For the purposes of this report the following currency conversion rates were used for one Australian dollar:

- 1.3 Dutch guilders
- 1.1 German marks
- 0.33 English pounds

11. ITINERARY

DATE	ORGANISATION
Friday 11/5/01	ADAS- Environmental Consultancy, Exeter UK.
Saturday 12/5/01	Elvendon Priory, Biomass heating installation, Goring on Thames, UK.
Monday 14/5/01	Timber Research and Development Association, High Wycombe UK.
Monday 14/5/01	Parkwood Waste Management Group, partners in the Envirofibre fibresolve project, Sheffield UK.
Tuesday 15/5/01	Sonae, particleboard manufacturer, Merseyside UK.
Tuesday 15/5/01	Hadfield Wood Recyclers, Manchester UK.
Wednesday 16/5/01	British Biogen, bioenergy industry association, London UK
Wednesday 16/5/01	Alstom Power, biomass project developer, London UK
Wednesday 16/5/01	Nordistribution Ltd, biomass project developer, London UK
Thursday 17/5/01	Dynamotive Europe Limited, commercialisation of pyrolysis technology, London UK.
Thursday 17/5/01	Energy from Waste Association, London UK.
Monday 21/5/01	Bronzeoak Group, biomass project developers, Caterham, UK.
Tuesday 22/5/01	LIGNA, international wood processing machinery fair, Hannover, DE.
Wednesday 23/5/01	Pfleiderer Industrie, particleboard manufacturer, Güttersloh, DE.
Thursday 24/5/01	LIGNA, international wood processing machinery fair, Hannover, DE.
Friday 25/5/01	LIGNA, international wood processing machinery fair, Hannover, DE.
Tuesday 29/5/01	Frauenhoffer Gesellschaft WKI Holzforschung, wood products R&D, Braunschweig DE
Thursday 31/5/01	Rethmann Facilities, waste management and recycling, Lippewerk, Dortmund and Muenster, DE.

DATE	ORGANISATION
Friday 1/6/01	Grumbach Gmbh&Co, paper, plastic and wood recycling, Harsewinkel, DE.
Tuesday 5/6/01	Van Werven, wood recycling, Biddinghuizen NL.
Tuesday 5/6/01	Afvalzorg, waste management and wood recycling, Halfweg NL.
Wednesday 6/6/01	Houtbank, wood recycling, Roosendaal, NL.
Thursday 7/6/01	NOVEM, Netherlands organisation for energy and the environment, Utrecht, NL.
Friday 8/6/01	CE, environmental consultancy, Delft, NL.
Monday 11/6/01	EBK, composting and wood recycling, Berlin, DE.
Monday 11/6/01	Rethmann, composting and wood recycling, Berlin DE.
Tuesday 12/6/01	Bad Arolsen, district biomass heating facility, Kassell, DE.
Tuesday 12/6/01	Sauerland Spanplatte, particleboard door core manufacturers, Gotha, DE.
Wednesday 13/6/01	Rudnick und Enners, processing machinery manufacturers, Alpenrod, DE.
Wednesday 13/6/01	Vecoplan, processing machinery manufacturers, Bad Marienberg, DE.
Thursday 14/6/01	V&V Recycling, wood waste recycling, Vianen, NL
Thursday 14/6/01	BOBI, wood waste recycling, Vianen, NL
Monday 18/6/01	Joanneum Research, biomass research and development, Graz, AT.
Tuesday 19/6/01	SAPPI, paper manufacture, Gratkorn, AT.
Tuesday 19/6/01	Weitzer Parkett, parquetry floor manufacture, Weiz, AT.
Thursday 21/6/01	TU Wien, Technical University of Vienna, research into flows of waste materials, Vienna AT.

12. CASE STUDY ADAS ENVIRONMENT (UK)

12.1. Background

ADAS Environment was originally part of the Ministry of Agriculture and Fisheries and Food. The acronym ADAS stands for Agriculture Development and Advisory Service and reflects the role that the organisation played during the 1980's as a government department. The organisation privatised in 1997 and is now known as ADAS Environment, a specialist consultancy service operating in four main areas. One of their areas of expertise is in the composting of waste materials.

12.2. Composting Wood Waste Materials

ADAS Environment undertakes research into composting, including the utilisation of woodchip and biosolids as feedstocks. They have the facilities for large scale composting research, including static pile & windrow composting and facilities for in-vessel systems and commercial windrow turners. These resources are used to provide analytical assessments of compost feedstocks, composting materials and finished composted products. One such project was the assessment of the suitability of different types of wood waste used in compost manufacture.

Other research includes investigations into alternatives to peat for commercial horticulture production, such as timber industry by-products, coir and certain grades of high quality green compost.

Figure 28: Offices of ADAS Environment at Mamhead Castle, Exeter UK

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13. CASE STUDY AFVALZORG (NL)

13.1. Background

Afvalzorg is a privatised landfilling organisation that is wholly owned by the North Holland Province. As part of their suite of recycling services, Afvalzorg started a wood waste operation in 1998 at their site in Halfweg, very close to the eastern side of Amsterdam. Currently, they receive, sort and process between 50,000 to 60,000 tonnes of wood waste per year. Processed wood waste is sold for use in energy generation and for use in the manufacture of particleboard.

13.2. Wood Waste Inputs and Processing

Afvalzorg accept “A-wood” and “B-wood” materials at their facility in Halfweg. There is a differentiated gate fee structure to encourage clean loads of high value wood waste. “A-wood” costs 50 guilders ($38.50 AUD) per tonne compared with “B-wood” at 100 guilders ($77 AUD) per tonne. These gate fee prices represent a saving of between 100 and 150 guilders ($77 - $115 AUD) per tonne compared to landfill disposal. Any loads visually identified with treated timber in them are rejected at the weighbridge.

Figure 29: Wood stockpile (left) and wood processing shed (right) at Afvalzorg, Halfweg, the Netherlands.

Afvalzorg use Haas processing equipment. The primary grinding is undertaken by a slow-speed shredder with a 25 tonne per hour throughput capacity. The output from the grinding process is conveyed under an overhead belt magnet to remove metals prior to entry into a sorting cabin. Here two labourers sort out “gross contaminants like masonry.

The secondary high-speed hammermill has a throughput capacity of 20 tonnes per hour of wood waste. The cutting surface is grooved to reduce the amount of output that exceeds size specifications (maximum size of 80mm). Conveyors are used to take the material under an additional overhead belt magnet and then through an eddy current separation. Other features include an air duct, dust collector, wind sifter and a fractionator to separate two-sized fractions and fines. The end product sizes are 5 – 30 mm, 30 – 80 mm and minus 5 mm (fines).

Figure 30: Primary shredder (front right), overhead magnet (front left) and hand sorting cabin (white) at Afvalzorg, Halfweg, the Netherlands. The roof had been recently destroyed by fire.

Large bays are used for storage prior to transport. Road, rail and barge transport are utilised. A barge will hold 1,200 cubic metres of product (approximately 350 tonnes) and takes between five and six hours to load with belt conveyers.

The size of Afvalzorg’s operation is approximately 7000 m² of undercover processing space and 20,000 m² of uncovered stockpiling space. The cost of installation was estimated to be six million guilders ($4.6M AUD).

13.3. Wood Waste Outputs

Wood waste products are sold on the basis of their composition and chip size. All of the minus 5 mm product is exported to cement kilns in other countries. Afvalzorg needs to pay 10 guilders ($7.70 AUD) per tonne plus the cost of transport, often between 50 and 60 guilders ($38.50 - $46.20 AUD) per tonne.

The two larger sized chip products manufactured form "A-wood" are exported to particleboard manufacturers. These products have a value of between 40 – 50 guilders ($30.80 - $38.50 AUD) per tonne.

The "B-wood" products and mixed "A&B-wood" products are exported as fuel products and have a zero guilder value delivered top the end user. Thus the cost to Afvalzorg is the cost of transport.

Figure 31: Proceed wood product ready for delivery at Afvalzorg, Halfweg, the Netherlands.

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14. CASE STUDY BAD AROLSEN BIOMASS HEATING PLANT (DE)

14.1. Background

Bad Arolsen is a town approximately 10 kilometres to the west of Kassel. A decision was made to install a biomass heating system to warm the public swimming pool “Arobella”. This initiative was in conjunction with a local government drive toward environmentally friendly heating systems. Local residential heating services were also developed as part of the project. Seeger Engineering provided the plant engineering and project management services.

14.2. Wood Waste Inputs

Primarily “A-wood” waste are ground up on-site by the wood waste generator, a furniture manufacturer located approximately one kilometre from the biomass plant. Some forest residuals are also utilised. The biomass plant uses between 3,000 and 4,000 tonnes of wood waste each year. Wood waste is unloaded into one of two 120 cubic metre unloading bays. The minus 50 mm product falls easily through a grate and onto a push-pull floor where it is transported to a belt conveyor. From here the wood waste is conveyed into the biomass boilers via a screw feed system.

Figure 32: Hydraulic mechanism of the push-pull floor at Bad Arolsen, near Kassel, Germany.

14.3. Biomass Boilers

Two grate fired biomass boilers are used. The first, a 1.1 MW thermal unit uses up to 0.4 tonnes of wood waste an hour. The second, a 0.4 MW unit, uses up to 0.15 tonnes of wood waste an hour.

Figure 33: Inside of grate fired boiler at Bad Arolsen, near Kassel, Germany.

Water is heated up to 90 °C via a heat exchanger. Approximately 30 tonnes of ash are produced each year.

Figure 34: Ash produced at Bad Arolsen, near Kassel, Germany.

There is a requirement to have emissions from the facility tested every three years. Tests undertaken so far show a reduction by over 50% of SO_2, slightly lower NO_X and almost net neutral CO_2 emissions when compared with a hot oil boiler. A hot oil boiler, however, does emit lower fine particulate matter.

14.4. Community Heating

Specialised 25kWh residential heating units have been installed into the immediate local community. There is heating capacity for 100 apartments to be supplied with heat.

Overall there was a positive community acceptance of a local biomass heating plant. Perhaps this was owing to the fact that it displaces the annual need for 230 kilolitres of heating oil and also reduces CO_2 emissions by 1,100 tonnes per year.

14.5. Contact

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15. CASE STUDY BRITISH BIOGEN (UK)

15.1. Background

British Biogen is a trade association for the British bioenergy industry, funded entirely by member subscriptions and contract project work. Representation of members is a key activity. Members include a mixture of users of biofuels, vendors of conversion technology, academics and individuals. Historically British BioGen has concentrated on clean energy crops, however there is a growing interest amongst members in recovered fuels from waste materials.

15.2. Activities

British BioGen acts as an information clearinghouse, providing advice and information on biofuels. This is enhanced by operating three networks for members around core themes such as heat generation, export opportunities and fuel crop management.

One of the major projects that British BioGen is involved in is the development of a standard for biofuel, that is fuel products derived from energy crops and forestry residues. For more information see www.bsi.org.uk. The development of a recovered fuels standard is part two of this project.

Part of the future for biofuels revolves around the provision of wood pellets for internal domestic boilers. This activity is supported by enhanced capital allowances for Combined Heat and Power (CHP) equipment (for more information see www.eca.org.uk). One member, Welsh Biofuels is manufacturing pellets from crops and wood waste. Pellet tankers will then deliver pellets to houses for internal domestic use, replacing a reliance on oil.

Other projects undertaken by British BioGen include the development of a coppice guide, anaerobic digestor guide and wood fuel guide as part of their Energy Crop Scheme. There are establishment grants for short rotation coppice forest and miscanthus crops (a woody weed) to provide an incentive for landowners to move into fuel cropping. To date there has been overall community acceptance to the notation of using crops and forestry residues as fuel sources.

The major driving force behind the development of these projects is the UK Department of Trade and Industry renewables obligation. This places an obligation on every energy generator to produce energy from renewable supplies.

15.3. Publications

Some of the publications available from British BioGen include:

1. Good Practice Guidelines, Wood Fuel from Forestry and Arboriculture – The Development of a Sustainable Energy Production Industry.

2. The British BioGen Code of Good Practice for Biofuel pellets and pellet burning appliances <25kW.

3. Local Wood Energy Plan- A model plan for the utilisation of local wood resources developed by the Forest of Mercia.

15.4. Contact

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16. CASE STUDY BRITISH WOOD WASTE TO ENERGY PROJECT DEVELOPERS (UK)

British BioGen were kind enough to set up a round of meetings with some of their members who had volunteered their time. Below is a brief summary of these companies and their core expertise.

16.1. Alstom Power

Alstom Power was involved in the world's first Biomass Integrated Gasification Combined Cycle (B-IGCC) scheme. They are also involved with the ARBRE Energy project (Arable Biomass Renewable Energy) This project will produce 10MW of electricity from clean and sustainable wood fuel sources. Wood will be converted into a low calorific value gas by gasification.

16.2. Contact

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16.3. The Bronzeoak Group

Bronzeoak has performed fuel supply strategy studies and fuel preparation assessments for a variety of clients. Current project include the use of forestry residues as biomass fuels. Conversion systems include combustion, pyrolysis and gasification. Other projects include producing biogas for boiler fuel, cooking or for electricity production. The size of their operations ranges from a few 100kW to 4MW. They are also involved in designing and developing anaerobic digestion plants.

16.4. Contact

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16.5. Nordistribution Ltd

Nordistribution is a manufacturer of combustion systems. They have introduced a model of wood-fired boiler into the market designed for use with wood-based waste products – the TEC 300. It is rated at 300kW thermal and can operate on a dual-fuel basis. This means that it can burn gas when wood is not available. A typical system comprises a bulk storage silo to contain fuel and an automated silo unloader to ensure a controlled delivery rate to an underfeed screw stoker.

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16.7. Torren Energy

Torren Energy build, own and operate biomass heating plants and then sell the heat that is produced by burning low-grade timber and forest residue woodchips. This is managed by metering the hot water produced from customised and automatically stoked boilers on customer's premises. The fuel used is considered to be carbon-neutral.

16.8. Contact

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17. CASE STUDY CE SOLUTIONS FOR ENVIRONMENT, ECONOMY AND TECHNOLOGY (NL)

17.1. Background

CE was established in 1978 and is an independent research and consultancy organisation specialising in solutions to environmental problems. CE has a wide range of clients including government, industry and NGOs, both Dutch and international. CE concentrates research activities around five key themes:

- Economics;
- Materials and Waste;
- Transportation and Traffic;
- Energy (wind, solar, sustainable and heat distribution); and
- Industry.

17.2. Wood Waste Utilisation

Recent research undertaken into the best use of wood waste concluded that the highest resource value of wood waste depends on the quality of wood and the efficiency of the chosen type of technology. Debates on CO_2 and greenhouse gases have had a large impact on waste management and planning. Emissions are an important factor when considering the optimal utilisation option for wood waste, such as whether extra flue gas cleaning will be required for a given type of technology or type of wood waste.

When comparing wood waste utilisation technologies, co-combustion gives up to ten times less emissions than an incinerator. In CE's opinion, gasification and pyrolysis should be used as a pre-treatment process for wood waste, with the resultant gases co-fired into an existing power facility.

17.3. Research Activities

Environmental assessment of Dutch waste wood-processing in Italian chipboard

Geert Bergsma, Gerard de Weerd
Delft, 1999 (November)
16 pag. ƒ 20,00 ($15 AUD)
http://www.ce.nl/eng/index.html

(This report is available in Dutch only.)

According to this 1999 study, commissioned by the Netherlands Agency for Energy and the Environment (NOVEM), the recycling of Dutch waste wood to particleboard in Italy would probably lead to at least the same savings on CO2 emissions as using the wood waste as a supplementary fuel in a coal-fired power station.

The follow-up study indicated that this conclusion was even stronger for the recycling practices adopted by Houtbank. Houtbank transport wood waste by rail to Italy for processing in a modern particleboard production facility. The wood waste is used both as a material feedstock and fuel source.

Despite some methodological uncertainties, it was concluded that this method of recycling wood waste leads to a considerably greater reduction in CO_2 emissions than using wood waste to co-fire into a power station. Given this conclusion, a government incentive to divert the waste wood from particleboard production and into use as an ancillary power station fuel would be extremely inefficient.

17.4. Contact

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18. CASE STUDY DOPPSTADT (DE)

18.1. Background

Doppstadt is a machinery manufacturing company that builds machinery for a variety of specialist environmental operations. Products vary from composting equipment to tractors and from conveyance systems to wood waste processing equipment, both mobile and stationary. The company's headquarters are located in Velbert, near Dusseldorf. There are three other manufacturing locations spread throughout Germany at Calbe, Schonebeck and Rott am Inn.

Wood waste processing equipment manufactured by Doppstadt includes slow-speed shredders and high-speed hammermills. These were demonstrated at facilities run by two of their clients – Rethmann- Berlin and EBK.

One of the new products that Doppstadt are bringing to market is a combination slow-speed shredder and high-speed hammermill on one mobile machine. This will be available early in 2002.

18.2. Rethmann-Berlin – Doppstadt Client

Rethmann-Berlin is a composting and wood waste processing facility approximately 30 kilometres to the southwest of Berlin. They process approximately 10,000 tonnes of wood waste per year.

Gate fee prices are between 30 – 40 DM ($27-$36 AUD) for "A-wood" (untreated timber) and between 60 – 70 DM ($54-64 AUD) for "B-wood" (engineered timber product). The prices are decreasing owing to increased competition for feedstock.

Wood waste is pre-processed with a slow-speed shredder and further reduced with a high-speed hammer mill. A worker estimated that throughput rates were 40 cubic metres for the slow-speed shredder and 40-60 cubic metres for the high-speed hammermill.

Because of the Bio-compost Ordnung (Compost legislation) no wood waste can be used in a compost product. Thus the markets for wood waste are as a feedstock to particleboard (1,000 tonnes from A-wood) and as a fuel (9,000 tonnes from B-wood).

Rethmann operated on a dirt floor when processing the B-wood product and used a concrete floor when processing their A-wood product.

Figure 35: Unprocessed demolition wood waste at Rethmann Berlin, Germany.

18.3. EBK – Doppstadt Client

EBK is a composting and wood waste processing facility approximately 20 kilometres to the southeast of Berlin. They process green waste, soil and wood waste into a variety of compost, biofilter, particleboard feedstock and fuel products. EBK process approximately 5,000 tonnes of wood waste each year.

The A-wood waste is processed with a high-speed hammermill to a minus 40 mm chip. The gate fee is 9 DM ($8 AUD) per cubic metre of A-wood waste (between 54 - 90 DM ($49 - $82 AUD) per tonne depending on compaction). The end product is delivered 80-120 km to be used for particleboard manufacture (approx. 1,000 tonnes per annum). EBK sells this product at approximately 20 DM ($18 AUD) per tonne delivered to the end user.

The B-wood waste is processed with a high-speed hammermill to make a minus 150 mm chip that is used as a fuel product. The gate fee is 25 DM ($23) per cubic metre of B-wood (between 100 and 150 DM ($91 – 136 AUD) per tonne, depending on compaction – although this material has a higher bulk density than A-wood). The product delivery distance is between 80 and 120 kilometres. EBK needs to pay 13 DM ($12 AUD) per tonne of fuel product delivered to the end-user.

A new biomass facility is starting up near Berlin which will provide a new market much closer to EBK and has the potential to take all of the wood waste product that EBK can supply.

Figure 36: Unprocessed A-wood waste at EBK, Berlin Germany.

18.4. Contact

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19. CASE STUDY DYNAMOTIVE EUROPE LIMITED (UK)

19.1. Background

Dynamotive Europe Limited was set up to commercialise the production of BioOil, a liquid fuel product manufactured from the fast pyrolysis of biomass such as timber sawdust and bagasse. The technology was originally developed by Dyanmotive, a Canadian based company.

19.2. BioOil

BioOil is produced by a fast pyrolysis process and can be used to substitute or supplement diesel in normal applications. It can also be used to drive a gas turbine to generate electricity.

Pyrolysis refers to the heating of a material, in this case forest and agriculture based biomass, in the absence of oxygen. The result is a combination of char and other non-condensable gases that when cooled forms a liquid – BioOil.

Figure 37: Dynamotive fast pyrolysis equipment (source Dynamotive).

The construction of a 25 tonne per day facility is currently underway in the UK. There are opportunities to expand this production up to a 50 - 70 tonne per day facility. A plant this size would have the capacity to produce approximately 30,000 litres of BioOil a day. The calorific value of the BioOil is approximately 20MJ per litre. Plans for semi-mobile processes are also underway to take into account seasonality and to reduce the transport costs of input materials.

The process requires clean supplies of wood waste to be processed down to a minus 5 mm chip size. Wood waste sources from landfills are unsuitable for the technology at this stage. However, once the process is established with clean input materials, further trials with biomass materials with high variability of quality (eg. wood waste from landfill) will be explored.

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20. CASE STUDY ELVENDON PRIORY COUNTRY ESTATE (UK)

20.1. Background

Elvendon Priory Country Estate is a residential, farming and sporting estate that lies within the rural location of Oxfordshire, UK. As part of major renovations to the complex, a wood waste heating system manufactured by Talbotts, was installed to utilise forest residues and sawmill waste.

20.2. Wood Waste Inputs

The grate fired 300kW boiler uses approximately 700 cubic metres of wood waste a year. This provides year-long heating to the country estate.

Approximately half of the feedstock is generated from managing Elvendon's 3000 acres of forest. The remainder of the fuel source is purchased in from local sawmills at a cost of £30 ($90 AUD) for a load that weighs six tonnes.

20.3. Operation of the Wood Waste Boiler

The chipped wood waste is unloaded into a top-fed silo with a seven cubic metre capacity. The chips are then fed into the boiler by means of a screw auger in combination with an agitator and air-locked rotary valve.

Figure 38: Infeed into silo at Elvendon Priory, Oxfordshire UK.

The boiler can handle feedstock up to a 60% moisture content because of an inbuilt drying stage before burning. The emissions from the operation have been assessed by the Department of Trade and Industry (DTI) and have received a clean bill of health.

Ash is removed from the boiler every three weeks. Three weeks supply of fuel (42 - 44 cubic metres) is reduced to 50 litres of ash (equivalent to a small household garbage bin) and is used in the garden.

One advantage of the boiler system is the Programmable Computer Controller (PCC) that allows the manufacturer to measure and troubleshoot remotely via modem.

The boiler provides a continuous supply of low pressure flow hot water at between 80-85 degrees Celsius. Heat loss is restricted to 1% through the heating system that comprises approximately 400m of 2.5 inch diameter pipe that is heavily insulated.

20.4. Contact

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21. CASE STUDY ENERGY FROM WASTE ASSOCIATION (UK)

21.1. Background

The Energy from Waste Association (EWA) is a not for profit business association that provides representation for the Energy from Waste (EfW) industry and leads the development of operational codes of conduct for that industry.

The specific aims and objectives of the EWA are to:

- To develop awareness and an informed understanding of the benefits of direct energy recovery from non-hazardous solid of a national strategy of sustainable waste management.
- To facilitate the development and efficient operation of plants designed to recover energy from an increasing proportion of household and other non-hazardous wastes.
- To promote and adhere to best practice in the planning, sizing, siting, construction and operation of energy from waste (EfW) plants, having regard to the protection of the environment; public and employee health and safety; and local community involvement.
- To work with Local Authorities, Government and the EU to improve the economic and regulatory regime to support the growth of energy from waste in the UK.
- To endorse the principles of integrated waste management including: waste minimisation, re-use, recovery of both materials and energy, and finally safe disposal to landfill.
- To co-operate with individuals, organisations and other trade associations in the promotion of EfW.

21.2. Some Background Issues to Energy from Waste in Britain

There used to be a heavy reliance on incineration for waste management in Britain. For example, 100 yrs ago there were 370 small incineration plants to destroy waste and in many cases home fires were used to achieve a similar result.

In 1996 the EU directive on waste incineration meant that most EfW plants in the UK closed down as they were too costly to upgrade to the new standard. Now there are 12 EfW facilities operating in the UK.

The renewables directive from EU has mandated that 10% of the British power supply must be generated from renewable sources by 2010. Energy from Waste is not counted as a renewable source at this stage.

Most of London's waste is exported. Approximately six million tonnes (80%) leaves London by barge or by road with a small proportion going by rail a distance of 30 to 80 miles away (primarily around Essex and Oxford). Now pressure is being brought to bear on this export activity with the aim of utilising the waste within the London surroundings.

21.3. Best use of Waste Material

On the "compost vs. energy" argument it should be noted that compost is not without environmental impacts. Pathogens, leachate and methane can be created as part of the composting process. The health risks and implications of composting of certain materials are of great concern. Thus there is more value in the energy content of waste materials. The current growth in waste generation (estimated at between 3% and 5% per annum) means that even if all of the reduction and recycling targets set out in the UK's national waste strategies and the European Landfill Directive are met by 2015 (the target date), there will still be the same net amount of waste going to landfill.

The best practical environmental option is Energy from Waste with combined heat and power where appropriate. This is for the 20% - 50% of waste that will not be able to be recycled. Cost will be the significant factor as to whether a Refuse Derived Fuel (RDF) is manufactured or whether the energy is captured as part of a waste management system. Low calorific value waste material downgrades the properties of a fuel but does allow the throughput of more tonnes, which in turn creates greater revenue through gate fees.

This issue still needs to be considered within the context of different uses for different materials - the movable feast of "waste" can feed many operations.

21.4. Cost of Landfill vs. EfW

Approximately 83% of waste is still disposed to landfill in the UK with current recycling rates standing at about 9% (recycled or composted). The remainder (8%) is utilised for EfW with mainly mass burn systems.

The current landfill tax is £12 ($36 AUD) per tonne with an average gate fee for disposal of approximately £21 - £22 ($63 - $66 AUD) per tonne. This compares with gate fees for EfW facilities of approximately £35 ($105 AUD) per tonne. 50% of UK EfW is exempt from the EU climate change levy.

Large EfW plants are set to become a thing of the past. The concept of “Waste Parks” is being promoted where a portion of the in-feed material provides the energy needs for all of the waste park activities.

21.5. Community Groups

Most people become active in the debate when a facility is being built in their immediate surroundings. At times it is difficult to understand which way the community will respond. Some projects have had favourable reactions from the community. These have had good design features, mainly in the form of architectural treatment to make them conspicuous in a proactive manner.

There are two EfW plants in London located in Edmonton and Lewisham. Edmonton has been the subject of much protest and controversy. Lewisham, while being smaller and newer, has virtually the same emissions profile and has received little or no protest.

EfW has the perception of mass burn incineration with associated pollution and other environmental risks. There is a need to take on new technologies and practices to overcome this perception in the community.

21.6. Contact

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22. CASE STUDY FRAUNHOFER GESELLSCHAFT - WILHELM-KLAUDITZ-INSTITUT HOLZFORSCHUNG (DE)

Wilhelm-Klauditz-Institut Holzforschung

22.1. Background

The Fraunhofer Gesellschaft is a German organisation of applied research, undertaking contract research for a varied client base and on a wide range of subject matters. The Wilhelm-Klauditz-Institut Holzforschung is a member institute within the Fraunhofer group and undertakes wood specific research on matters ranging from wood preservation to wood materials testing with thermal imaging. The WKI Holzforschung has also been researching issues surrounding the utilisation of wood waste for over 10 years. They have successfully commercialised a process that recycles particleboard and are currently researching opportunities to produce Medium Density Fibreboard (MDF) from wood waste.

22.2. Recycling of Particleboard

Of the 7 - 9 million tonnes of wood waste generated each year in Germany, approximately 2.5 million tonnes are particleboard. This presents a problem for recycling as waste particleboard was only suitable for energy generation or landfill. A chemo-thermo-mechanical batch process was developed that took waste particleboard material and produced a clean wood chip that was suitable for substitution into the manufacture of new particleboard.

Figure 39: Pilot process developed by WKI Holzfoschung, Braunschweig Germany (source WKI Holzforschung).

Waste particleboard is broken down into large pieces of approximately 200 mm through a slow-speed shredder. It is then conveyed into a pressure vessel where a solution of water with small amounts of urea and sulfuric acid are added under a slight vacuum, effectively impregnating the particleboard pieces with solution.

After removal of excess solution the mix is heated to 110°C for approximately 20 minutes. This breaks down the bonds of the resins, disintegrating the particleboard into wood chips, pieces of laminate and metal contaminants like hinges, handles and screws. The batch is removed and conveyed to a screening drum where the laminates and contaminants are removed and the wood chips are taken for drying and utilisation.

The commercial scale units have a holding capacity of 25 cubic metres which is approximately 6.5 tonnes of broken down particleboard. The batch cycle varies between 90 and 120 minutes. Annual throughputs of up to 25,000 tonnes per annum are available per unit (with 24 hour operation and one person per shift).

The process recovers approximately 95% of wood fibre from the waste particleboard. It is also possible to utilise some of the fibre and laminates to generate part of the process heat required to recycle the particleboard material. This demonstrates a balance between material recovery and energy generation.

22.3. Manufacture of MDF from Wood Waste

The particleboard industry has been using untreated wood waste as an alternate feedstock into particleboard manufacture for many years. The manufacture of medium density fibreboard (MDF) from sources of wood waste, however, has so far eluded the timber industry. WKI Holzforschung are researching and developing processes to manufacture MDF board from wood waste material. The largest obstacle to overcome is the cleanliness of the infeed material. The MDF manufacturing process has lower tolerances of contamination than does particleboard manufacture. This project began September 2000 and preliminary results are expected at the end of 2001.

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23. CASE STUDY GRUMBACH (DE)

23.1. Background

Grumbach is a recycling company that recycles paper, plastic and wood waste. Their annual throughputs are approximately 30,000 tonnes of paper, 48,000 tonnes of plastic and 6,000 tonnes of wood. Grumbach has only recently started to recycle wood waste and is looking at opportunities for expansion.

The wood waste is collected within a 50 kilometre radius, mainly from industry. There is more wood waste in summer as many companies have a boiler for heating and use their wood waste as fuel in winter. Because of this variation there is a corresponding variation in the gate fee prices, lower in winter and higher in summer. Between 20 -60 DM ($18 - $56) is charged for source separated "A-wood" (untreated timber) and between 65 - 125 DM ($59 - $114 AUD) for "B-wood" (engineered timber products). These gate fees represent a difference of approximately 100 DM ($91 AUD) compared to the cost of disposing waste to landfill.

23.2. Wood Waste Inputs and Processing

There is approximately 500 tonnes of "A-wood" and 5,500 tonnes of "B-wood" that Grumbach processes. The primary grinding is performed by a mobile slow-speed shredder with a throughput of 8 tonnes/hour. This stage produces a particle size of approximately 200 mm. The secondary grind is with a mobile high-speed hammermill. For metal separation there are two overhead magnets located on the conveyor outfeed. The final product is loaded directly into 33 cubic metre capacity roll on bins. These bins are loaded onto trucks and delivered directly to the end user.

Figure 40: Unprocessed wood waste stockpile at Grumbach, Harsenwinkel Germany.

There are few maintenance problems with the slow-speed shredder as compared to the high-speed hammermill. This is primarily due to metal contamination causing damage to the hammers and screens of the hammermill. The high-speed operation also creates more dust than the slow-speed plant and water is needed for dust suppression.

Figure 41: Unprocessed wood waste stockpile at Grumbach, Harsenwinkel Germany .

A new facility is being planned for sorting commercial & industrial and construction & demolition wastes. This will double Grumbach's wood waste handling capacity.

23.3. Wood Waste Outputs

The "A-wood" material is processed into a particleboard grade feedstock material and delivered to Pfleiderer Industrie (see separate case study), a round trip of 30 kilometres. This product sells for 30 - 40 DM ($27 - $36 AUD) per tonne delivered FIS. The "B-wood" material is also delivered to Pfleiderer to be used for energy generation. Grumbach has to pay 25 DM ($23 AUD) per tonne to Pfleiderer to take delivery of this material.

There are new facilities being built that will accept "B-wood" materials for energy generation. These operations will accept this fuel for a "zero" gate fee, dramatically improving the economics for Grumbach.

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24. HAAS (DE)

24.1. Background

Haas is a specialist wood waste processing machine manufacturer located in the Westerwald region of Germany. (See also Westerwald Manufacturers case study). One of their specialities is manufacturing turnkey stand-alone systems with a guarantee on throughput capacity. These systems include slow-speed primary and high-speed secondary grinders, magnetic and electro-magnetic separation, wind sifters and fractionating screens. Haas also manufacture mobile grinding machinery and small-scale processing machines.

24.2. V&V Recycling – Haas Client

V&V Recycling, located in southern Netherlands, are large-scale recyclers of paper, plastic and wood.

V&V Recycling process approximately 30,000 tonnes of wood waste each year. They use a mobile slow-speed shredder for primary grinding. This feeds directly into a high-speed hammermill that produces a minus 50 mm chip.

Figure 42: Output from Haas high speed grinder at V&V Recycling near Vianen, the Netherlands.

24.3. BOBI Netherlands – Haas Client

BOBI Netherlands is a specialist wood waste processing facility located in Appledoorn Netherlands that has been in operation for two years. BOBI processes approximately 200,000 tonnes of wood waste a year for particleboard and energy markets.

Figure 43: Haas Precrusher at Bobi Recycloing, Appledoorn, the Netherlands.

Unprocessed wood waste is accepted for a gate fee of 145 guilders ($104 AUD) per tonne. The stationary slow-speed shredder uses a 320kw engine and processes 80 tonnes per hour. There is a trap door for tramp iron that gets removed via an overband magnet.

Conveyors transport material to the sorting cabin that requires four people to sort out large contaminants like demolition rubble. The wood waste is then conveyed to a secondary high-speed hammermill that uses a 400kw electric motor and also has a throughout of 80 tonnes per hour. Wood chip is then transported by a double screw to a cascading magnet separator.

Figure 44: Wood waste material on conveyor through a sorting cabin at BOBI Recycling, Appledoorn, the Netherlands.

A star sieve removes minus 30 mm material from the hammermill out feed. Eddy current separation is used to remove non-ferrous metals. A swinging fractionator sorts the over 30 mm faction chips into required chip sizes and sends over sized chips back to start of process. Air ducting is used to remove fines. Large bunkers are used for product storage. The final product is transported via road to end-users.

24.4. Contact

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25. CASE STUDY HADFIELD WOOD RECYCLERS (UK)

25.1. Background

Hadfield Wood Recyclers is a wood waste recycling company located near Manchester in the UK. Each year between 50,000 and 70,000 tonnes of wood waste is recycled. Most of this wood waste is picked up in 40 or 55 cubic yard (30 to 42 m³) containers. These containers are spread around a 100 mile (161 km) radius. Hadfield's also offer wood waste only tipping at their wood recycling operation for customers with their own transport. Some customers travel 250 miles (400 km) to bring wood waste only loads. This is primarily because of the low rate for wood waste only loads as compared to landfill. Wood waste is charged at between £5 and £10 ($15 - $30 AUD). This compares to a landfill tax in the UK of £12 ($36 AUD) additional to the charge of landfilling.

Figure 45: Main wood waste processing shed at Hadfield Wood Recyclers, Manchester, UK. This houses the secondary grinder and the separation equipment.

25.2. Wood Waste Inputs

The wood waste materials are primarily untreated softwoods with some hardwoods, plywood, particleboard, and oriented strand board. There is occasionally some medium density fibreboard. Treated timber is not allowed on-site. The wood waste goes through two grinding stages – a slow-speed shredder and a high speed hammermill.

Figure 46: Cable ends stacked for processing at Hadfield Wood Recyclers, Manchester, UK.

There are a variety of automated sorting processes. These include a drum magnet and secondary overhead belt magnet to remove ferrous contamination, a wind sifter to remove plastic, paper and foils, an eddy current separator that removes non-ferrous metals such as aluminium and a number of screens to screen out dirt, glass and grit. The processing machinery is manufactured by PAL.

The throughput rate of the machinery is approximately 20 tonnes per hour. Water is used as a dust suppressant. The managing director lives on site which acts as the local community guarantee that any dust or pollution is completely eliminated.

Figure 47: Eddy current separator for non-ferrous metal at Hadfield Wood Recyclers, Manchester, UK.

25.3. Wood Waste Products

The chipped wood waste is used to manufacture particleboard feed stock, animal bedding and compost. The animal bedding product "Easibed" goes through another two screening stages to ensure that the chips are correctly sized, free of dust and do not contain any sharp splinters that may act as an irritant to animals. The animal bedding product is bagged and bundled for distribution and is proving to be a high value add product.

Figure 48: "Easibed" animal bedding product from Hadfield Wood Recyclers, Manchester, UK.

The quality of the chip product prepared for particleboard applications is not valued by the market as many particleboard manufacturers have their own processing, cleaning and screening equipment and are unwilling to pay a premium for pre-processed material.

In general, compost sells for approximately £10 ($30 AUD) per tonne, particleboard feedstock for between £20 and £30 ($60 - $90 AUD) per tonne and animal bedding for approximately £90 ($270 AUD) per tonne.

Hadfield Wood Recycling is also an accredited agency to issue Packaging Recovery Notes. They are a tradable commodity with a value of approximately £15 - £20 ($45 - $60 AUD) per tonne of packaging waste. (See the TRADA case study for more information on Packaging Recovery Notes.)

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26. CASE STUDY HOUTBANK WOOD DISTRIBUTION EUROPE (NL)

26.1. Background

Houtbank Wood Distribution Europe (WDE) is a specialist wood waste recycling operation with three sites in the southern half of the Netherlands. Collectively these sites (Roosendaal, Moerdijk and Amerloo), handle approximately 500,000 tonnes of wood waste each year. The wood waste is exported for particleboard and energy utilisation, used for manufacturing block supports for pallets, or converted into wood fuel pellets.

26.2. Wood Waste Inputs and Processing

Roosendaal Site

Roosendall receives 250,000 tonnes per year of both “A-wood” and “B-wood”. It acts as a transfer station, receiving approximately 40 truck loads of source separated wood waste a day and loading this material into rail carriages for export to Italy. Roosendaal is a wholesale receiver of wood waste, with trucks coming from all over the Netherlands. Trucks are weighed before entering on-site, making it unnecessary to have a weighbridge.

Figure 49: Mixed wood waste received by Houtbank at Roosendaal, the Netherlands.

The gate fees are 40 guilders ($29 AUD) per tonne for loads of “A-wood” only and 80 guilders ($57 AUD) for loads of “B-wood” or mixed “A&B-wood”. Train carriages are loaded with modified excavators and take six hours to load. There are seven large bays with fire resistant walls to reduce the risk of fire. The size of the site is approximately 2.5 hectares (500 metres by 50 metres).

Each train comprises 34 carriages, each carriage with a 100 cubic metre capacity. When the train is fully loaded it carries approximately 800 tonnes of wood waste. The material is delivered to SIA, an Italian particleboard manufacturer. SIA has developed its own sorting, processing and cleaning technology that is able to produce particleboard feedstock and fuel product from the mixed wood waste.

Figure 50: Loading mixed wood waste for transport to Italy at Houtbank, Roosendaal, the Netherlands.

The cost of transport is 68,500 guilders ($48,950) for each train load (85 guilders ($61 AUD) per tonne). In comparison, it would cots 3,000 guilders ($2,140 AUD) to send one 20-tonne truck load of wood waste to the same destination (150 guilders ($107 AUD) per tonne). Houtbank WDE receives 37.5 guilders ($27 AUD) for each tonne landed in Italy.

Moerdijk Site

Moerdijk handles approximately 100,000 tonnes of “A-wood” waste per year. This material is processed into a minus 50 mm product with a slow-speed shredder. It is delivered locally to a company that manufactures fuel pellets for export to some of the Scandinavian countries. The pellet manufacturer charges Houtbank WDE to receive the processed wood waste.

Amerloo Site

Amerloo handles approximately 120,000 tonnes of "A-wood" waste per year. A high-speed shredder is used to process the material prior to delivery to a local pallet manufacturer. Here the wood waste is used in a process similar to particleboard manufacture. Compressed chip blocks are made and used as supports in multi-directional loading pallets.

Across all Sites

Approximately one load is rejected each month due to contamination. This low contamination rate is a result of high-sorting efforts from customers and much education on the part of Houtbank WDE.

In general, after handling, processing and transport costs are taken into account, there is a profit margin of approximately 5 guilders ($3.50 AUD) per tonne.

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27. CASE STUDY JOANNEUM RESEARCH - INSTITUTE OF ENERGY RESEARCH (AT)

27.1. Background

Joanneum Research is a technology research and development organisation that is owned by the state government of Styria, one of the nine states in Austria. Joanneum Research is part government (1/3) and part contract research (2/3) funded and employs 350 people over 20 principle areas of research. The Institute of Energy in Graz is one such area of interest, providing research and development around biomass energy issues.

Austria's electricity supply comprises 75% hydro, and 25% thermal (coal and gas). There is a government initiative to produce 4% of the total electricity supply from new renewable supplies. However the process of deregulation in the European Union has resulted in cheaper electricity, making it harder for biomass facilities to be commercialised.

50% of the land mass in Austria is covered by wood forests. Thus the major source of biomass available for energy recovery is wood and wood waste materials.

27.2. Research Projects

Small Scale Co-generation at District Heating Plants

Biomass for energy is used mainly for small scale energy supply, for example, district or factory heating. The size of these facilities usually precludes the generation of electricity. Joanneum Research has undertaken the design, construction and operation of a Stirling engine to generate electricity from such small scale biomass facilities.

Flue gas at 1000 degrees Celsius was used to drive a 3kW alpha-type Stirling engine with a heat exchanger that requires no flue gas cleaning. When the primary purpose of the biomass plant is the production of heat, the electricity generated is between 6% and 8% of the total fuel input.

However, there are also applications for small scale electricity generation as the primary focus of a biomass facility, especially in rural locations that have no connection to an electricity grid. For these cases, Joanneum Research is developing a Stirling engine between 5kW and 100kW electric capacity. Such a configuration has an electrical efficiency of 20%.

27.3. Desiccant Systems for Combined Heat Power and Cold

Joanneum Research is also developing technology to use biomass for air conditioning. Heat at 50-100 degrees Celsius is required to run the desiccant system. The heat from burning biomass can thus be used to provide heating during the winter and "cooling" during the summer. This results in longer operational times for boilers and creates the opportunity to generate electricity for the entire year via a Stirling engine.

27.4. Green House Gas Balance of Wood and Wood Products

With the use of biomass material such as wood waste, there is invariably discussion as to what the actual benefits of using biomass for fuel are, as compared with using fossil fuels.

The use of biomass does not result in a 100% reduction in green house gases. Early results from Joanneum Research indicate that it ranges from 85% to 95%. In order to quantify this amount there is a need to compare the reference use of biomass – that is, is it used to replace fossil fuels and, if so, what fossil fuel is it replacing?

Extensive modelling work on this topic is carried out at Joanneum Research. The results are utilised in an international network under IEA Bioenergy with 12 countries, including Australia participating (www.joanneum.at/iea-bioenergy-task38). This work is lead by Bernhard Schlamadinger.

The European Cooperation of Science and Technology (COST) is a European network of researchers. One task that is being coordinated is a Life Cycle Assessment of Forestry and Forest Products. One of the projects is to compare the energy generation, recycling and landfilling of wood waste in order to identify the most environmentally beneficial practices. This working group is chaired by Gerfried Jungmeier of Joanneum Research. A final report is expected early 2002.

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28. CASE STUDY NOVEM (NETHERLANDS ORGANISATION FOR ENERGY AND THE ENVIRONMENT) (NL)

28.1. Background

NOVEM's mission is to stimulate the sustainable development of society within the Netherlands as well as abroad, in the field of energy and the environment. They manage national and international government programs aimed at environmental improvement, increasing energy efficiency, and introducing renewable energy sources. The organisation is made up of over 400 employees and includes four divisions; Sustainable Energy Production, Sustainable Housing, Sustainable Manufacturing and Sustainable Living and Recreation.

NOVEM administer the Renewable Energy Program of the Ministry of Economic Affairs. Wood waste related activities include:

- Contracting research organisations to be involved in the development of codes of practice,
- Certification / characterisation of wood waste fuels, and
- Sampling and analysis of wood waste for quality assurance.

28.2. Issues with Wood Waste Utilisation

NOVEM believes that a 'whole of life cycle approach' is needed to resolve the issues surrounding the definition of renewable energy and the inclusion of woody waste materials. The highest resource value of wood waste includes recycling and energy generation, depending on market conditions and CO_2 benefits.

They also believe that codes of practice and quality assurance standards need to be set through an interaction between suppliers and users of wood waste.

28.3. Publications:

Recent papers and publications are available on www.biomasster.nl and can be ordered through the website.

28.4. Contact

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29. PFLEIDERER INDUSTRIE (DE)

29.1. Background

Pfleiderer Industrie are particleboard manufacturers with two large operations in Güttersloh, Germany. Pfleiderer employ over 300 people at both of their sites. The production capacity of the original site, built over 30 years ago, is approximately 1500 cubic metres of finished product per day. The capacity of the second site, a much newer facility, is approximately 2000 cubic metres per day. Pfleiderer recently installed wood waste handling capacity. Presently between 15% and 25% of their feedstock material is wood waste. Gisiger Technik machinery is used for the processing, cleaning and screening of the recycled wood waste chip.

29.2. Wood Waste Inputs

Wood waste (both A-wood and B-wood) is delivered either pre-processed or unprocessed. Pre-processed material is delivered by truck and received into storage bunkers. The material is then either used directly as fuel or taken into secondary processing stages to remove metals, grit and plastic, prior to chipping for use in manufacture of particleboard. The fuel is used primarily for process heat during manufacture.

Figure 51: Loading A-wood waste for processing at Pfleiderer Industrie, Güttersloh, Germany.

Unprocessed wood waste material is stockpiled on a hard stand area. A slow-speed shredder is then used to shred unprocessed material into a minus 200 mm particle size at a rate of approximately 20 tonnes per hour. High-speed hammermills are used to further reduce the size of the particles to a minus 40 mm chip, with a throughput capacity of between 10 and 15 tonnes per hour. An overhead belt magnet removes metals. Sometimes pieces of wood with nails or metal staples still attached get pulled out because of the strength of the magnet.

Figure 52: Use of a fractionator to screen out over sized particles at Pfleiderer Industrie, Güttersloh, Germany.

The processed chips are then passed over a combination disk and roller screen to remove the minus 6 mm fraction prior to the material going over a rotating disk screen. Any oversized particles (>200 mm) are screened out through a fractionator and reprocessed through a high-speed hammer mill.

The screened 40 mm chips are then cut by four ring flakers to produce flake ready for the particleboard core layer. Each ring flaker has a capacity of 8-10 tonnes per hour.

Large silos are used for storage of material, prior to being dried and combined with virgin feedstock. If there is a need for surface material for the particleboard, a tertiary grinding is undertaken. At this stage there can still be metal and grit present. The lesson to be learned is that a large amount of effort is required to produce good clean particleboard quality chip from wood waste sources.

On average the cost for processed wood waste of particleboard quality is approximately 60 DM per tonne ($55 AUD), compared with a cost of 100 DM per tonne ($91 AUD) for chipped virgin feedstock.

Figure 53: Pre-processed B-wood waste for use as fuel at Pfleiderer Industrie, Güttersloh, Germany.

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30. CASE STUDY RETHMANN - LIPPEWERK (DE)

30.1. Background

Rethmann - Lippewerk is a large recycling park that is situated on the former grounds of an aluminium smelter. A large range of materials are recycled on site. These include, amongst others, manufacture of a refuse-derived-fuel from mixed plastics, composting of garden vegetation and wood waste recycling.

30.2. Wood Waste Inputs

Approximately 80,000 tonnes of wood waste are received from a collection radius of approximately 300 kilometres. (Some wood waste is brought in from the Netherlands to be recycled). The source of the wood waste is both the Commercial and Industrial (C&I) and Construction and Demolition (C&D) sectors.

Figure 54: Unprocessed B-wood waste at Rethmann - Lippewerk, Germany.

The gate fee structure is 55 DM $50 AUD) per tonne for source separated loads of "A-Wood" (untreated wood) and 60 DM ($55 AUD) per tonne for source separated loads of "B-Wood" (engineered timber products). The untreated wood waste makes up approximately 20% or the total input with engineered timber product waste accounting for the remainder.

30.3. Wood Waste Processing

The different quality wood waste inputs are kept separate and are processed in batches to create different product types. A Hammel shredder is used for the primary size reduction grind, making a minus 300 mm product. This machine can processes 40 tonnes per hour of wood waste. An overhead belt magnet is used to remove tramp metal. Two people hand sorting in an air-conditioned cabin remove other large contaminants.

A high-speed hammermill is used for the secondary size reduction to a minus 50 mm product. A second overhead belt magnet is also used to remove smaller metal fixings and fasteners.

Figure 55: Metal contamination removed by the overhead magnet at Rethmann - Lippewerk, Germany.

A sieve removes fines that are ducted to dust collection containers. The ducting has a capacity of 40 cubic metres per hour. Water is also used for dust suppression. A wind sifter is used to remove plastic, styrofoam and textiles. Contamination rates are approximately 3% of total input.

A fractionator then screens the wood chips into different sized fractions. The different sized outputs are then taken to storage sheds by a front-end loader.

The processing area occupies a footprint of 2,500 square metres. There is a similar amount of floor space under cover for product storage.

30.4. Wood Waste Outputs

The processed "A-Wood" is used as a feedstock for particleboard manufacture. This product sells for 20 DM ($18 AUD) per tonne from the Rethmann site. The lesser quality "B-Wood" product is used for cement kiln fuel or for power station fuel. Rethmann - Lippewerk has to pay the end user to take the material even though the cost of coal is relatively high at 80-120 DM ($73 - $109 AUD) per tonne.

Figure 56: Processed wood product stored undercover at Rethmann - Lippewerk, Germany.

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31. CASE STUDY SAPPI GRATKORN MILL (AT)

31.1. Background

Sappi is an international company in the pulp and paper industry with manufacturing operations in ten countries. One such operation is the Sappi Gratkorn Mill, located approximately 15 kilometres to the northwest of Graz, Austria.

The Sappi Gratkorn Mill produces nearly 1,000,000 tonnes of pulp and paper products annually. Process heat and electricity are generated from a coal-fired boiler and a biomass fluidised bed combustor. The coal-fired boiler has a 133 MW thermal output and the fluidised bed combustor has a 23 MW thermal output. The electrical efficiency is approximately 25% of the total energy input.

31.2. Wood Waste as Biomass

The fluidised bed combustor (FBC) was installed in 1983 and is fuelled with a mixture of bark, (80,000 tpa) and pulp slurry (30,000 tpa). The bark is removed from logs delivered to site for papermaking. It is processed with a hammer mill and passed through a water bath to remove dirt and grit from the bark before entering the FBC. Dirt and grit cause slagging within the FBC and increase the cost of maintenance while decreasing the efficiency of heat exchange within the boiler.

Figure 57: Bark passes through a water bath at SAPPI, Gratkorn near Graz, Austria.

The bark is then transported 1.5 kilometres from the log de-barking site to the FBC via enclosed conveyors to a storage bunker with a capacity of 800 cubic metres. The bark has a moisture content of approximately 50% and a calorific value between 6-7 GJ/tonne. Sometimes there is a need to purchase supplies of bark to make up shortfall in availability.

There are 60,000 tonnes of waste pulp slurry produced annually. This material is passed through a variety of presses to bring the moisture content down to 55%. 30,000 tonnes are used to co-fire with coal and 30,000 tonnes are co-fired with bark.

Figure 58: Paper slurry is pressed prior to combustion at SAPPI, Gratkorn near Graz, Austria.

The circulating medium in the FBC is quartz (sand). It needs to be pre-heated by two natural gas burners to a temperature of 450 degrees Celsius before either of the fuel materials can be combusted. There are 60 tonnes of quartz and it is replaced every three months. The boiler is also sand blasted every six months to remove slagging.

The combustion of bark and slurry in the FBC produces 30mg of particulate matter per cubic metre of exhaust gas. There are two electro-static precipitating filters to control pollution.

10,000 tonnes of ash is produced by the FBC each year. This material is used in cement manufacture.

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32. CASE STUDY SONAE UK

32.1. Background

Sonae is a Portuguese owned particleboard manufacturing company that recently opened a plant in Merseyside, UK. The plant was specifically designed to utilise recycled wood chip as the primary source of feedstock into manufacture. This was owing to the scarcity of round wood and inefficiencies in transporting round wood. (The high moisture content of round wood compared to recycled wood means a higher cost of transport per dry tonne equivalent of fibre).

32.2. Wood Waste Inputs

When operating at full capacity the plant requires approximately 300,000 of softwood for particleboard manufacture and 40,000 tonnes of mixed wood (excluding treated timber) for boiler fuel.

Previously Sonae accepted loads of unprocessed wood waste on site. Depending on the quality, the material was either processed for particleboard feed stock or boiler fuel. This gave them flexibility in accepting material – especially for boiler fuel. For example, taking back waste off-cuts from customers and taking in Council's green waste trimmings. This, practice, however, is changing and the trend is now to accept only processed loads of the two grades of wood waste. Sonae are paid between £0 and £10 ($0 - $30 AUD) per tonne to receive material that will be used as boiler fuel.

Figure 59: Part of the on-site processing operation being phased out by Sonae, Merseyside UK.

Sonae purchase processed recycled-softwood chip for between £20 and £30 ($60 - $90 AUD) per tonne. The chip is checked at the weighbridge prior to being unloaded into overhead bunkers by means of hydraulic elevators that lift the entire truck and trailer. Cleaning and screening the chip is of primary importance and a combination of magnetic belt separation and screening is used to remove any contamination.

Figure 60: Whole of truck unloading mechanism used at Sonae, Merseyside UK.

The chip is then conveyed to flaking knives for cutting into the requisite shape and size for particleboard. One consequence of using recycled wood chip is that the flaking knives have to be sharpened more often than when using virgin chip. Sonae use primarily PAL equipment to handle the recycled wood chip.

Recycling into new particleboard is seen as a high value add to wood waste. It extends the life of the wood fibre rather than simply using it as a boiler fuel.

However the positives associated with recycling wood waste into particleboard and the associated increase in local jobs available are not the only issues. There has been a problematic history with the site prior to the Sonae operation and a “cancer scare” campaign run in the local papers regarding the steam coming from the boiler operation. Recycling is no longer seen as the ‘must have’ environmental option.

Figure 61: Steam plume from the stack that provided a focal point for community opposition at Sonae, Merseyside UK.

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33. CASE STUDY TRADA (THE TIMBER RESEARCH AND DEVELOPMENT ASSOCIATION) UK

33.1. Background

TRADA was originally set up some 60 years ago in the United Kingdom to research timber drying. Today TRADA's activities are spread across the entire timber industry. Everything from fire testing timber of products to a range of timber related business support services. This wide sphere of involvement also includes sustainable wood waste management.

33.2. Wood Residues: Waste or Resource?

Landfill tax on wood waste residues in the UK was £12 ($36 AUD) per tonne at the time of the study tour. This provided a strong financial incentive to recycle wood waste. A survey was undertaken with timber processors and demolition and reclamation companies in order to quantify types of residues and their use or disposal. The report is available for purchase through TRADA and details not only the results of the survey, but also discusses barriers to recycling and methods for overcoming them.

33.3. EnviroFibre

Figure 62: The "Fibresolve" processing vessel and wood fibre resulting from MDF breakdown (Source: TRADA Technology UK).

Previous TRADA research, 'Mapping the UK Wood-Residue Resource', identified that large quantities of particleboard and MDF were disposed of to landfill. The EnviroFibre project aims to take waste from wood-based panels and recycle it into high quality 'new' fibre on a commercial scale.

The process that will be commercialised is called "FibreSolve" and involves using a low pressure vacuum vessel and steam to break panel products down into component wood fibre/chip. FibreSolve uses no chemicals and is relatively inexpensive.

33.4. Timber Industry Environment Trust

TRADA established the Timber Industry Environment Trust (TIET) in 1999 as a vehicle for the timber industry to proactively engage in minimising wood waste. Through TIET the industry is able to apply for funding under the Landfill Tax Credit Scheme. To date a number of projects have been approved for funding. These include an information web-site (Timber Recycling Information Centre), a feasibility study into the recycling of treated timber and a case study of sustainable waste management through timber frame design and construction.

33.5. Timber Recycling Information Centre

TRADA is working on a project as part of the TIET to raise awareness in the UK timber industry regarding wood waste minimisation. The focal point of this work is a website that serves as an information clearing house.

The Timber Recycling Information Centre – www.recycle-it.org - contains information that sets the context for wood waste minimisation. For example the report *Mass Balance – Exposing Hidden Costs* places the timber industry within the context of the planetary machine and argues that the challenge of sustainability is also a business opportunity. Other information such as *A Simplified Guide to the Packaging Waste Regulations* provides practical guidance in complying with UK legislation applicable to timber content in packaging waste.

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34. CASE STUDY VAN WERVEN BV (NL)

34.1. Background

Van Werven BV is a recycling operation that manages a range of materials, including wood waste. The operation has four sites, three of which process wood waste for energy generation. The site located at Biddinghuizen, approximately 1 hour drive to the northeast of Amsterdam, is the youngest of the four sites, however it is also the largest, receiving and processing approximately 10,000 tonnes of "A+ and A" grade wood waste per year. This material is collected and delivered from a 30 - 80 km radius.

34.2. Wood Waste Inputs

Van Werven BV accepts A+, A and B grades of wood waste (Forest residues, untreated timber and engineered timber product). There is differentiated gate fee structure to attract clean loads of high value wood waste. "A+-wood" costs 60 guilders ($43 AUD) per tonne; "A-wood" costs 90 guilders ($64 AUD) per tonne and "B-wood" costs 125 guilders ($89 AUD) per tonne. A Bruks and Klöckner tub grinder with a throughout of approximately 20 tonnes of wood waste per hour is used as a one stage grinding process to produce a coarse (minus 100 mm) product. All processing and stockpiling is undertaken on a hard stand of paving bricks.

Figure 63: Wood waste ready for processing at Van Werven, Biddinghuizen, the Netherlands.

Van Werven BV sample their product as part of their quality assurance management system by conducting tests to measure percent water, percent fines, and percent overs (amount of materials above size specification). PVC edging and laminates, and treated timber are controlled through conditions on source-separated loads that are received.

34.3. Wood Waste Products

Processed wood waste at Van Werven BV is used for energy generation and composting. Products made from B-wood waste (engineered timber product) are exported to Belgium, Germany and/or Sweden.

There are two local energy generation markets for a high quality, processed wood waste product. The first, a grate-fired boiler with 30,000 tonnes per annum capacity, is located at Lelystad, a round trip of 60 kilometres. The second is a fluidised bed combustor with 250,000 tonnes per annum capacity, is located at Cuyk, a round trip of 200 km. The energy products sell for approximately 65 guilders ($46 AUD) per tonne delivered.

All other materials that are considered to be of a lesser quality are used for compost and are mixed with mud and sand removed during processing. Mud and sand cause slagging in the boiler, leading to inefficient burning and increased ash output, but are beneficial additives to a composting products.

34.4. Contact

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35. CASE STUDY WEITZER PARKETT (AT)

35.1. Background

Weitzer Parkett is a parquetry floor manufacturer located in the south east of Austria. They manufacture a range of solid and composite/laminated wood flooring surfaces.

35.2. Wood Waste as Biomass

Weitzer Parkett produce approximately 30,000 cubic metres of sawdust, 15,000 cubic metres of shavings and 8,000 cubic metres of timber offcuts as waste each year.

Figure 64: Customised shredder used at Weitzer Parkett, Weiz Austria.

The offcuts and waste packaging material and processed and taken off-site, along with approximately 12,000 cubic metres of sawdust and 5,000 cubic metres of shavings to external markets for wood waste, such as regional district heating schemes.

The remainder of the wood waste is used to fuel three boilers that heat the factory buildings during autumn, winter and spring months.

Mobile grinding equipment is used to process waste packaging material, while a stationery shredder is used to process offcuts with little or no potential for metal contamination.

Figure 65: Processed fuel product stores at Weitzer Parkett, Weiz Austria.

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36. CASE STUDY WESTERWALD WOOD WASTE MANUFACTURING CENTRE (DE)

36.1. Background

The Westerwald is a region approximately 70 kilometres to the northwest of Frankfurt in Germany. There are five wood waste machinery manufacturers located within 15 kilometres of each other. These are Haas, Klöckner, Rudnick und Enners, Vecoplan and Zeno. As such the Westerwald could be considered the heart of German wood waste manufacturing.

36.2. Haas

Haas manufacture and deliver recycling plants for wood waste, particleboard and waste furniture. Recycling systems include:

- Primary crusher with an output of up to 30 tons per hour,
- Belt conveyor with sorting station for the separation of films, roofing, paper, etc
- Horizontal screening machine with an output of up to 250 cubic metres per hour for the separation of fines,
- Chain conveyor to fill the storage silos.

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36.3. Klöckner Wood Technology

Klöckner Wood Technology manufacture a wide range of machinery for wood waste recycling and also for the particleboard manufacturing industry.

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36.4. Rudnick und Enners

Rudnick & Enners
Maschinen- und Anlagenbau GmbH

Rudnick und Enners manufacture disposal and recycling plants for bulky wood waste, demolition wood, pallets and tree roots. Product outputs include chips for the particleboard industry as well as fuel for energy purposes.

A wood waste plant usually consists of:

- Heavy duty feeding conveyor for automatically filling of the crusher,
- Feeding by wheel loader or grabber,
- Pre-crushing of wood waste wood and residues,
- Belt conveyor with automatic magnetic separation
- Secondary grinder, a slow speed machine system to produce the final chip size,
- Tertiary processing through a vertical hammer mill.

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36.5. Vecoplan

Vecoplan

Vecoplan are manufacturers of machinery for the shredding, separating, recycling and storage of waste. They also provide machinery for smaller wood working companies, for example:

- Single-shaft shredder with an infeed ram,
- Smaller opening size of 80 x 70 cm to accommodate low throughput volumes,
- Controlled and monitored by a programmable integrated logic controller,
- Focus on producing a fuel product from offcuts.

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36.6. Zeno

Zeno manufacture machinery for the processing of wood waste to produce products for particleboard in addition to thermal recycling.

Specialist machinery includes:

- Grinding,
- Sorting,
- Processing of plastics and other synthetic materials
- Sawmill waste handling,
- Dosing and conveying.

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