BUSINESS ADVISORY SERVICES

STRATEGIC WASTE MANAGEMENT BOARD WESTERN AUSTRALIA

WOOD WASTE RECOVERY AND REUSE STUDY

31 July 2007

In Partnership With EMRC

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31 July 2007

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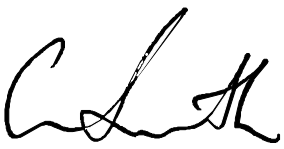
Dear Bianca

Final Report - Wood Waste Recovery and Reuse Study

Ernst & Young, in partnership with the Eastern Metropolitan Regional Council are pleased to present the final report on the Wood Waste Recovery and Reuse Study. We believe that the study has identified substantial and viable opportunities for industrial wood waste recovery and its reuse.

Both Ernst & Young and the EMRC have appreciated the opportunity to contribute to this worthwhile initiative and are pleased to provide this report.

Yours sincerely



Gary Smith
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Disclaimer.

It must be advised that all assessments in this study, although based on qualified desktop research and interviews with knowledgeable experienced respondents, remain subjective. The assessments include statements, estimates and projections that reflect various assumptions, which may or may not prove to be correct. The assessments do not purport to contain all the information a recipient of the study may require. The information gathered and presented within the assessments may not be appropriate for all persons and it is not possible to have regard to the investment objectives, financial situation and particular needs of each person who reads or uses the information. The projections contained in the assessments should not be taken as being statements or assurances of actual future returns. Readers of this study should make their own independent assessment and investigation. The information is of preliminary nature, and in light of the above, subject to clarification and change.

Executive Summary

This study represents an investigation into industrial wood waste recovery and its reuse opportunities in Perth. It assesses the types and amounts of industrial wood waste generated in the Perth's Eastern Region and the potential viable end use markets for the processed woodchip or sawdust across metropolitan Perth. The research, analysis and report have been prepared by Ernst & Young in partnership with the Eastern Metropolitan Regional Council (EMRC). The study expands on previous research conducted on the quantities of industrial wood waste generated by cabinetmakers in the Malaga business district (E&Y, 2005).

The study was undertaken in two workstreams. Workstream one assessed the types and quantities of industrial wood waste generated by selected businesses in the Eastern metropolitan Region, whilst workstream two assessed the potential end user markets for this type of industrial wood waste.

Workstream One – Types and Quantities of Generated Wood Waste

Workstream one determined that about 45,000m^3 of industrial wood waste per annum was generated from 50 selected significant wood waste generating businesses in Perth's Eastern Region. Industry sectors such as construction and demolition, shipbuilding, vehicle and equipment suppliers and timber manufacturing were identified as the predominant generators of waste wood.

Approximately 80% (36,000m^3) of the waste stream identified was held in the form of untreated timber, representing a strong potential raw materials base as an input to reuse markets. Of this untreated industrial wood waste, 59% was identified as source separated. For the untreated mixed industrial wood waste category to be further source separated, collaboration with existing waste collection companies is expected to be vital in fully capturing the resource potential.

Lessons learned in cardboard and paper recycling industries were used to enrich the recommendations for industrial wood waste recovery. Discussions with a major paper recycler, Amcor, confirmed the conclusions developed in the previous study that it is preferable to initially target larger generators of industrial wood waste to partake in industrial wood waste recovery, prior to focussing on small to medium enterprises. Larger companies tend to generate economies of scale through bulk collection and storage of industrial wood waste, with more efficient and focussed source separation of the required product.

Workstream Two – Potential End User Markets

Workstream two assessed the reuse opportunities of reusable industrial wood waste in nine different local markets: Animal beddings, Biomass energy, Composts, Fibre cement composites, Particleboard manufacturing, Spillage absorbents, Surface mulches, Water filters and Wood plastic composites.

The reuse opportunity of industrial wood waste in those markets was assessed on:

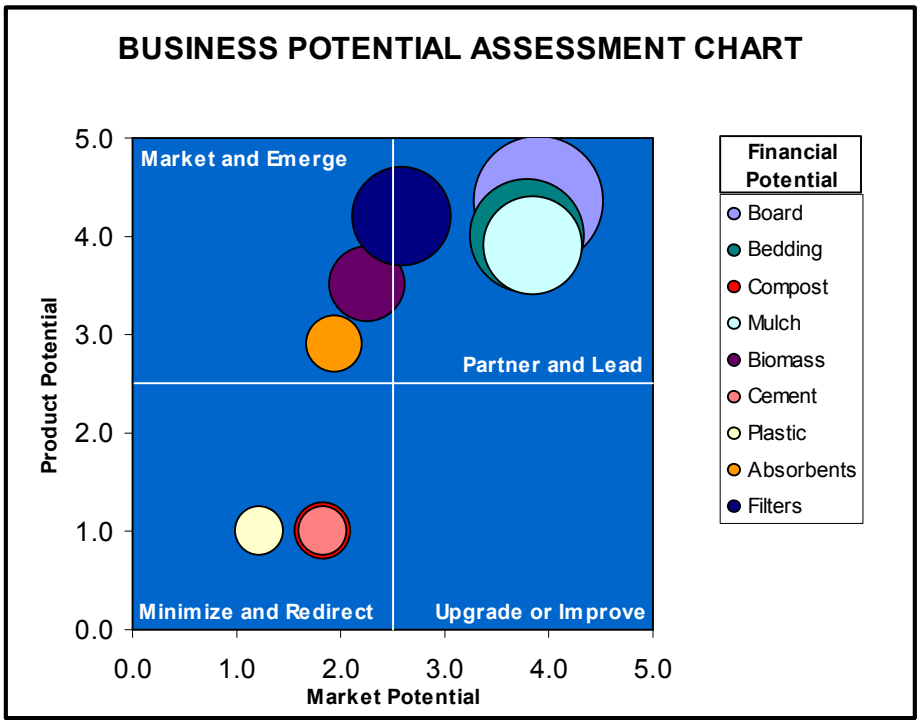
- product potential (compared to alternative raw materials);
- market potential (buyer specifications, drivers and barriers); and
- financial potential (expected revenues compared to investments).

Strategic Market Options

The assessment resulted in the dissection of the different market options into four different strategies for further market and product development:

- *Partner and Lead* – those options that have the opportunity to create leading opportunities in industrial wood waste deliveries, predominantly implemented through the creation of business partnerships and liaison with existing distributors or suppliers.
- *Market and Emerge* – those options that are considered to represent definite emerging markets with high revenue potential but still need significant product trials and marketing activities to create and secure future market positions.
- *Minimise and Redirect* – those options where industrial wood waste has not proven to be fit for purpose, requiring effort and investment to be redirected towards more sustainable ventures.
- *Upgrade or Improve* – those options that need product upgrading or improvements to service existing or different markets.

The strategies proposed for each business opportunity are presented graphically below.



Market Conclusions

Workstream two revealed three short-term viable local markets for the uptake and reuse of industrial wood waste: particleboard manufacturing, animal bedding and surface mulch.

Local surveys with industry players (manufacturers, wholesalers and end users) in these markets, supported by desktop research on international practises, revealed that these three markets together are expected to represent a total short-term demand of approximately 115,000m^3 of processed industrial wood waste per year, generating an estimated revenue potential of approximately $1,150,000.

Particleboard manufacturing represents an immediate demand of roughly 60,000m^3. Animal bedding and surface mulch represent a short-term demand potential for 55,000m^3. It is important to note that definite market potential needs to be created and secured through product trials, market and economic assessments.

The findings of this study thereby indicate that the immediate and short-term demand for approximately 115,000m^3 of processed industrial wood waste in metropolitan Perth exceeds the approximate identified supply potential of 36,000m^3 identified from 50 businesses in Perth's Eastern Region. At present there is only limited industrial wood waste processing capacity in metropolitan Perth servicing that demand.

The current supply potential of 36,000m^3 is expected to generate approximately $360,000 in annual sales revenues. This revenue estimate is based on first product output price calculations of the proposed EMRC industrial wood waste processing facility substantiated through findings from this study associated with current market price expectations.

Although this cannot be stated with certainty, it is expected that longer-term growth opportunities for the uptake and use of processed industrial wood waste will develop for markets such as water filters, biomass energy and spillage absorbents and the further substantial expected increase of uptake of industrial wood waste in particleboard manufacturing.

All opportunities are considered viable provided that the industry requirements for a contaminant free product, processed to specifications, are met.

The study further identified that collaboration with existing traders and wholesalers would be vital for the achievement of the reuse options identified. This study thereby confirms the preliminary projections proposed in the previous study, the Wood Waste Recycling in Malaga Project (E&Y 2005). Findings from that report stated that a regional industrial wood waste recovery and reuse program was considered to be viable, based on expected volumes of reusable industrial wood waste material and the expected demand potential for that resource, provided that products delivered met market specifications and were sufficiently free from contaminants such as nails and plastics.

The current study also identifies potential risks to the quantities of industrial wood waste generated in Perth's Eastern region. In an effort to mitigate destruction caused by termites, the Department of Agriculture's European House Borer division has advised that the use of treated pine for construction structures has increased to 30% during the past two years. In addition, recently introduced regulations to control the spread of the European house borer recommend the treatment of pine for those companies located within 'Risk Management Zones'. Both these measures could negatively impact on the quantities of reusable untreated industrial wood waste available for use by other markets.

The report proposes however, that a industrial wood waste recovery and processing facility would process industrial wood waste in such a way as to support control of the spread of the European House Borer. The European House Borer division fully supports and encourages companies to dispose of their industrial wood waste to such a facility, thereby creating an opportunity for the facility to receive additional materials that it may not have attracted without this new regulatory approach

1. Introduction

This research, analysis and report have been prepared by Ernst & Young in partnership with the Eastern Metropolitan Regional Council (EMRC). The study was funded by the Strategic Waste Initiative Scheme grants awarded by Waste Management Branch of the Department of Environment and Conservation.

Global context

Population growth and an increasing affluence on a global scale generate immense demands on our natural resources. Most natural resources known have become commodities on the global market and many of them are recycled to a great extent.

Five years ago the value of recycled paper was minimal and yet today it is a global trade commodity worth $150 a tonne. This global context demonstrates the opportunity to "make money out of waste" with important economic, environmental and social benefits. New business opportunities arise, creating new jobs, and waste that was formerly sent to landfill finds new ways to a market.

This study explores further industrial wood waste recycling in a local context in Western Australia, capturing the opportunities that are driven by global developments.

Background to Study

In 2005, the City of Swan commissioned Ernst and Young to conduct a feasibility study to examine the extent of industrial wood waste generated in the Malaga business district, and identify opportunities to divert the industrial wood waste from landfill (E&Y, 2005). Opportunities were identified for the recycling of an annual supply of 4,500m^3, of untreated and engineered industrial industrial wood waste produced by Malaga cabinetmakers. The study also ascertained that viable and stable markets for recycled timber would only emerge when major sources and quantities of high-grade industrial wood waste were determined, and reuse options identified, enhanced and developed.

The *Wood Waste Recycling in Malaga Project* was funded by the Waste Management Branch Strategic Waste Initiative Scheme (SWIS) grants. Subsequent to its findings, the City of Swan applied for further SWIS grant funding to quantitatively research the extent of industrial wood waste generated in Perth's Eastern Region, and to undertake qualitative assessment into viable local reuse market potential.

The *Wood Waste Recovery and Reuse Project* aims to therefore identify major sources of industrial wood waste generated in Perth's Eastern Region and reuse markets in metropolitan Perth.

The project has been classified into two workstreams:

- Workstream one: Extent and Type of Recoverable Industrial Wood Waste
- Workstream two: Assessing Local Markets for Reuse Options

The viability of a large scale industrial wood waste recovery and reuse programme is assessed by comparing the identified supply of reusable industrial wood waste generated in relation to the expected immediate, short term and longer term demand for the processed material. The operational business case to assess the viability of the actual business operation of a industrial wood waste recycling facility was not part of the scope of this study.

In parallel to the research for this study the EMRC has been developing a Wood Waste Recovery and Processing Facility in Lakes Rd, Hazelmere.

The EMRC operates the Red Hill Waste Management Facility, which includes a landfill, transfer station and green waste processing operations. The purpose of the establishment of the industrial wood waste recovery facility is to address regional waste disposal needs and divert industrial wood waste from landfill. The EMRC is responding to member council and commercial requirements for alternative waste treatment to landfill. Interviews held with members of the EMRC indicated that processed industrial wood waste could be sold to reuse markets for approximately $10/m^3$[1].

[1] Prices can range from $5 to $15 per m3 depending on market, contract volumes and the final specifications of the output material. In this stage of market development and research a reference price of $10 is used.

2. Key Findings

- Workstream one determined that about 45,000m^3 of industrial wood waste per annum was generated from 50 selected significant wood waste generating businesses in Perth's Eastern Region. Industry sectors such as construction and demolition, shipbuilding, vehicle and equipment suppliers and timber manufacturing were identified as the predominant generators of waste wood.
- Approximately 80% (36,000m^3) of the waste stream identified was held in the form of untreated timber, representing a strong potential raw materials base as an input to reuse markets. Of this untreated wood waste, 59% was identified as source separated. Providing this waste could be collected and disposed of in this manner, processing for reuse to other markets would be more cost efficient.
- For the untreated mixed wood waste to be source separated, education of wood waste generators and collaboration with existing waste collection companies is expected to be vital in fully capturing the resource potential. The untreated wood waste mixed with engineered and treated timber waste could also be manually separated at a processing facility to achieve effective market reuse potential. However extensive manual handling would increase processing costs.
- Some waste collection companies offer separate wood waste collection services and the majority of companies surveyed indicated that it would be relatively easy to source separate wood waste. This would contribute to the economic viability of processing industrial wood waste, as contamination and manual separation would be kept to a minimum.
- Industrial waste wood in good condition is reused, salvaged and on-sold by industry. The waste stream comprises predominantly damaged untreated pallets, crates, blocks and boards, along with untreated and engineered off cuts, treated and untreated hard and soft woods.
- Potential risks to the quantities of reusable wood waste generated in Perth's Eastern region were identified as: the trend for construction companies to utilise treated pine in an effort to mitigate destruction caused by termites; and companies located in 'Risk Management Zones' purchasing or treating wood following the introduction of recent regulations to control the spread of the European house borer pest.
- Some of the potential risk posed by the European house borer regulations could be mitigated through the use of a wood waste recovery facility; as it could process the wood waste in such a way as to adhere to the regulations. The European House Borer division fully supports and encourages companies to dispose of their wood waste to such a facility.
- It is advised to closely monitor trends in the construction industry, and it was noted that demolition wood waste was identified as the worst quality grade and the most difficult to reprocess. The quantities of reusable wood waste may therefore not be significantly impacted by the measure to utilise treated wood in this industry sector.
- Workstream two of this study identified three short-term viable local markets for the supply of industrial wood waste as a raw material[2].

[2] Conversion: 1 tonne industrial woodchip equates to approximately 4m^3

- Particleboard manufacturing was expected to have an immediate annual demand of 60,000m^3 for processed industrial wood waste. The particleboard-manufacturing market can be serviced directly, without the use of intermediate wholesalers or traders, for in WA it covers only one major industry player.
- Animal bedding is a market with an estimated annual demand potential of 47,000m^3. Product trials are needed with existing end users and wholesalers to ensure delivery of a product that meets industry requirements. Collaboration with existing traders and wholesalers may prove vital in successfully capturing the business potential.
- The market for surface mulches is expected to have an annual demand for industrial wood waste of 7,500m^3 in a very competitive market. Production trials in collaboration with existing mulch suppliers are needed to ascertain if industrial wood waste can be processed at a cost effective price to supply this market.

- The total annual value captured through servicing the three industries mentioned above is estimated to be $1,150,000, based on a total annual demand of roughly 115,000m^3 priced at $10 per m^3. A current supply potential of 36,000m^3 is therefore expected to generate $360,000 in sales revenues. This market potential may be realised within a period of three years provided that products delivered meet industry requirements and are sufficiently free from contaminants like metal and plastics.
- Potential future additional demands are expected from:
  - A substantial increase in raw material uptake capacity by the particleboard manufacturing market to a total of 240,000m^3 per year.
  - The water filter market that is still in experimental stages of development in Perth. The water filters market, applied in water sensitive urban design, is postulated to grow in the longer term into a bulk demanding market for processed industrial wood waste (no volume estimates are possible as yet).
  - Biomass energy production which may have substantial future potential (ranging from 100,000 to 400,000m3) when and if a large scale producer of thermal energy or electricity can be identified and located in the proximity of large scale suppliers of wood waste.

  The biomass energy option is a longer-term option due to the lengthy processes needed for planning and environmental approvals. The water filter option also represents a long term option due to lengthy product trials (>10 years). It is advised that processed industrial wood waste should be utilised in local current trials for the water filter market to determine product use viability. It is also advised to further explore, monitor and develop opportunities in the biomass energy market.
- This study confirms the projections performed in the previous study (the *Wood Waste Recycling in Malaga Project*) stating that a regional wood waste recovery and reuse operation is expected to be a viable business operation provided that products delivered fit industry requirements and are sufficiently free from contaminants like metal and plastics.
- Given that there is limited industrial wood waste processing capacity in metropolitan Perth, demand may currently outstrip supply.

3. Workstream One: Extent and Type of Industrial Wood Waste

Introduction

The aim of workstream one was to assess the extent and type of industrial wood waste generated from fifty selected significant wood waste generating businesses across Perth's Eastern Region. The research expands upon previous investigations conducted into the quantities of wood waste generated from cabinetmakers in the Malaga business district (E&Y, 2005), representing a broader cross section of industry sectors from a wider regional focus.

Specifically, the research aimed to identify:

- Industry sectors likely to generate large volumes of industrial wood waste in Perth's Eastern Region;
- Quantities and types of industrial wood waste generated from selected businesses in the Region;
- Current disposal methods and issues associated with contamination of wood waste materials; andPotential risks and opportunities that may impact the generation of industrial wood waste.

Methodology

To identify businesses generating significant volumes of wood waste, the following preliminary steps were undertaken:

- Perth metropolitan transport supply chains were reviewed;
- The wood waste chain of waste collection services and landfill operators was reviewed;
- Interviews were held with timber packaging and timber pallet manufacturers;
- Interviews were held with the Department of Agriculture (European House Borer division); and
- Discussions were held with members of the Waste Management Branch.

From these preliminary steps, a list was compiled of 123 businesses potentially generating large quantities of wood waste. Initial interviews with a cross section of twenty businesses on the list further refined the identification of industry sectors that generate significant quantities of industrial wood waste. Having refined the list, site visits and surveys were conducted with fifty industrial wood waste generators predominantly in Perth's Eastern Region, for identification of quantities and types.

Research was undertaken on a qualitative and quantitative basis, and results were analysed using a purpose developed MS Access database. The interview process is detailed further in Appendix 2.a.

A summary of the number and types of industries surveyed is presented in the table below. Despite its larger manufacturing base, these findings are consistent with a study conducted on waste timber generated by Melbourne businesses (Meinhardt, 1999).

Industry Sector	Nr of Interviews
Cabinet Makers	7
Construction Industry	7
Demolition Companies	2
Electronic Suppliers	1
Engineering Foundries	1
Mining Laboratory	1
Retail	3
Ship Builders	2
Timber Manufacturers	14
Transport and Logistics	2
Vehicle and Equipment Suppliers	10

Results

Industry sectors likely to generate large volumes of industrial wood waste in Perth's Eastern Region

The findings from the fifty businesses interviewed indicated that the generation of large quantities of industrial wood waste is concentrated to certain industry sectors including:

- Furniture and Timber Manufacturers;
- Construction and Demolition Industry;
- Ship Building Industry; and
- Vehicle and Equipment Suppliers.

Site observations found that the types of industrial wood waste generated by these industry sectors could be allotted into several categories, encompassing:

- *Untreated timber:* Softwood, pine packaging and lightly coloured materials including pallets, crates, off cuts, blocks, cable drums and sawdust. Small amount of hardwood off cuts, predominantly jarrah, also comprise this waste stream.
- *Engineered timber:* Particleboard, panel board, veneer coated panels and sawdust that can be utilised in other market segments when processed.
- *Treated engineered timber:* Predominantly MDF that cannot be utilised in other market segments when processed.
- *Treated timber:* Softwood, hardwood, pallets and packaging materials that have been treated with chemicals such as copper chrome arsenate (CCA).
- *Mixed timber:* Treated and untreated timber and engineered timber including blocks, off cuts, pallets, packaging, crates, sawdust, MDF and particleboard.

An analysis of the types of wood waste produced and quantities generated by each sector is summarised in the table below.

Table Industry Sectors Generating Larger Volumes of Wood Waste

Industry Sector	Type of Business	[3]Weekly Total (m^3)	Major types of wood waste generated
Furniture and Timber manufacture	**Timber frame and Pallet manufacturers**	247	Untreated off cuts (45%) Mixed timber – untreated (37%) Treated timber (6%)
	Cabinet Makers	184	Engineered timber off cuts (54%) Mixed timber (29%) Mixed timber sawdust (10%)
Construction Industry	**Demolition companies**	168	Mixed timber (100%)
	Building Supply Trade	67	Untreated timber pallets, wooden crates and off cuts (97%)
Ship Building Industry		110	Untreated timber pallets and off cuts (100%)
Vehicle and Equipment Suppliers	**Suppliers to the construction and mining industry**	73.5	Untreated timber pallets and wooden crates (99%)
TOTAL PER WEEK		849.50	

The above table illustrates that the construction building supply trade, shipbuilding and vehicle and equipment suppliers predominantly dispose of untreated wood waste that is currently source separated. The quality of this wood waste is high and minimal manual handling would be required for cost effective processing for reuse to other markets, providing that it is not mixed with other waste streams when collected.

Engineered timber off cuts generated by the cabinet making industry were generally source separated and it is noted that some of this material could be reused in other markets, particularly in the manufacture of particleboard. Where timbers were mixed in disposal bins, the majority of respondents indicated that it would be relatively easy to separate those materials. The motivation of cabinetmakers to further source separate would be encouraged by:

- Education as to the reuse markets for industrial wood waste; and
- Cost savings that could be passed on by collection companies (lower disposal fees be incurred at a wood waste recovery and processing facility as opposed to landfill).

[3] Note: the weekly volumes represent the greatest proportion of wood waste generated, which are categorised into types of wood waste generated as a percentage of this greatest proportion. Minor quantities have not been included in this table as the premise is to demonstrate which types of wood waste are being generated in larger volumes.

Timber manufactures usually separate untreated timber off cuts. It is noted that for both the cabinetmaker and timber manufacturing industries, hardwood off cuts or blocks represented a small percentage of the waste stream. Machinery is 'set' in such a way as to minimise waste, as hardwoods are a more costly raw material source than softwoods.

A number of respondents from the building supply trade, timber and pallet manufacturing industries were located in EHB 'Risk Management Zones' and some interviewees indicated that they were considering treating timber to comply with regulations. This decision may potentially restrict the quantities of reusable wood waste available for reuse.

The construction demolition industry sector generated the least quality reusable wood waste. It is envisioned that considerable efforts would have to be made in terms of source separation or manual separation at a wood waste recovery and processing facility for viable reuse of this material. Whilst this industry generated considerable amounts, it was predominantly mixed with other waste streams from the construction industry. Further site visits and discussions would need to be held with proponents of this industry sector to determine the best cost effective option for a wood waste recovery and processing facility to accept this waste.

Quantities and types of industrial wood waste generated from selected businesses in the Region

Collated Data

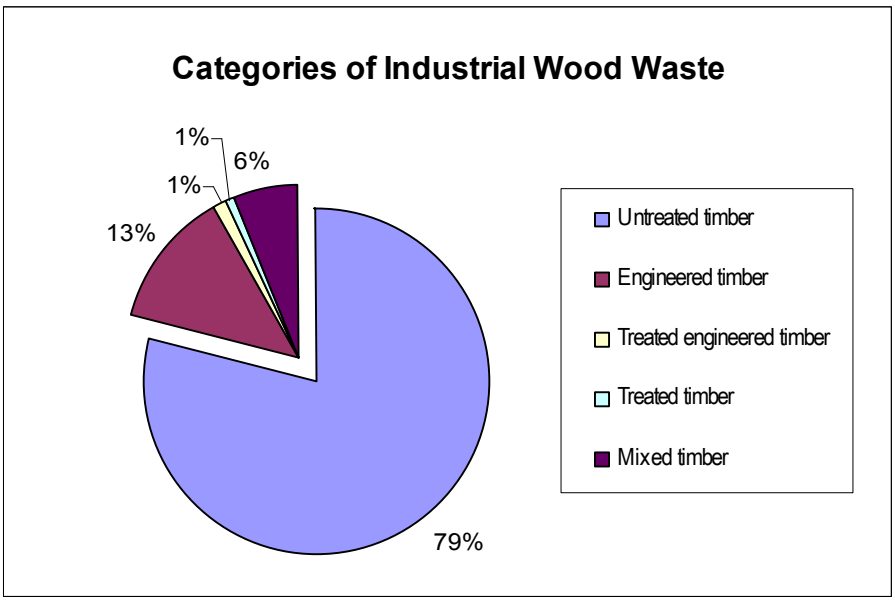
On aggregate, the responses from the businesses surveyed indicated that approximately 880m^3 per week of industrial wood waste is generated. This figure equates to 45,760m^3 per annum if simply extrapolated across the year.

Categorised Data

In summary, industrial waste wood in good condition is reused, salvaged and on-sold by industry. The waste stream comprises predominantly damaged untreated pallets, untreated pine packaging crates, untreated timber off cuts, blocks and boards, along with engineered off cuts. Untreated off cuts, blocks and boards included minimal amounts of hardwood and majority pale soft woods.

Table Quantities and Types of Industrial Wood Waste Generated

Category of Industrial Wood Waste	Crates	MDF	Mix	Off Cuts	Pallets	Saw Dust	Category Total	% of Total
Untreated timber	89		265	146	176	20	696	79%
Engineered timber				109		3	112	13%
Treated engineered timber		5.5		6			11.5	1%
Treated timber				10	0.5		10.5	1%
Mixed timber			50				50	6%
Total for Category types	**89m^3**	**5.5 m^3**	**315 m^3**	**271 m^3**	**176.5 m^3**	**23 m^3**	**880 m^3**	100%



Whilst section 4 of this report discusses in more detail the potential viable markets for processed wood waste, it is worth noting now that all identified markets require untreated wood waste processed into woodchip, as wood fibre or as sawdust. This study did not reveal any markets for

treated wood waste whilst particleboard and veneer panelling could be reused in particleboard manufacture.

Untreated wood waste accounted for 79% of the industrial wood waste stream or 696m^3/week. This represents about 36,000m^3/annum when extrapolated on an annual basis. Of this untreated wood waste, 59% was identified as source separated, which was made up of pallets, off cuts and wood crates. For the untreated mixed wood waste category to be further source separated and designated wood waste collection services to be established, education of wood waste generators as to the markets for wood waste and collaboration with existing waste collection companies is expected to be vital. In addition, any cost savings experienced by the waste collection companies in disposing of wood waste to a designated wood waste recovery facility as opposed to landfill would further motivate generators to source separate.

Current disposal methods and issues associated with contamination of wood waste materials

Observations made during the site visits did not record high contamination levels of the wood waste from food waste or general rubbish. The main contamination present by each industry sector was:

Industry Sector	Type of contamination
Furniture and Timber manufacture	Cardboard, plastic wrappings, empty drums
Demolition companies	Construction waste including metals, bricks, tiles, sand and soil, plastics
Building Supply Trade	Nails, bolts, plastic strapping
Ship Building Industry	Nails, plastic strapping
Vehicle and Equipment Suppliers	Nails, plastic strapping, cardboard

All of these materials will present issues for the reuse of processed wood waste into markets. Therefore, it is necessary to either source separate on disposal, manually separate at a processing facility or remove items by processing equipment.

General discussions with interviewees indicated that cardboard could be readily separated but it would be difficult to remove all strapping and plastic wrappings. Essentially, employees would either not have the time or motivation to do so.

Of the fifty businesses interviewed, 33 responses were received detailing waste disposal practices. The majority of respondents (23) utilise commercial waste collection services, thus underlying the importance of collaborating with these companies to provide source separated designated wood waste collections.

Lessons learned from the paper recycling industry (Appendix 4) and site visits indicated that larger generators should be targeted first. Quantities generated, current source separation practices and lack of contamination revealed that the shipbuilding, vehicle and equipment suppliers and building supply industry sectors generated the highest quality wood waste for reuse to markets. The establishment of a wood waste recovery facility is advised to consider targeting the larger generators within these industry sectors, as well as the waste collection companies, to facilitate receipt of source separated wood waste for cost effective processing.

Potential risks and opportunities that may impact the generation of industrial wood waste

European House Borer

Several respondents reported that whilst they currently generate untreated industrial wood waste, they are considering treating timber as a result of recently introduced regulations to control the spread of the European House Borer (State of WA, 2006). This has the potential to negatively impact the volumes of reusable wood waste received at the processing facility.

However, a wood waste recovery and processing facility would process wood waste in such a way as to control the spread of the pest. The European House Borer division fully supports and encourages companies to dispose of their wood waste to such a facility. Consequently, it may therefore receive additional materials due to it's creation of a treatment method that complies with regulations.

Use of alternatives

Large users of pallets such as Midland Brick actively assess alternatives to their use including pallets manufactured from plastics. To date, the alternatives have proved more expensive. Fuji Xerox indicated that they have trialled pallets manufactured from corrugated recycled cardboard. However, as packages of paper are invariably stored on these pallets, intrusion of moisture can cause damage to the paper. The supermarket chains Coles and Woolworths stated that there has been a shift from fruit and vegetables being supplied in wooden crates to cardboard boxes. Bunnings have requested that suppliers deliver goods packaged in cardboard as they now operate a warehouse style layout at their stores. This saves costs as goods are simply shelved in the packaging they are received in. However, the use of alternatives is not viewed as a risk in the short to medium term. The major shifts have already occurred and no other major shifts are expected and deemed to be viable in the short to medium term.

Both cabinet makers and equipment or vehicle suppliers, especially to the mining industry, expect an increase of about 5% in the volumes of wood waste produced. Both these markets are inter-related and should a downturn occur in the mining sector, it is expected that wood waste generation would be adversely affected.

'Green Star' Accreditation

The 'Green Star' accreditation is an internationally recognised rating system that assesses the environmental performance of buildings. Developed by the Green Building Council of Australia in conjunction with the Property Council of Australia, it provides an extensive assessment of energy performance, management, indoor environment quality, transport, water, materials, land use and ecology, and emissions (www.buildingcommision.com.au).

The 'Green Star' accreditation is a voluntary system and although not currently widely used in Australia, it is a mechanism to encourage builders and developers adopt a more sustainable

approach. Pressure from increasing consumer awareness and media interest in global warming issue, may translate to more rapid adoption of accreditation programmes such as the 'Green Star'. These types of programmes can be used effectively as a marketing tool by builders and developers and add value to products. Products such as particleboard manufactured from processed woodchip, due to it's high recycled content, can attract a greater market demand due to the wider implementation of the Green Star scheme (based on recent insight: products by itself cannot apply for Green Star accreditation) . If these products lead to increased sales, it will encourage more manufacturers to consider utilising recovered resources where possible.

Additional Information

Stockpiles

Through the course of the study several stockpiles of wood waste were identified (approximately 1,800m^3) at council operated and private landfill sites and transfer stations.

There is the potential for these identified stockpiles to be processed on site or diverted from landfill to a wood waste processing operation. The difficulty with processing on site is the prevention of contamination of the material. In addition, transportation of these large stockpiled quantities may prove too costly for effective processing at a facility.

Key Consideration to the Data

A number of factors should be considered in review and representation of the data from the surveys conducted for this study:

- Quantities generated may not be typical of other regions.
  It is noted that Perth's Eastern Region incorporates the business districts of Malaga, Belmont, Bellevue, Bayswater and Bassendean (see appendix 2.c. for a map). Centralised business districts by their nature attract other industries to establish in close proximity. The quantities generated may therefore not be typical of quantities generated in less industrial regions.
- Some approximations on cubic metres generated are made.
  Not all companies surveyed utilise waste collection operators to collect and dispose of wood waste. Some distribute wood waste such as pallets to neighbouring industries, others allow the general public to collect for firewood and others dispose of wood waste to landfill by their own means. Therefore, not all companies surveyed could provide exact data on volumes generated. Approximations were made based on an analysis of volumes generated by similar industries surveyed and the margin of error is considered to be 5 - 10%.

Sources

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- Meinhardt (Vic) Pty Ltd, 1998, Collection of Waste Timber from Melbourne Businesses.
- Ernst & Young, 2005, City of Swan Strategic Waste Initiative Scheme Wood Waste Recycling in Malaga.
- Interviews with 50 selected businesses across various industry sectors in Perth's Eastern Region.

4. Workstream Two: Assessing Markets for Reuse Options

Introduction

Workstream one identified 36,000m^3 of largely source separated (59%) untreated industrial wood waste with reuse potential being generated from 50 selected significant wood waste generating businesses in Perth's Eastern Region. Desktop research reviewing wood waste recovery and re-use practises around the world and in Australia identified a number of emerging markets for the reuse of industrial wood waste. The aim of workstream two was to qualitatively assess the potential for these markets in metropolitan Perth.

With the possible further identification of significant volumes of generated wood waste, a number of reuse applications could become feasible thereby increasing the viability of the establishment of a comprehensive regional wood waste recovery and reuse operation.

Methodology

This study aims to contribute to the development of substantial, stable and efficient Western Australian markets for products made of industrial wood waste. Viable options, opportunities, constraints, strengths and weaknesses for the use of industrial wood waste are outlined. The study focuses specifically on those markets that are expected to generate a bulk and clustered demand for the industrial wood waste. It is not considered feasible to aim for a retailing market with scattered and small volume demand in the start-up phase of a wood waste recovery and reuse program or facility as the processing and logistical costs would be too high.

Markets assessed

Internationally, the following (bulk demanding) markets demonstrated or were expected to demonstrate successful and commercial uptake of industrial wood waste:

- Animal (cattle, horse and poultry) beddings;
- Biomass energy;
- Composts;
- Fibre cement composites;
- Particleboard manufacturing;
- Spillage absorbents
- Surface mulches;
- Water filters; and
- Wood plastic composites.

This study explores each of those markets locally in metropolitan Perth and aims to identify viable markets for the use of industrial wood waste as a raw material.

In order to meet these aims the study considers:

- Existing and emerging markets for industrial wood waste in metropolitan Perth in order to increase understanding regarding how such markets operate;
- The characteristics of the main alternative raw materials available in those markets;
- The preferences and buying behaviour of the purchasers of these products; and
- If and how industrial wood waste might achieve penetration into those markets.

Assessment criteria

In order to assess the market potential for the uptake of industrial wood waste, the wood waste was compared with the feedstock alternatives currently used in that market. This comparison was made not only on cost and product performance, but also on durability, availability, legal implications, compatibility with existing handling systems and perceptions regarding the potential for contamination as being a waste derived product.

For each market the following characteristics were described to assess the business potential for the supply of industrial wood waste by appraising a combined *product potential*, *market potential* and *financial potential*. All indicators were reviewed in an integrated *business potential* assessment chart resulting in the identification of relevant business strategies per market opportunity.

The **product potential** of industrial wood waste compared to alternative feedstock materials is developed through an assessment of the following dimensions:

- Fit for purpose: product performance on client requirements.
- Cost: prices for the product compared to alternatives.
- Feedstock availability: ability to source sufficient adequate grade wood waste feedstock.
- End use efficiency: life cycle costs of using the product.
- Availability: is there a gap in supply of competing alternatives that can be assuaged.
- Ease of handling: is the product easy to work with / process.
- Ease of disposal / recycling: can the product be disposed off easily or even recycled.

Its **market potential** is assessed through an appraisal of the following dimensions:

- Demanding players / industries: expected structural and clustered demand for the product.
- Competition intensity: expected number of industry players and alternative products competing for the same market.
- Market perceptions: the nature (positive or negative) of the general perceptions about a waste derived product.
- Regulations and standards: the impact (prohibitive or stimulating) of regulations and standards on the market introduction.
- Distribution infrastructure: existing infrastructure of traders, wholesalers, client relationships where the new product can build upon.

- Other drivers and barriers: other external drivers and barriers known that can stimulate or prohibit the market introduction.

Its **financial potential** is assessed through an appraisal of the following dimensions:

- Expected revenues: revenues to be expected from the introduction of industrial wood waste on that market
- Expected capital investments: investments (in processing technology, quality assurance, handling, storage and delivery) to be done to be able to supply a product derived from industrial wood waste that fits market requirements.
- Financial potential: the assessment of the relative financial potential is done through dividing the expected revenues through the expected investments.

All scores on every dimension are subjective appraisals based on desktop research and local surveys and range from low=1, minimal=2, medium=3, significant=4 and high=5. The desktop research identified global and national practises and trends. Local surveys (interviews and site visits) revealed local practises meeting with customers, traders and producers acting in the various markets.

The summarising market assessments on the dimensions mentioned above are provided in the subsequent sections of this chapter. A further detailed account of the study findings is included in the market details section in Appendix 3.

Animal Bedding

Application

The use of wood waste shavings and sawdust as animal bedding has a long tradition around the world. In farming areas, straw dominates the market, as it is available in large quantities as a by-product of grain crops. Away from farming areas, sand, shavings and sawdust generally represent the bulk of the market.

Product Potential

Industrial wood waste has a high product potential for use as animal bedding, particularly for the following reasons:

Product Potential	Score
Fit for purpose	5
Cost	5
Feedstock availability	2
End use efficiency	3
Availability	5
Ease of handling	3

- *Fit for purpose:* When the processed industrial wood waste feedstock is delivered without contaminants like metal and plastic, it has the potential to outperform the current alternatives of sand and "clean and green" sawmill residue sawdust. It outperforms these alternatives based on its dust free properties, durability and cost effectiveness. The industrial wood waste product combines the preferred thermal properties of sawmill residue sawdust and the economics of sand.

  The local industry leader in racehorse training demonstrates this by using wood chips made of recycled pine pallets delivered to the company at only a third of the price of the current alternatives.

- *Cost:* Where generated locally, industrial wood waste can be delivered at half or even a third of the price of the alternatives, such as sand and sawmill residue sawdust.

- *Availability:* The current demand for sawmill residue sawdust is outstripping supply, which increases the prices for the preferred "clean and green" product. This is forcing the market to search for more affordable alternatives. Industrial wood waste has significant potential to fit that gap as a cost effective alternative.

Dimensions that particularly need attention for this market are:

Feedstock availability: The wood waste feedstock for bedding material is a fine chip (sawdust). This is typically smaller than the product output from most industrial wood waste processing operations, however, it may be generated as a 'fine fraction' by-product. Further market trials need to be performed to better ascertain the industry demands and potential facility outputs for product specifications.

Market potential

Industrial wood waste has significant market potential to be used as animal bedding, particularly when the following dimensions are considered:

Market Potential	Score
Demanding players and industries	5
Competition intensity	5
Market perceptions	2
Regulations and standards	2.5
Distribution infrastructure	5
Other external drivers and barriers	2.5

- *Demanding players:* Local research across several potential markets for wood based bedding identified two significant, clustered and relatively well organised local industries, both demanding significant amounts of wood based materials for animal bedding:
  - the Perth based poultry farm industry demanding a total of 105,000m^3 of sawdust per year and paying a total amount of $2.3m per annum.
  - racehorse trainers clustered around Ascot estimated to use 30,000m^3 of wood based animal bedding per annum and paying $750,000.

  Cattle and dairy farms, piggeries, livestock transporters, dog kennels and catteries were also investigated but were not broad scale and bulk users of wood based animal bedding or litter.

  This adds up to a substantial annual current demand estimate of 135,000m^3 for wood based animal bedding in Perth (refer to further details on the calculations to Appendix 3.c.). Both industries indicated they would trial industrial wood waste to assess if it meets market specifications and is an economic alternative. Based on a successful outcome from these trials, market demand potential could increase by an extra 30,000m^3 (substituting sand as animal bedding with racehorse trainers).

- *Competition intensity and distribution infrastructure:* The study identified three bulk suppliers servicing the animal bedding market that were open to the introduction, trial and testing of the industrial wood waste product. When introduced through existing suppliers, distributing and introducing a product derived from industrial wood waste can build on existing client relationships and distribution channels.

Dimensions that particularly need attention for this market are:

- *Market perceptions:* Earlier experiences with the use of wood waste based products have made end users sceptical of the success of a new provider. Metals, glass and chemical contamination seemed unavoidable with earlier trials. Contamination concerns must be clearly addressed before similar products are reintroduced to the market.

  It is noted that the local industry leader in racehorse training is using wood chips made of recycled pine pallets delivered to the company at only a third of the price of the current alternatives. It would therefore appear that once contamination issues have been addressed, the market may be driven by cost effective alternatives.

Financial Potential

The relative financial potential is based on estimated market volumes, annual revenues and capital investments. The score results in a relative financial potential estimate based on dividing the expected annual revenue score by the expected capital investment score.

Financial potential	Score
Expected revenues	4
Expected investments	3
Relative financial potential	1.3

- *Market volume estimate:* Research in the UK demonstrated that recycled wood waste products currently make up 35 per cent of the wood-based products market in the UK, with the potential for further growth based on demand for dust-free properties and price competitiveness. The identified willingness of the local market in Perth to purchase cost effective alternatives indicates a similar outlook. Applying the 35% proportion of market penetration for the total of the Perth market of 135,000m^3 results in potential estimated market volume in Perth of 47,000m^3/year.
- *Annual revenue estimate:* Based on current product output price estimates, a wood waste recycling facility would be able to provide a bedding product at $10 per m^3 (excluding freight). This generates an average estimated annual revenue potential of $470,000.

  The estimated volume demand in this market is more than 150% of the identified reusable wood waste material of workstream one (36,000m^3) and would therefore be classified as high (=5). Further market trials need to be performed to better ascertain the industry demands and facility outputs for product specifications; therefore the classification is reduced to a more conservative significant (=4).
- *Estimated investments:* Apart from regular but stringent quality control standards and processing technology needed to provide a contaminant free product, there are no extra capital investments needed to service this market. The estimated investments therefore are rated as medium (=3).
- *Relative financial potential:* The relative financial potential is based on dividing the expected annual revenue potential score = 4 by the rating on expected capital investments = 3 and results in the score 1.3.

Conclusion

The local animal bedding market provides significant opportunities for industrial wood waste to be successfully introduced as a lower cost, high value option compared to alternatives. It provides the thermal and dust free properties of "clean and green" sawdust along with the economics of sand. The significant potential local demand for product derived from industrial wood waste expected to be represented by two industries: poultry farmers and over 200 racehorse trainers located in Perth. Together they could represent a demand of 47,000m^3 per year, generating expected revenue of $470,000 per year.

The estimated volume demand in this market is significant but not expected to be simply secured due to the uncertainty of feedstock availability. This stems largely from the ability of a wood waste processing facility to produce the specified fine particle size product in sufficient quantities. Further industry trials are needed to get the definite industry specifications and capture its demand.

Biomass Energy

Application

Bio energy in the form of heat or electricity is produced by burning biomass (organic products, residues and wastes) directly as a fuel, or by converting it to biogas or liquid bio fuel. Increasing concern over global warming and rising oil fuel costs may lead to wood being viewed as an increasingly attractive energy source along with other forms of biomass. Approximately 11% of the world's energy now comes from biomass, and about half of this is wood (more so in developing countries than in developed countries) (IEA, 2003).

Product Potential

There is moderate product potential for the use and uptake of industrial wood waste in the production of biomass energy. The key aspects of the assessment of that potential were:

Product Potential	Score
Fit for purpose	4
Cost	3
Feedstock availability	5
End use efficiency	2.5
Availability	2
Ease of handling	2.5
Ease of disposal	4

- *Fit for purpose (electricity and thermal energy):* If wood waste were mixed with other sources of wood supplies, it would produce adequate calorific value (similar to coal) for electricity and thermal energy plant operations.
- *Cost:* The generation of electricity and thermal energy from wood waste could be viable in WA. It offers a renewable fuel source for energy generation and could reduce fuel costs for thermal energy. For this to occur, the source of wood waste must be in close proximity to a large-scale reuse option.
  Some businesses have been identified to use industrial wood waste and forestry wood waste as a viable alternative.
  - In Western Australia Pinetec supplies forestry wood waste from their sawmill operation to the Western Power power grid in Collie. The operation is one of the largest cogeneration plants in Australia using approximately 80,000 tonnes (320,000m^3) of wood waste per annum.
  - The cement producer, Adelaide-Brighton in Birkenhead, Adelaide, uses demolition timber waste producing thermal energy for their cement manufacturing process. Whilst this option is viable in Adelaide, a similar operation may prove uneconomical in Western Australia due to the abundant local supply of natural gas and coal.
  - It is noted however that workstream one identified a significant generator of industrial wood waste in close proximity to a local cement manufacturer. Preliminary discussions with the manufacturing parent company revealed that the possibility of utilising industrial wood waste for thermal energy could be considered.

  The environmental cost of coal and oil is not attributed to their market price. If triple bottom line accounting was employed, biomass may have a more positive cost profile. However, discussions with various stakeholders in the bio energy market revealed that this was unlikely to occur in the near future.

- *Feedstock availability:* Industrial wood waste must be chipped for its use in the biomass energy market. It is expected that the main output of a wood waste processing facility would meet biomass industry requirements.
- *Availability:* A CSIRO report demonstrates that biomass is one of the most costly supplies of energy in Australia (The Heat is On, CSIRO, 2006). With Australia's abundant supplies of coal and gas, its infrastructure well established and paid off, and many industries dependent on it the scope for alternatives is limited. Furthermore the biomass option as a power source is dependent on securing a reliable supply of significant quantities of wood waste, which can be a challenge.
- *Ease of Disposal:* The ash residues of biomass can be used in the manufacture of cement or compost. The ash must adhere to certain specifications and be free from contaminations.

Market Potential

Biomass and the use of industrial wood waste in electric and thermal energy production seem to have a somewhat constrained market potential, particularly through the scores on the following dimensions:

- *Demanding players:* In Australia less than 5% of energy is generated using biomass fuels (Australian Institute of Energy, 2007). There is growing interest in producing bio energy in Australia by burning biomass in power stations, including waste wood chip. Power stations at Isis in Bundaberg, Maryborough, Proserpine, Rocky Point and Collie all use forestry waste wood chip as a supplementary fuel to increase capacity. In Western Australia, the current use of industrial wood waste as a resource in the generation of electricity or thermal energy is non-existent.

Market Potential	Score
Demanding players and industries	3
Competition intensity	3
Market perceptions	2
Regulations and standards	1
Distribution infrastructure	1
Other external drivers and barriers	3

  Whilst it is understood that a biomass plant may be established on the outskirts of Perth and that planning and environmental regulations have been met, it is not known whether short-term implementation is expected. There are a number of other factors that must be met apart from planning and environmental regulations.

  As the prices of non-renewable energy sources such as oil continue to increase, the residential market for bio fuel may also increase. For instance, the major market for biomass fuel is Europe where the demand has increased rapidly since the adoption of the Kyoto Protocol and the reluctance to rely on another country for energy.

  The assessment reveals a minimal current potential but a medium future potential demand for processed industrial wood waste in this market.

- *Competition Intensity:* Competition for bio energy resources is coming from both the demand and supply side. On the demand side the biomass market is competing with less expensive and widely available fossilised fuels. On the supply side, larger players and industries compete for forestry residues and when available processed industrial wood waste. On the demand side, collection and processing of industrial wood waste may prove more costly than available coal and gas supplies, for the generation of electricity and heat. The competition on the supply side will affect processed industrial wood waste quantities available for biomass energy plants.

- *Market perceptions:* The overall market perception on using processed industrial wood waste as an energy source is positive. In general however, industry players do not seem to proactively invest in the uptake and use of biomass as a resource in the production of energy. Industry seems to have adopted a 'wait and see' approach which has been further underlain by the recent establishment of investigations into carbon emission schemes introduced by both State and Federal governments.
- *Regulations and standards:* The use of industrial wood waste as a thermal or electrical energy source incurs considerable adherence to regulations and standards. Processes can take five years or more to establish the infrastructure, undertake community consultation and adhere to planning and environmental regulations.
- *Other external drivers and barriers:* As yet, there is no established carbon-trading scheme in Australia. In 1997, The Australian Biomass Taskforce was established to promote the use of biomass in manufacturing and electricity generation. Recommendations from this Taskforce may encourage increased market uptake of biomass technologies.

Financial potential

The financial potential of a market is based on estimated annual revenues and capital investments. The score results in a relative potential estimate based on dividing the expected annual revenue score by the expected capital investment score.

Financial potential	Score
Expected revenues	3
Expected investments	5
Relative financial potential	0.6

- *Expected annual revenues:* Short term expected revenue is minimal but potential revenues might be high as industrial wood waste can be a less expensive fuel source if the supply source is located in close proximity to a biomass plant (=3).
- *Estimated capital investments:* Creating a viable market opportunity requires the establishment of a wood waste processing facility in close proximity to a thermal or electricity producer. In addition lengthy processes for obtaining appropriate planning and environmental permissions are required (=5).
- *Relative financial potential:* The relative financial potential is based on dividing the expected annual revenue potential score = 3 by the rating on expected capital investments = 5 and results in the score 0.6.

Conclusion

The local market for generating biomass energy using industrial wood waste has reasonable product potential due to acceptable calorific values of the product, providing the source of wood waste is in close proximity to a biomass plant. Successful implementation in Australia is rare but not impossible. Possible synergies and opportunities need to be further explored and identified.

The present local demand for industrial wood waste as a source of thermal energy is non-existent. A biomass power plant may be established on the outskirts of Perth but it is not known whether short-term implementation can be expected. In summary, the market potential for industrial wood waste to be utilised for biomass energy is constrained by factors including: competition for supply, competition from fossilised fuel industries, industry taking a cautious approach to investment, planning and environmental regulations required and the required proximity of supply. It is advised that opportunities be further identified and explored.

Compost

Application

Composts are commonly and successfully applied in the fertilisation of turf in parks and road verges or as a soil structure improver and a nutrient source.

Product potential

- *Fit for purpose:* Although composts are expected to generate a growing market demand, industrial wood waste is not considered as the preferred feedstock for the production of composts. Alternative preferred feedstock sources like fresh green wastes, manures and food residues are widely available at lower costs to the market. In many cases, no charges for those feedstock materials apply and some cases producers even get a fee to receive and process those feedstock materials.

Product Potential	Score
Fit for purpose	1
Cost	1
Feedstock availability	1
End use efficiency	1
Availability	1
Ease of handling	2.5

Market potential

- *Demanding players and industries:* As detailed above, industrial wood waste is not the preferred feedstock for compost producers.
- *Distribution infrastructure:* A well established existing distribution infrastructure of compost producers and suppliers exists.

Market Potential	Score
Demanding players and industries	1
Competition intensity	1
Market perceptions	1
Regulations and standards	1
Distribution infrastructure	5
Other external drivers and barriers	2.5

Financial potential

- Expected revenues: no revenues are expected from the supply of wood waste to the compost producing industry (=1).
- Expected investments: further to the regular requirements of removing contaminants, no significant capital investments are needed to be able to supply the compost industry with wood waste feedstock material if it was preferred (=3).

Financial potential	Score
Expected revenues	1
Expected investments	3
Estimated financial impact	0.3

Conclusion

No short or longer-term market potential was identified for the use of processed industrial wood waste as a feedstock material to compost production. Alternatives like shredded green wastes perform better are widely available at lower or no cost.

Fibre Cement Products

Application

Fibre reinforced cement building materials were developed by James Hardie in the early 1980s. These materials enabled the use of alternative reinforcing materials to create asbestos-free cement-based building products. Fibre reinforced cement products encompass a range of planks, pipes, columns and sheets that can be used in renovations and the construction of commercial buildings and new homes.

Product Potential

- *Fit for purpose:* Current fibre cement products are a mixture of cellulose fibre, from plantation-grown Radiata Pine trees, cement, sand and water. Members of the Cement Industry Association revealed that industrial wood waste is not expected to be a viable resource in the manufacture of fibre cement products. The cellulose fibre is sourced from plantation timber and of the highest quality to meet structural building requirements.

Product Potential	Score
Fit for purpose	1
Cost	1
Feedstock availability	1
End use efficiency	1
Availability	1
Ease of handling	1

Market potential

- *Demanding players and industries:* The study identified one niche industry supplier, Timbercrete, located in Donnybrook. Timbercrete produces hand-made and air-dried bricks, and the owner expressed an interest in trialing alternative feedstock material. Mainstream bulk demanding local industries have no current or proposed plans to trial the use of industrial wood waste as an input to fibre cement products.

Market Potential	Score
Demanding players and industries	1
Competition intensity	1
Market perceptions	1
Regulations and standards	1
Distribution infrastructure	5
Other external drivers and barriers	2.5

- *Market perceptions:* The Western Australian building industry is booming and the market does not seem to have the capacity or interest to trial new products. Western Australian homes are predominantly built from 'brick and tile'. Resources would need to be dedicated to marketing efforts to persuade the marketplace to use a different product, especially one partially derived from wood waste.
- *Distribution infrastructure:* If a fibre cement product utilising wood waste was developed, cement manufactures could utilise existing distribution and supply chains and marketing channels.

Financial potential

Short-term revenue is expected to be low in this market and expected investments medium to high due to extra processing and trialing requirements related to building standards accreditation. In addition, considerable spending would likely be required on marketing activities due to educate the market about the new product.

Financial potential	Score
Expected revenues	1
Expected investments	4
Estimated financial impact	0.25

Conclusion

There is no potential expected for the uptake of industrial wood waste in the production of fibre cement composites. The current feedstock is required to be of high quality plantation timber in order to meet structural building requirements.

Particleboard

Application

Particleboard was engineered as a replacement for plywood and commercially produced in Germany during the war. Particleboard is an engineered wood product manufactured from wood particles such as wood chips, sawmill shavings, sawdust, industrial wood waste and a resin or binder that is pressed and extruded. Particleboard is now less expensive than wood or plywood and is substituted when appearance and strength are less important than cost. Apart from furniture design, particleboard is used in shop fittings, built-in units, kitchen cabinets, shelving and toilet partitions and for structural applications including access flooring, commercial and domestic flooring, and concrete formwork.

Product potential

Industrial wood waste has significant product potential as a feedstock in particleboard manufacturing particularly on the following dimensions:

Product Potential	Score
Fit for purpose	5
Cost	5
Feedstock availability	5
End use efficiency	2.5
Availability	4
Ease of handling	2
Ease of disposal / recycling	5

- *Fit for purpose (general):* The Australian Wood Panel Association (AWPA) has indicated that three of its five utilise industrial wood waste in their particleboard manufacturing operations. Industrial wood waste fits industry requirements well.
- *Cost:* Although particleboard plants are generally located in close proximity to forestry's, stakeholders in the particleboard market and indicative figures from the Australian National University (ANU) indicate that industrial wood waste is a less expensive input than forestry wood chip ($10 compared to $18.5 per m^3). Even though the majority of wood waste will be generated in and around a metropolitan area, costs can be greatly reduced when back loading of vehicles on return trips is applied. This is particularly the case for Perth.
- *Feedstock availability:* Industrial wood waste must be chipped to market specifications; however the general output specifications of a wood waste processing facility seem to meet industry standards.
- *Availability:* There is a growing demand for wood based resources perceived by various local industry players interviewed for this study. Industrial wood waste can be a cost effective option resolving a generally perceived wood fibre scarcity.
- *Ease of handling:* Handling and processing costs of industrial wood waste will be dependent on levels of contamination.
- *Ease of disposal:* Particleboard off cuts can be reused in the manufacture of particleboard.

Market Potential

The use of industrial wood waste in particleboard manufacturing has significant market potential, particularly through high scores on the following dimensions:

Market Potential	Score
Demanding players and industries	5
Competition intensity	4
Market perceptions	3
Regulations and standards	4
Distribution infrastructure	4
Other external drivers and barriers	3

- *Demanding players and industries:* The Laminex Group is the only producer of particleboard in Western Australia. Their Dardanup plant utilises approximately 7% recycled wood waste in its 400,000 tonnes usage of wood per annum. Of this amount, approximately 15,000 tonnes (60,000m^3)[4] is industrial wood waste. The facility at current capacity can utilise an additional 240,000m^3 of processed industrial wood waste.
- *Competiotion intensity:* Increasing competion with Chinese and European less expensive imports will encourage the use of industrial wood waste as less expensive raw material reducing processing costs.
- *Market perceptions:* Interviews with The Laminex Group indicate that the Australian marketplace is less susceptible and willing to purchase particleboard with levels of contamination comparable to markets in Europe. Store managers at Bunnings and Mitre 10 revealed that grit in cutting particleboard reduces market sales as a result of the increased wear on tradesmen tools. Essentially, the European market is more accustomed to working with products derived from industrial wood waste, and construction tools and techniques are designed to handle these products.
- *Regulations and standards:* Manufacturers of particleboard in Australia comply with Australian and Industry Standards (AS/NZS 1859.1 and 1860.1) for the mechanical and physical properties and AS/NZS 1859.3 for surface decorative properties of particleboard. This includes the uptake of industrial wood waste in the manufacturing process.
- *Distribution infrastructure:* Local distribution of industrial wood waste to the particleboard operations is well established.

[4] Based on 1 tonne of industrial waste woodchip equating to 4m^3

Financial potential

- *Expected revenues:* Particleboard manufacturing in Perth is currently using 60,000m^3 per annum of industrial wood waste, estimated to grow to 240,000m^3. As there are limited wood waste processing facilities in Perth, demand currently outstrips supply. Expected revenues and demand potential from this market are therefore expected to be high (=5).

Financial potential	Score
Expected revenues	5
Expected investments	3
Estimated financial impact	1.7

- *Expected investments:* Quality control standards and processing equipment are required as additional investments to utilise industrial wood waste as a raw material. The amount of investment is dependent on the amount of industrial wood waste utilised in the manufacturing process. For local use, expected capital investments are expected to be medium (=3).

Conclusion

Particleboard manufacturing in Western Australia provides a significant opportunity for the substantial and continued uptake of industrial wood waste. The end product is expected to meet industry requirements. The local major industry player is already set up and currently using around 60,000m^3 of industrial wood waste per annum and is expected to increase to 240,000m^3 per annum in the future (within five years). The demand for the product is immediate with The Laminex Group able to accept all untreated and some engineered wood waste identified in workstream one of this study.

Spillage Absorbents

Application

A spillage absorbent may be used for any application where liquids need to be absorbed, including absorbing and/or removing liquids from a floor or other surfaces. Absorbents can be generally classed into three categories: organic, inorganic and synthetic. With the rise of environmental awareness and responsibility, absorbents of choice have moved towards greener options. By comparison, organic absorbents are now seen as the preferred option from an eco-friendly perspective, although inorganic and synthetic absorbents still have their roles to play in certain situations.

Product potential

Industrial wood waste has a limited product potential as a feedstock for spillage absorbents. The assessment on the following dimensions was relevant to this appraisal:

Product Potential	Score
Fit for purpose	4
Cost	4
Feedstock availability	1
End use efficiency	2
Availability	2
Ease of handling	2
Ease of disposal / recycling	5

- *Fit for purpose:* The US Patent Office lists a patent for a wood waste based absorbent displaying successful application of absorbing petroleum or petroleum derivatives, including oils, greases, gasoline, diesel, and hydraulic fluids. Interviews with local spillage absorbent suppliers indicated that wood fibre based products were a low cost, easy to handle and dispose off solution for dry outdoor oil spillages. For indoor solutions the more expensive organic products were preferred. For wet conditions and more complex chemical spillages, the preferred absorbents were synthetic non-organic products.
- *Feedstock availability:* The single manufacturer of spillage absorbents in Australia, Envirosmart (Qld), specified that the feedstock for wood fibre based absorbents is fine wood flour derived from a clean source, for instance, the end product of sanding a light coloured untreated timber. Availability of this feedstock as an input to or output from a wood waste processing facility is expected to be minimal based on the research findings of workstream one. Nevertheless, the manufacturer has expressed a keen interest to trial wood fibres provided from industrial wood waste.
- *Cost:* Non-organic alternative absorbents are priced between $30 and $100 for a 10kg bag. Wood fibre based spillage absorbents are sold at $20 per 10 kg bag.
- *Availability:* Local market adoption in Perth of wood fibre based and other organic products is slow. Other non-organic alternatives are wider available.

Market potential

The use of industrial wood waste in the manufacturing of spillage absorbents has a limited short term local market potential, particularly due to the following elements:

Market Potential	Score
Demanding players and industries	2
Competition intensity	1
Market perceptions	2
Regulations and standards	2.5
Distribution infrastructure	1
Other external drivers and barriers	3

- *Demanding players and industries:* The single manufacturer in Australia of cleaning products incorporating wood fibres, Envirosmart (Qld), does not represent a substantial demanding market base for industrial wood waste. Sensis lists seven distributors of industrial cleaning absorbents in Perth. These local suppliers indicated that wood fibre based absorbents were commonly used in Australia but have only been slowly adopted by the local Perth market, thus resulting in an overall expected low industry demand for the processed industrial wood waste resource.
- *Competition intensity:* The market is highly competitive and tends to be price sensitive with intensive marketing. There are many organic and non-organic products available for a wide range of applications at a variety of price ranges.
- *Market perceptions:* Generally organic absorbents are increasingly seen as the preferred option from an environmental perspective. However, inorganic and synthetic absorbents still have their roles to play in certain situations. Locally in Perth however there has been a resistance to change from inorganic and synthetic absorbents, notwithstanding cost and environmental from organic absorbents. One reason for this is the propensity for the market to utilise products that are known to work in particular situations. This is most relevant to emergency responses to spillages. In general the local market is careful in trialing new products.
- *Distribution infrastructure:* There is no existing distribution infrastructure known that provides industrial wood waste fibres from Perth to the single manufacturer based in Queensland. The possibility of exploring stockpiling of wood fibre material at a wood waste recovery facility and back-loading this material to Queensland could be further explored with the establishment of a facility.

Financial potential

Financial potential	Score
Expected revenues	1
Expected investments	3
Estimated financial impact	0.3

- *Expected revenues:* Wholesalers and manufacturers are receptive to the introduction of a waste wood fibre based product; however, sales in Perth have been slow. Bulk transport of an industrial wood waste product to an Eastern States (Qld) manufacturer might prove viable depending on available quantities. Currently, the limited identified available quantities of 'fit for purpose' wood flour make this option have low expected revenues (=1).
- *Expected investments:* Capital investments are expected to be medium (=3) for sourcing of the wood based fibre. At a wood waste recovery facility, the product would be accepted at the gate and consolidated into purpose built fire safe silos pending subsequent transport to a manufacturer.

Conclusion

Spillage absorbents are expected to have very low short-term market potential for industrial wood waste products, primarily due to the fact that the raw material grade wood waste required was not identified in substantial quantities from research undertaken in workstream one. However the single manufacturer of wood fibre based spillage absorbents in Australia expressed interest in trialing the performance of wood fibres derived from industrial wood waste in the manufacturing of an organic spillage absorbent.

Surface Mulch

Application

Surface mulch is used to help stabilise surfaces, prevent erosion, retain moisture, or to enhance landscaping. It is also applied to assist the establishment of crops and to create conditions where vegetation can be re-established in the creation of parks, gardens, golf courses, urban renewal projects and restoration of industrial sites.

Product potential

Industrial wood waste has a moderate product potential as a feedstock for surface mulches. Assessment on the following dimensions is relevant for this appraisal:

Product Potential	Score
Fit for purpose	3
Cost	5
Feedstock availability	5
End use efficiency	3
Availability	4
Ease of handling	3
Ease of disposal / recycling	3

- *Fit for purpose:* The preferred feedstock for surface mulches is pine bark (due to its fire retardency, colour and softness) and in most cases green waste (due to its lower cost and wider availability). Coloured woodchips (derived from sawmill residues) were introduced recently and are popular for their lack of potential weed and pathogens and the current lack of available pine bark. A wood chip derived from industrial wood waste will have to be trialled and tested positively on fire retardency, colour and softness to gain market potential.
- *Cost:* It is estimated that an industrial waste woodchip can be offered at $10-$15 per m^3 which is half to a third of the price of the current alternative pine bark and coloured wood chip. It is noted however that the woodchip is not coloured. A company in Perth currently sells coloured woodchip processed from forestry woodchip for approximately $30/$m^3$. Coloured industrial woodchip would therefore expected to be sold from $20 to 25m^3$. Shredded green waste is still sold at about $10/$m^3$, with freight costs included.
- *Feedstock availability:* A coarse wood chip could be produced from a wood waste processing facility, and thus the feedstock for coloured surface mulch is expected to be available.
- *Availability:* Local industry players stated that demand for pine bark increasingly outstrips supply. In the longer term shredded green waste is expected no longer be the preferred feedstock option for surface mulch. This is due to potential environmental and safety issues directly applying shredded green waste. This creates a market potential for the supply of an industrial wood waste woodchip to this market.

Market potential

Market Potential	Score
Demanding players and industries	4
Competition intensity	2
Market perceptions	2
Regulations and standards	4
Distribution infrastructure	5
Other external drivers and barriers	4

The use of industrial wood waste in the manufacturing of surface mulches has a moderate local market potential, particularly due to the scores on the following dimensions:

- *Demanding players:* A WRAP (the Waste & Resources Action Programme) marketing campaign in 2006 in the UK informed the landscaping sector of the benefits of recycled woodchips, leading to more than 11,500 tonnes of additional material being sold in just 12 months. Thirty three local authorities subsequently conducted trials of recycled woodchips. Compost WA and the association representing the recycled organics industry in Western Australia, , are working hard to educate the marketplace as to the benefits of quality mulches and develop markets.

  Sensis counts roughly 550 landscape designers, contractors and architects in Perth and 40 suppliers providing mulch products. Local suppliers estimate the market to demand 75,000m^3 of pine bark a year, with one remarking, *"If there was more product available the market would take it."* The current supply covers an estimated 750 Ha per annum of new developments and maintenance of existing applications.

- *Competition intensity:* Sensis counts 40 suppliers of mulch products. Four of these service the bulk supply market. Competition seems to be based on the efficiency of the logistics rather than product price.

- *Market perceptions:* The perception of the market based on prior experiences is that a product made out of wood waste will encounter difficulties in delivering an uncontaminated product free from plastics, metals and splinters.

- *Regulations and standards:* The low-priced shredded green waste product is expected to have difficulties to retain its market share as a surface mulch due to industry and government efforts to educate the marketplace about quality recycled organics and the safety and environmental issues associated with applying shredded green waste.

- *Distribution infrastructure:* Efficient bulk distribution of processed industrial wood waste is expected to be relatively straightforward due to the opportunities to cooperate with existing mulch suppliers. These suppliers already have established relationships with clients along with experience in product development and delivery to client requirements. Variable feedstock availability causes these suppliers to be open to trailing alternative products.

- *Other external drivers and barriers:* There is a growing trend to substitute and complement turf in landscaping enhancement with native plants planted in mulched planting beds. This will increase the demand for surface mulches further.

Financial potential

Financial potential	Score
Expected revenues	3
Expected investments	3
Estimated financial impact	1

- *Expected revenues:* A low cost good quality wood chip derived from industrial wood waste marketed in collaboration with existing suppliers is expected to generate a moderate short term annual local demand of 7,500 m^3 generating an estimated annual revenue of $75,000 (@$10/m^3).
- *Expected investments:* the estimated investments are medium and can essentially be attributed to processing equipment required to remove contamination from the wood waste material.Existing processors expressed an interest in blending and colouring the industrial wood waste to market requirements.

Conclusion

Experiences from the UK and discussions with pine bark users illustrates that this market might be receptive to the introduction of a woodchip derived from industrial wood waste. It provides a lower cost option when preferred alternatives are difficult to obtain or short in supply. However rapid local market penetration in Perth is not expected in the short term due to the availability and widely spread use of higher 'fit for purpose' products such as pine bark, coloured wood chips (from forest residues) and the low cost option of shredded green waste. Commencing on a trial basis market penetration is expected to create an annual demand of 7,500m^3 generating estimated annual revenue of $75,000.

Growth of market share is expected to be stimulated by the implications of increased market awareness with respect to applying quality surface mulches, thus impeding the use of the low cost shredded green waste, along with the future predicted lack of pine bark availability. Existing mulch suppliers and wholesalers are willing to trail the processed industrial wood waste as a surface mulch feedstock. Further marketing and industry trials are vital to create and secure the demand potentials.

Water Filters

Application

Water filters using waste wood chip or saw dust can be used to improve water quality by removing contaminants such as particles, oil or grease, heavy metal ions, pesticides, nitrogen and phosphorous. Water filters are increasingly used in Water Sensitive Urban Design (WSUD). WSUD provides for:

- the sustainable management and improvement of water quality entering waterways from urban regions;
- opportunities for stormwater and grey water harvesting and reuse; and
- results in innovative reductions in potable water demand.

Product potential

Industrial wood waste has high product potential as a feedstock in water filters. The following dimensions were relevant to this appraisal:

Product Potential	Score
Fit for purpose	4
Cost	5
Feedstock availability	4
End use efficiency	5
Availability	4
Ease of handling	2
Ease of disposal / recycling	5

- *Fit for purpose:* Water filters used in WSUD in Victoria are predominantly used to remove heavy metal contaminants from previous industrial land use. Due to Western Australia's more agriculture than industrial background, filters in WSUD are used to prevent nitrogen and phosphorous from leaching into water tables and waterways. As a filter medium, forest residue sawdust and woodchip have been proven to successfully remove nitrates particularly. Local experimental trials would be required to confirm the effectiveness of industrial woodchip in removing nitrates and phosphorous.
- *Cost:* The price of a wood chip derived from industrial wood waste is about half that of forestry woodchip (10/m^3 as opposed to 18/m^3).
- *Feedstock availability:* The feedstock required for this application is a coarse clean wood chip. This type of feedstock is expected to be an output of a wood waste processing facility.
- *End use efficiency:* In general the end use efficiency of wood based filter mediums is high as they can be used to manufacture compost. In general, they need to be replaced after a period of between 10 to 20 years.
- *Availability:* Forestry wood chip and sawdust from sawmills is used for a number of purposes including thermal and power generation, animal bedding, exported as a raw material to paper production and particleboard manufacture. Availability of this feedstock might become an issue considering these competing demands, thus creating a gap for an industrial wood waste to be a cost effective option in the construction of water filters.
- *Ease of handling:* Bulk handling of industrial woodchip is comparable to the alternative, that is, forestry woodchip.
- *Ease of disposal:* Following replacement as a filter, chipped wood waste or sawdust could be effectively used as a nutrient rich input to compost or mulch manufacture.

Market potential

The use of industrial wood waste in the application of water filters has significant future local potential, particularly due to the scores on the following dimensions:

Market Potential	Score
Demanding players and industries	3
Competition intensity	4
Market perceptions	2
Regulations and standards	4
Distribution infrastructure	4
Other external drivers and barriers	4

- *Demanding players:* The market for WSUD applications comprises local government, land developers and the Water Corporation. There is currently no expected large structural demand from these markets. The use of WSUD is experimental in Western Australia and the markets are slow to adopt the technology due to perceived increased costs compared to current stormwater management practices. There might be a future market potential due to a combination of factors. Local trials with forestry woodchips might prove to be effective and water shortages may necessitate more effective management of Perth's water resources and thus require a more rapid and wider implementation of WSUD.
- *Market perceptions:* The market including land developers and local government has generally been slow to adopt WSUD as an 'unproven' and not widely used technology in Western Australia. Furthermore, maintenance costs and the cost to retro-fit existing stormwater management techniques are perceived to be high.
- *Regulations and standards:* New standards and regulations on water management are expected to stimulate more rapid development and implementation of WSUD practises.
  - The Department of Water is currently finalising guidelines for the *Drainage and Management Strategy for Structural Controls* including specifications for the use of filter media such as wood chip.
  - The Water Corporation considers that WSUD will soon be designed into water quality management systems for new sub-divisions as a requirement from the Department of Planning and Infrastructure.
- Distribution infrastructure: Once in full operation land developers and other end users would probably organise distribution through existing supplier networks.
- *Other external drivers and barriers:* The construction and implementation of WSUD in Western Australia currently occurs on a site specific and experimental basis. However, the drying climate and water shortages in Western Australia' south west will necessitate more rapid implementation of WSUD as it has done for Victoria. It is also likely that future triple bottom line management techniques will favour better practise WSUD water management techniques over traditional stormwater management.

Financial potential

- *Expected revenues:* Present market potential is minimal. However future potential revenues could be medium to high. Current expected revenues are minimal due to WSUD being still a site specific and experimental market.
- *Expected investments:* Processing wood waste into wood chip or sawdust for this market would generate no extra investments on top of regular screening and removal of contaminants.

Financial potential	Score
Expected revenues	3
Expected investments	3
Estimated financial impact	1

Conclusion

Industrial wood waste has significant potential to be used as a water filter in water sensitive urban design. Although local application is still in experimental stages, woodchip derived from forest residues has been proven to be effective filters for nitrogen in particular. The drying climate and water shortages in Western Australia's South West are expected to lead to more rapid implementation of WSUD. Furthermore, triple bottom line assessment techniques are expected to encourage WSUD practises and the use of waste woodchip in water filtering.

Currently the first larger scale applications of wood waste in water filters are not expected to emerge within ten years, due to lengthy trial processes. Inclusion of industrial wood waste as feedstock material in current trails is recommended to create and secure future market positions.

Wood Plastic Composites

Application

Wood Plastic Composites (WPC's) blend wood waste (sawdust, fibres, flakes or flour) and plastic into a compound product combining the properties of both pure wood and high-grade plastic. The wood waste serves as a filler to reduce the composite production costs. The use of additives, such as wood sawdust and fibres in plastics is likely to grow with the introduction of improved compounding technology.

Product potential

- *Fit for purpose:* Discussions with the single Australian manufacturer of WPCs, Modwood (Vic), indicated that industrial wood waste does not have a short term product potential. The current wood fibre used is a very fine kiln dried wood flour derived from very clean sources. It is not a current priority for Modwood to test or trial wood fibres based on industrial wood waste.

Product Potential	Score
Fit for purpose	1
Cost	1
Feedstock availability	1
End use efficiency	1
Availability	1
Ease of handling	1
Ease of disposal / recycling	1

Market potential

- *Demanding players:* The only potential demanding player in Australia has no immediate demand for wood fibres derived from industrial wood waste. However the international market for WPC is rapidly growing in the US and Europe, and innovation in production techniques might enable the future uptake of lower grades of wood fibres, sawdust and flakes.

Market Potential	Score
Demanding players	1
Competition intensity	1
Market perceptions	1
Regulations and standards	1
Distribution infrastructure	1
External drivers and barriers	2.5

Financial potential

- *Expected revenues:* no revenues are expected from the supply of industrial wood waste (=1).
- *Expected investments:* capital investments are expected to be medium to high (=4) due to extra trialing that will be required to meet industry specifications and building codes (in addition to the regular processing techniques and quality assurance for the removal contaminants).

Financial potential	Score
Expected revenues	1
Expected investments	4
Estimated financial impact	0.25

Conclusion

There is no short-term (within five years) market potential for industrial wood waste to be used as a feedstock for the production of wood plastic composites. Opportunities may be expected through the development of innovative technologies enabling the uptake of lower grades of wood fibre and/or the local establishment in Western Australia of a subsidiary plant of an international manufacturer.

Note:

The market details in the Appendix 3 reflect a market assessment of the WPC option compared to virgin timber, not the assessment of the viability of the uptake and use of industrial wood waste as a raw material input to the production of WPC. The results of the survey give a good picture of a sustainable market in development and are therefore included in this study.

5. Proposed Strategies and Actions

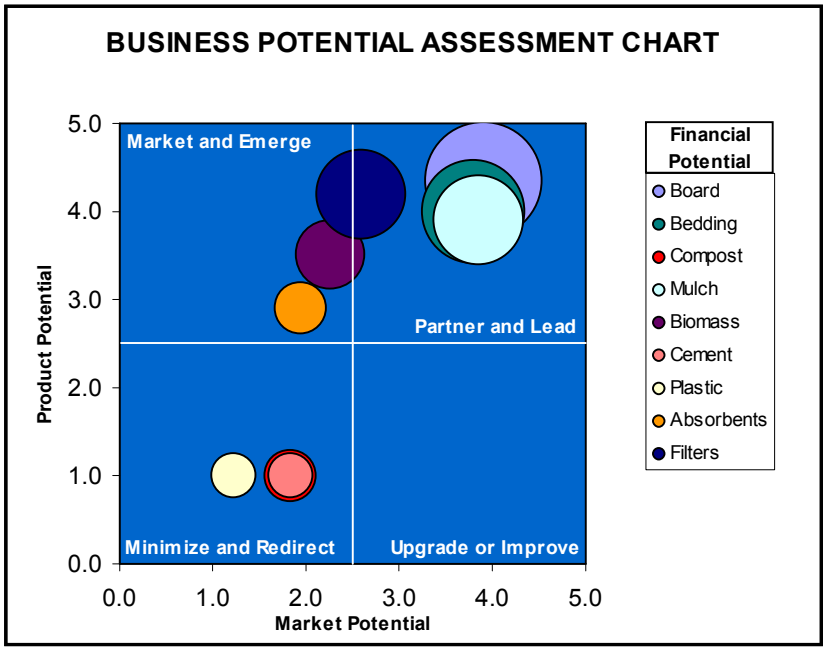
As stated in the methodology, the business potential for industrial wood waste reuse in targeted markets was based on:

- product potential (compared to alternatives);
- market potential (potential buyers, drivers and barriers); and
- financial potential (expected revenues compared to investments).

The assessment resulted in the distribution of the different market options into four different strategies for further market and product development:

- *Partner and Lead* – those options that have the opportunity to create leading opportunities in industrial wood waste deliveries, predominantly implemented through the creation of business partnerships and liaison with existing distributors or suppliers.
- *Market and Emerge* – those options that are considered to represent definite emerging markets with high revenue potential but still need significant product trials and marketing activities to create and secure future market positions.
- *Minimise and Redirect* – those options where industrial wood waste has not been proven to be 'fit for purpose'. Efforts and investments need to be redirected towards more sustainable ventures.
- *Upgrade or Improve* – for those options that need product upgrading or improvements to service existing or alternative markets.

The strategies proposed for each business opportunity are presented graphically below.



- P*artner and Lead:* The manufacture of particleboard, animal bedding and surface mulch scored well on both product and market potential.

  The high scores achieved on product potential represent a likely high 'fit for purpose' and lower product cost of industrial wood waste for the market. They also scored highly for market potential based on the demonstrated existence of local bulk demanding industries and the prospect of successful partnering with existing distributors and suppliers to service those markets. Further marketing and industry trials are vital to create the definite demand potentials.

- *Market and Emerge:* Water filters, biomass energy and spillage absorbents scored relatively high on product potential and moderate on market potential.

  The uptake and use of industrial wood waste in water filters that are applied in water sensitive urban design indicated significant future product potential and a potentially extensive future industry demand. However, local application is still in the experimental stages of development. It is advised to incorporate the inclusion of industrial wood waste in current local product trials to create and secure future market positioning.

  The biomass energy market is only deemed a viable option for the use and uptake of industrial wood waste when a large-scale biomass plant can be located in close proximity to a large-scale supplier of processed wood waste. This study identified one proposed biomass plant that will generate electricity and an opportunity to explore utilising wood waste as thermal energy in the manufacture of cement.

  The short-term market potential of spillage absorbents is hindered due to a lack of availability of the required feedstock (kiln dried clean wood flour) and the absence of a local manufacturer in Western Australia. Industrial wood waste has been demonstrated internationally to be an adequate feedstock for this application and the existing manufacturer based in the Eastern States (Qld) expressed an interest in trialing the product.

- *Minimize and Redirect:* Compost, cement fibre and wood plastic composites all have a very low market potential across either the short or longer-term. The industrial wood waste identified in workstream one was not preferred as a raw material source in the manufacture of these products. In addition, both the cement fibre and wood plastic composite manufacturers have no plans to trial the use of industrial wood waste in the manufacture of the products.

- *Upgrade or Improve:* No market option was identified in the Upgrade or Improve section.

6. Business Potential Summary

Supply versus demand

Workstream one determined that about 45,000m^3 of industrial wood waste per annum was generated from 50 selected significant wood waste generating businesses in Perth's Eastern Region. Industry sectors such as construction and demolition, shipbuilding, vehicle and equipment suppliers and timber manufacturing were identified as the predominant generators of waste wood.

Approximately 80% (36,000m^3) of the waste stream identified was held in the form of untreated timber, representing a strong potential raw materials base as an input to reuse markets. Of this untreated wood waste, 59% was identified as source separated. Providing this waste could be collected and disposed of in this manner, processing for reuse to other markets would be more cost efficient.

The findings of this study further indicate an immediate and short-term annual demand for processed industrial wood waste in metropolitan Perth of approximately 120,000m^3. It is postulated that this demand could be serviced from businesses generating wood waste within the Eastern Metropolitan Region, as 36,000m^3 of reusable wood waste was identified from just fifty businesses in the region. Furthermore, there is only limited industrial wood waste processing capacity in metropolitan Perth currently servicing the demand.

Demanding local industries

The particleboard industry has an immediate demand of 60,000m^3 for industrial wood waste. Its demand for processed industrial wood waste could grow to 240,000m^3 in the short to medium term. It is expected that most of the 36,000m^3 of reusable wood waste identified in workstream one would be adequate for reuse in particleboard manufacturing.

The animal bedding market is estimated to have a potential uptake of 50,000m^3 of industrial wood waste per year as a lower cost alternative. This estimate is based on developments in the bedding market in the UK, combined with site surveys and interviews with wholesalers and bulk end user industries of bedding products in Perth. Market trials are needed to assess if the woodchip derived from industrial wood waste can be dust free, of appropriate particle size, and contain minimal physical and chemical contamination such as resins, plastics and metals.

In the market for wood based surface mulches, industrial wood waste is expected to grow but be limited to a short-term market share of 10%. This equates up to an annual demand of 7,500m^3. This estimate is based on illustrations of developments in the market for wood based surface mulches in the UK, complemented with site surveys and interviews with wholesalers and bulk end user industries of surface mulches in Perth. It is expected that most of the identified 36,000m^3 of reusable wood wastes identified in workstream one is adequate for reuse in surface mulches, provided it is delivered free from physical and chemical contaminants (resins, paint, plastics and metal). Existing mulch suppliers will colour the product to meet industry specifications.

Revenue potential

A wood waste processing facility is expected to be able to offer a woodchip processed from industrial wood waste at prices ranging from \$5-\$15/m^3 (average price \$10/m^3). The actual price depends on the quality of the processed end product and the sales contract volumes negotiated. A total annual demand of approximately 115,000m^3 of industrial wood waste is therefore expected to generate a total revenue potential of about \$1,150,000. Consequently a current supply potential of 36,000m^3 is estimated to generate \$360,000 in sales revenue. This market potential may be realised within a period of three years provided that products delivered can meet industry requirements and are sufficiently free from contaminants like metal and plastics.

A wood waste processing facility might also be expected to charge a gate fee for acceptance of the wood waste, thereby providing income from both the receival and the sales of processed material.

Market	Volume Demand	Price m^3	Annual Value	Sold Through	Actions	Volume growth in 5 years
Particleboard	60,000m^3	\$10	\$600,000	Directly	Immediate Negotiations	240,000m^3
Animal Bedding	47,000m^3	\$10	\$470,000	Existing traders	Trials Needed	47,000m^3
Surface Mulches	7,500m^3	\$10	\$75,000	Existing traders	Trials Needed	7,500m^3
TOTALS	**114,500m^3**		**\$1,145,000**			**294,500m3**

Although this cannot be stated with certainty, it is expected that longer-term growth opportunities for the uptake and use of processed industrial wood waste will develop for markets such as water filters, biomass energy and spillage absorbents and the further substantial expected increase of uptake of industrial wood waste in particleboard manufacturing.

Market	Volume Demand	Actions
Water Filters	no demand estimates available	Conduct local trials into the use of processed industrial wood waste chip for use in water sensitive urban designs.
Biomass Energy	200,000m3 – 400,000m3	Assess the possibility for bulk wood waste generators to supply this end use market.
Spillage Absorbents	no demand estimates available	Trial industrial wood waste feedstock and await technological developments.
Particleboard	240,000m^3	Contract negotiations.

Projections of the previous study

This study thereby confirms the preliminary projections proposed in the previous study, the Wood Waste Recycling in Malaga Project (E&Y 2005). Findings from that report stated that a regional wood waste recovery and reuse program was expected to be viable, based on expected volumes of reusable wood waste material and the expected demand potential for that resource, provided that products delivered met market specifications and are sufficiently free from contaminants like nails and plastics.

Future potential - lessons learned in paper recycling

Discussions held with Amcor in WA presented the lessons learned in four decades of experience in paper and cardboard recycling. Large-scale paper and cardboard recycling is significantly advanced over timber recycling and 'lessons-learned' can be applied to the assessment of the future market potential for wood waste recovery and reuse.

Rapid changes in the market for packaging material were not predicted when Amcor commenced recycling in the sixties. In hindsight these unpredicted changes nowadays account for the larger parts of the current demand for cardboard packaging material. Cardboard packaging traditionally focused on providing the local trade of fruit and vegetables with cardboard box packaging material, and yet now it services a global trade in a wide range of products. Future markets are not easily predicted. Amcor recommends for the performance of substantial further product trials, market monitoring and development to capture the potential of those changing circumstances and emerging markets. This reflects the requirement for some of the markets identified in workstream two (water filters, biomass energy, spillage absorbents) and probably others still unknown today.

Furthermore, Amcor noted that waste recycling has the potential to grow into a business of its own, potentially even larger than the founding businesses. Amcor's recycling operation at present is three times larger than its paper production operation. For further details on the Amcor case study on paper and cardboard recycling refer to Appendix 4.

Immediate issues impacting the viability of wood waste recycling

This study also identified potential risks to the quantities of reusable wood waste generated in Perth's Eastern region. The majority of housing constructions in Perth utilise untreated pine for structural purposes. In an effort to mitigate the destruction caused by termites, the Department of Agriculture's European House Borer division indicated that treated pine has been increasingly used, rising from 15 to 30% in the past two years. Recently introduced regulations to control the spread of the European house borer may also negatively impact on the quantities of reusable wood waste generated from companies within designated 'Risk Management Zones'. Several respondents reported that they are considering utilising treated wood in an effort to comply with the regulations.

However, some of the risk to quantities generated may be mitigated by an industrial wood waste processing facility. The facility could process the wood waste in such a way as to adhere to the European house borer regulations, thereby offering a sustainable alternative treatment method to the current chemical treatments being considered.
It is advised to closely monitor the trend of the construction industry to utilise treated wood and the development of the spread of the European house borer to further assess any impacts to the generation of reusable wood waste for a wood waste recovery and reuse program.

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2. Work stream 1

a. Methodology Details

Scan of transport chains

To identify major generators of industrial wood waste, an investigation of key transport hubs in the Perth metropolitan area was conducted. Respondents within the transport industry assisted in identifying the industry sectors and businesses that typically generate higher volumes of timber packaging in the transport of their products. Representatives from industry peak bodies including the Transport Forum WA (TFWA), the transporters Toll West, P&O, Maersk, and local transport terminals, Fremantle Ports, Westralia Airports, Metro Freight Terminal were contacted.

Scan of the Perth wood waste chain

Perth metropolitan landfill operators and waste collection services were requested to verify the identification of the major sources of timber packaging and pallet waste. A list of companies contacted is presented in the Appendix section 2.d. List of Industries Surveyed.

Interview timber packaging and timber pallet manufacturers

Timber packaging and timber pallet manufacturers were interviewed with respect to their client base and specifically about how they handle returned industrial wood waste.

Interview with Department of Agriculture

The Department of Agriculture was contacted, as a potentially significant knowledge base in locating sources of industrial wood waste. To prevent the spread of the European House Borer (EHB) pest, State and Local government are managing the ongoing destruction of major quantities of dead pine trees and firewood. Through this research, it was discovered that processing wood waste into woodchip at a wood waste processing facility would contribute to the efficient and effective management of the pest.

Interview with Amcor

To enrich recommendations for wood waste recovery and re-use, lessons learned in four decades of cardboard and paper recycling were summarised from a meeting with Amcor in Perth.

Survey

Following identification of the sources of industrial wood waste across the metropolitan area, an initial telephone survey of twenty businesses from a cross section of industry types was undertaken. This further highlighted industry sectors and businesses generating higher volumes of wood waste.

Subsequently, site visits or telephone interviews with business representatives were undertaken to ascertain the quantity, type and quality of industrial wood waste generated on a weekly basis. To facilitate this process, the template developed for the Malaga study (E&Y, 2005) was updated and is presented in Appendix 1.b.

Survey Program Map

The region of focus for workstream one is presented in Appendix 1.c.

b. Questionnaire Industry Surveys

TIMBER WASTE QUESTIONAIRE

Company: _____ Date of visit: _____ Street Address: _____

Business Type: _____ Contact: _____ Telephone number: _____

Timber waste recovery and reuse

The EMRC is planning to establish a timber waste processing facility in Hazelmere. We research Perth's Eastern Region to identify the timber waste generated and assess the potential supply to the facility. This project will save disposal costs to your business and will reusing a valuable resource that would normally be send to landfill.

Quantity and Quality of Timber Waste

The purpose of this site visit is to determine the qualities and quantities of timber waste generated by your business on a weekly basis (please estimate in m^3) the current costs of disposal to your business and the forecasted trends in the amounts of timber waste that your company generates.

	Pallets	Off Cuts	Shavings	Sawdust
Untreated timber				
Engineered timber				
Treated timber				
Contaminants				
Mixed				
Ability to Separate				

Costs

How do you dispose your timber waste ? _____
(if applicable please state the name of the Waste Management company used)

Please estimate the your spend on timber waste removal on a monthly basis?
☐ Disposal fees $ _____ (per m3)
☐ Total disposal costs $ _____ (per month)

Trends

Will your timber waste increase or decline in the near future? By _____%

What are the reasons for the change?

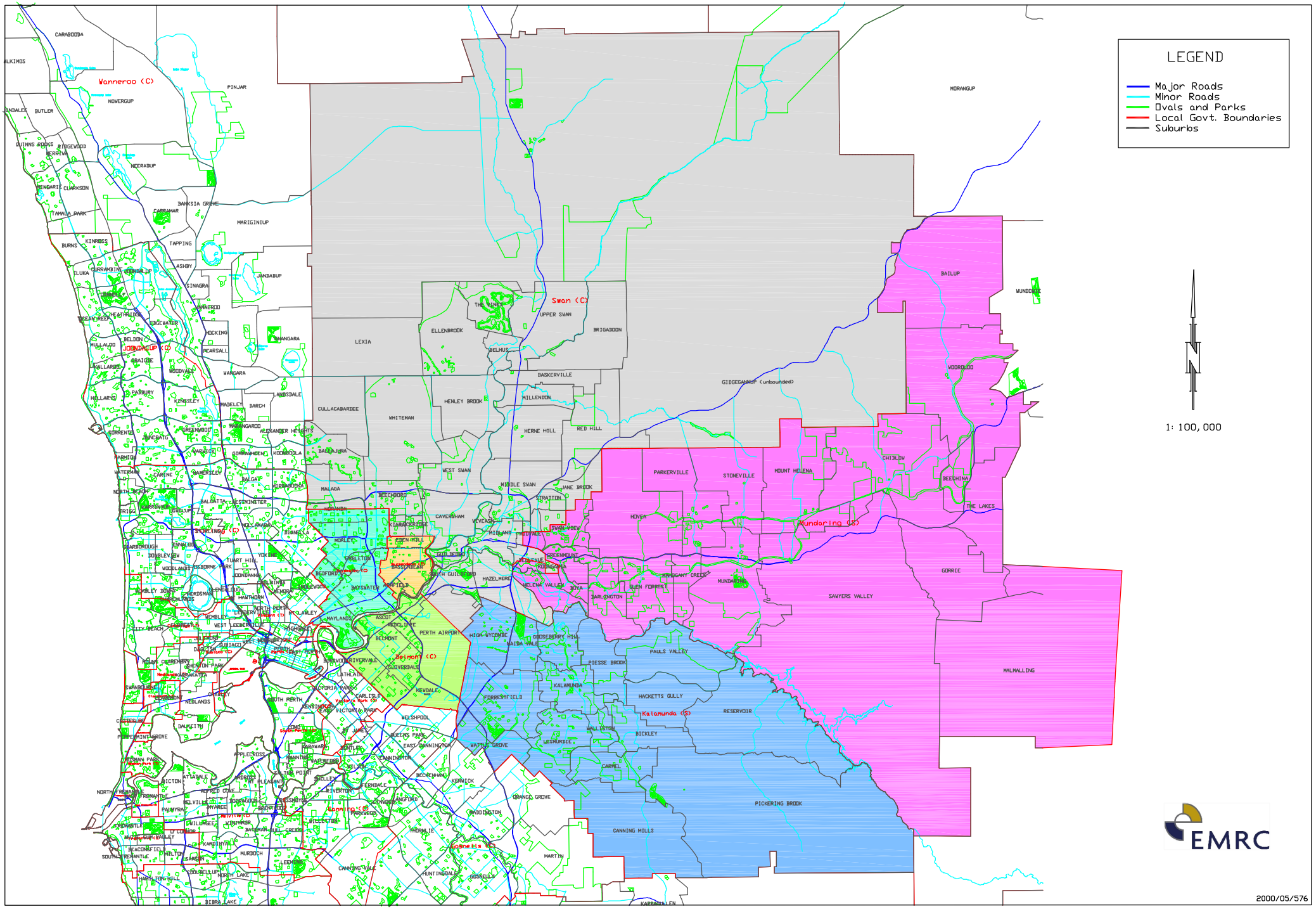
_____

DEFINITIONS TIMBER WASTE QUESTIONAIRE

Untreated timber	- timber that is not treated
Engineered timber	- processed timber bound by resins
Treated	- timber that is treated with fungicides, veneers, paint
Mixed	- mixed timber of treated, untreated and engineered timber
Contaminants	- nails, screws, laminates
Pallets	- sheets or planks used for/in pallets or total pallets
Off Cuts	- substantial pieces of wood that are disposed from operations or end of life products
Shavings	- small thin slices of wood produced in shaving wood
Sawdust	- small particles (dusty) of wood produced in sawing wood

c. Map of Eastern Metropolitan Region

Please see overleaf for map detail.


LEGEND
Major Roads
Minor Roads
Ovals and Parks
Local Govt. Boundaries
Suburbs
1: 100, 000
Wanneroo (C)
Swan (C)
Joondalup (C)
Stirling (C)
Belmont (C)
Canning (C)
Kalamunda (S)
Mundaring (S)
Gosnells (C)
EMRC
2000/05/576

d. List of Industries Surveyed

Business Category	Name
Cabinet Makers	ARTL Woodcraft
Cabinet Makers	Coastline Kitchens
Cabinet Makers	Kitchens by the Maker
Cabinet Makers	Precision Cabinets
Cabinet Makers	Subiaco Restoration
Cabinet Makers	Western wood turners
Cabinet Makers	Worldwide Timber Traders
Construction Industry	BGC Transport
Construction Industry	Bloc Pave
Construction Industry	Blue Scope Steel
Construction Industry	Bluescope Steel
Construction Industry	Federal Sheet Metal
Construction Industry	M & B Sales
Construction Industry	Midland Brick
Construction Industry	Vision Clad
Demolition	Diacon Demolition
Demolition	Statewide Demolition
Electronics	Fuji Xerox Australia Pty Ltd
Engineering Foundry	Galvin Engineering Pty Ltd
Engineering Foundry	Hammersley Iron
Food and Beverage	Coles Supermarkets and Grocery Stores
Food and Beverage	IGA
Food and Beverage	Woolworths
Private Companies	Australian Gypsum Industries Pty Ltd
Retail	Harvey Norman
Ship Building	Austal Ships
Ship Building	Skippers Aviation
Timber manufacturers	Aussie Crates
Timber manufacturers	Australian Box and Cases
Timber manufacturers	Brians Joinery
Timber manufacturers	Build All
Timber manufacturers	CHEP
Timber manufacturers	Crate Masters
Timber manufacturers	Loscam
Timber manufacturers	Olex Cables
Timber manufacturers	Perth Regional Roof
Timber manufacturers	Pine Timber Products
Timber manufacturers	Pinetec
Timber manufacturers	Recycled Timber Co
Timber manufacturers	Roofland Timber Frames
Timber manufacturers	WA Pine Shavings
Transport and logistics	Sadleirs Transport
Transport and logistics	Triumph
Trucks and Vehicles	CJD Equipment Pty Ltd
Trucks and Vehicles	Coventry Fasteners
Trucks and Vehicles	Cummins Engine Company
Trucks and Vehicles	Diesel Motor Trucks
Trucks and Vehicles	JC's Motorcycleds
Trucks and Vehicles	John Deere
Trucks and Vehicles	Kenworth DAF
Trucks and Vehicles	Komatsu
Trucks and Vehicles	Liebherr
Trucks and Vehicles	Macintosh & Son
Trucks and Vehicles	Scania Australia

e. List of Waste Collection Services and Landfill Operators Contacted

Company	Suburb	Quantities received-collected (m3 per week)
A West Bin	Malaga	5
Affordable Mini Bins	Mullaloo	5
All Aussie Bins	Kalamunda	5
All Earth	Maddington	20
Century Bins	Beechboro	5
City of Armadale	Armadale	5
City of Canning	Canningvale	5
City of Rockingham	Baldivis	15
Cleanaway	Malaga	150
Collins Recycling Depot	Willetton	Not available
Direct Bins	Stirling	60
Henderson Landfill	Henderson	15
Instant Waste Management (Instant Bins)	Bassendean	Not available
Red Hill	Gidgegannup	188
RRRC	Canningvale	5
Sita Environmental Solutions	Welshpool	Not available
Tamala Park	Mindarie	5
Veolia Environmental Services - Collex	Willetton	Not available

3. Work stream 2

a. Business Planning Model

BUSINESS PLANNING MODEL

ERNST & YOUNG

DATA INPUT

			Animal Bedding		Biomass Energy		Compost		Fibre Cement		Particle Board		Spillage Absorbents		Surface Mulch		Water Filters		Wood Plastic	
		Weight	Score	Weighted Score	Score	Weighted Score	Score	Weighted Score	Score	Weighted Score	Score	Weighted Score	Score	Weighted Score	Score	Weighted Score	Score	Weighted Score	Score	Weighted Score
PRODUCT POTENTIAL																				
1. Fit for purpose	High=5	0.20	5.0	1.0	4.0	0.8	1.0	0.2	1.0	0.2	5.0	1.0	4.0	0.8	3.0	0.6	4.0	0.8	1.0	0.2
2. Cost	High=5	0.20	5.0	1.0	3.0	0.6	1.0	0.2	1.0	0.2	5.0	1.0	4.0	0.8	5.0	1.0	5.0	1.0	1.0	0.2
3. Feedstock availability	High=5	0.20	2.0	0.4	5.0	1.0	1.0	0.2	1.0	0.2	5.0	1.0	1.0	0.2	5.0	1.0	4.0	0.8	1.0	0.2
4. End use efficiency	High=5	0.10	3.0	0.3	2.0	0.2	1.0	0.1	1.0	0.1	2.5	0.3	2.0	0.2	3.0	0.3	5.0	0.5	1.0	0.1
5. Availability	High=5	0.10	5.0	0.5	2.0	0.2	1.0	0.1	1.0	0.1	4.0	0.4	2.0	0.2	4.0	0.4	4.0	0.4	1.0	0.1
6. Ease of handling	High=5	0.10	3.0	0.3	2.0	0.2	1.0	0.1	1.0	0.1	2.0	0.2	2.0	0.2	3.0	0.3	2.0	0.2	1.0	0.1
7. Ease of disposal / recycling	High=5	0.10	5.0	0.5	5.0	0.5	1.0	0.1	1.0	0.1	5.0	0.5	5.0	0.5	3.0	0.3	5.0	0.5	1.0	0.1
		1.00		4.0		3.5		1.0		1.0		4.4		2.9		3.9		4.2		1.0
MARKET POTENTIAL																				
1. Demanding players / industries	High=5	0.20	5.0	1.0	3.0	0.6	1.0	0.2	1.0	0.2	5.0	1.0	2.0	0.4	4.0	0.8	3.0	0.6	1.0	0.2
2. Competition intensity	High=5	0.20	5.0	1.0	3.0	0.6	1.0	0.2	1.0	0.2	4.0	0.8	1.0	0.2	4.0	0.8	1.0	0.2	1.0	0.2
3. Market perceptions	High=5	0.15	2.0	0.3	2.0	0.3	1.0	0.2	1.0	0.2	3.0	0.5	2.0	0.3	2.0	0.3	2.0	0.3	1.0	0.2
4. Regulations and standards	High=5	0.15	2.5	0.4	1.0	0.2	1.0	0.2	1.0	0.2	4.0	0.6	3.0	0.5	4.0	0.6	3.0	0.5	1.0	0.2
5. Distribution infrastructure	High=5	0.15	5.0	0.8	1.0	0.2	5.0	0.8	5.0	0.8	4.0	0.6	1.0	0.2	5.0	0.8	4.0	0.6	1.0	0.2
6. Other drivers / bariers	High=5	0.15	2.5	0.4	3.0	0.5	2.5	0.4	2.5	0.4	3.0	0.5	3.0	0.5	4.0	0.6	3.0	0.5	2.5	0.4
		1.00		3.8		2.3		1.8		1.8		3.9		2.0		3.9		2.6		1.2
FINANCIAL POTENTIAL																				
1. Expected revenues	High = 5		4		3		1		1		5		1		3		3		1	
2. Expected investments	High = 5		3		5		3		4		3		2		3		3		4	
3. Estimated financial impact				1.3		0.6		0.3		0.3		1.7		0.5		1.0		1.0		0.3

b. Questionnaires Market Assessments

QUESTIONAIRE MARKET POTENTIAL (FOR RETAIL AND END USERS)

Scores

Questions: 1, 5, 6, 8	Question: 2, 3, 4, 7
1 – Opposing, Negative or None	1 – Major (increasing potential)
2 – Limited (with uncertain potential)	2 - Substantial (ongoing potential)
3 – Reasonable (with reasonable potential)	3 – Reasonable
4 – Substantial (with ongoing potential)	4 – Limited
5 – Major (with increasing potential)	5 - None

1. Demand stability

a. How many demanding players are there by estimate?

b. Are these players large or small by estimate?

c. What is the trend in their take up of timber waste?

2. Availability of alternative products

a. Are there many other alternative products competing with the new initiative? (e.g. pallets made out of recycled plastic i.s.o recyled timber)?

3. Intensity of competition/players

a. Are there many other players in the market offering similar benefits/products?

4. Quality of competing products

a. Do they have many technological benefits compared with new initiative (the timber waste option)?

b. Do they have many economic benefits compared with the new initiative?

5. Market readiness/perceptions

a. How are the market perceptions for the new initiative?

6. External drivers

a. Are there external drivers forcing businesses to take up more timber waste to their production processes?

7. External barriers

a. Are there external barriers hindering to take up more timber waste to their production processes?

8. Potential future applications?

a. Are there any future applications expected (apart from the current under investigation)?

QUESTIONAIRE BUSINESS POTENTIAL (FOR WHOLESALE/PRODUCTION)

1. Source stability

a. How many timber waste generators are there identified?

b. What quantities can they provide?

(also use results from stream 2 to assess the score on this dimension)

2. Availability quality grade

a. Are the quantities provided in the quality grade that is needed?

b. Are there major contaminants that make the quality

(also use results from stream 2 to assess the score on this dimension)

3. Distance from source to end use

a. are the timber waste sources scattered or clustered?

b. are the timber waste sources close (within 20k radius) or long distance?

c. is back loading from distant though major sources an option?

4. Product match to requirements

a. will the product match technical requirements that are in demand?

5. Environmental impact (costs / benefits)

a. What is the environmental benefit of the production/operation expected to be?

6. Embedded in existing organisation/promotion/distribution

a. Will the new initiative be embedded in existing operations? Or

b. Will the new initiative be a new initiative by itself?

7. Research needed

a. Is research needed to further develop the project/product/solution?

8. Planning permissions needed

a. Is planning permission needed to implement the project?

b. Is it easy to obtain that permission?

Scores:

Questions 1, 2, 4, 5, 7	3	6
1 – Opposing (Negative or None)	none	none
2 – Limited (uncertain potential)	limited (small, scattered)	small (by itself)
3 – Reasonable (reasonable potential)	reasonable (clustered)	reasonable (by itself)
4 – Substantial (ongoing potential)	substantial (close, clustered)	substantial (embedded)
5 – Major (increasing potential)	major (close, clustered)	major (embedded)

8

1 – Permission needed extremely difficult to obtain
2 – Permission needed, difficult to obtain
3 – Permission needed
4 – Permission needed, easy to obtain
5 – No permission needed

QUESTIONAIRE FINANCIALS (FOR WHOLESALE / PRODUCTION)

1. Estimated Revenue/Savings of the new initiative:

The expected revenue/savings of the new initiative are expected to be:

1 – Low	less than 1% of total revenue
3 – Medium	less than 1% - 10% of total revenue
5 – High	more than 10% of total revenue

2. Estimated Capital Investments needed to implement the initiative:

Compared to current capital investments, the investments needed to be able to take on timber waste are:

1 – High	more than 10% of current investments
2 – Medium	between 1% and 10% of current investments
3 – Low	less than 1% of current investments

3. Estimated financial performance

The estimated financial performance of the initiative is the score of question 1 divided by the score of question 2 (Estimated revenue or savings/ estimated capital investments).

c. Market Details – Animal Bedding

Application

The use of industrial wood waste shavings and sawdust as animal bedding has a long tradition around the world. In rural areas, the bedding market is dominated by use of straw as it is available in large quantities from farms and traded widely within local communities. Away from rural areas, sand, wood shavings and sawdust generally represent the bulk of the bedding market sales.

PRODUCT POTENTIAL

Fit for purpose (general)

The Waste and Resources Actions Programme (WRAP) in the UK concentrates considerable effort in market development for the reuse of industrial wood waste (IWW). A review of their "Guide to Marketing Recycled Wood Products (2006)" and the "Characterisation of Emerging Higher Value Markets for Recycled Wood Products (2004)" revealed the following performance requirements for animal bedding:

- Durable
- Safety (no glass particles) and freedom from infectious (bacterial) substances
- Dust free
- Good drainage properties
- Absorbency and water holding capacity
- Odour reduction
- Comfort
- Warmth
- Local availability
- Consistent supply of bulk quantities
- On time delivery due to limited storage capabilities
- Ease of handling, spreading, mucking out, disposal
- In some cases light in colour for reflectiveness of light

The WRAP reports mentioned also detailed the following advantages that animal bedding derived from wood waste has in comparison to straw and sand:

- Insulator and thermal store
  Products derived from wood waste tend to remain dry on the surface in comparison to sand and straw and therefore provide more comfort and warmth to animals.
- Resistant to trampling and surface fouling
  Alternatives to wood waste products tend to become saturated and degrade more rapidly under heavy trampling.

- Easier to handle
  Wood waste products are lighter than sand and less awkward to handle than straw due to its tendency to break apart.
- Less susceptible to fungi
  Wood waste products are less susceptible to the growth and spread of fungi and bacteria.

The WRAP reports also indicated that the recycled wood products are expected to outperform "clean and green" sawdust and wood chips on end user efficiency, as they are more durable with less dust.

Fit for purpose (local)

Discussions with local industry associations identified two local markets that are bulk users of wood based animal bedding: the poultry farm and racehorse training industry. Cattle, dairy, pig farmers, livestock transporters, dog kennels and catteries were investigated but were not identified as current bulk users of wood based products for animal bedding or litter. The Cattle Council of Australia stated that the lack of intensive production indoor stables was a reason for not utilising wood based products. Local boarding kennels indicated that they predominantly use concrete sealed slab flooring whilst the members of the Australian Livestock Transporters Association generally use metal frames, thus eliminating the need for loose animal bedding material.

Poultry Farms

In Europe, the primary choice for bedding in poultry farms is planer shavings, produced by timber importers and joinery manufacturers from kiln-dried timber. According to Len Brajkovich (former vice president of Western Australian Broiler Growers Association), the local Perth poultry industry prefers a clean jarrah or a mix of pine and jarrah woodchip, as *"chickens easily identify their light coloured feed on the dark coloured jarrah so not much feed is left to rot."* In addition, sawdust must be coarse (particles <5mm), avoid sharp splinters and limit dust.

Animal bedding woodchip is currently delivered to the poultry farms at $\$22/m^3$ including freight. Mr. Brajkovich explained that straw is generally not used by the industry as it tends to inflict respiratory problems on the brood through fungal infections when the straw gets wet. Sand is too heavy to handle and transport in bulk quantities.

For the industry to use a product derived from industrial wood waste as opposed to "clean and green" forestry woodchip, strict requirements would have to be met. Mr. Brajkovich stated that *"the product must have no glass, metals or chemical contaminants, and it should preferably be sold as a package incorporating the sale of animal bedding and disposal of animal bedding wastes"*. The industry has would benefit from an alternative source of bedding to "clean and green" sawdust as prices of this product have doubled in the past five years and consistent bulk supplies are difficult to maintain.

Racehorse trainers

Interviews with three local racehorse trainers revealed similar performance requirements for the use of horse stable wood bedding products, that is, the provision of durable, dust free, warm bedding.. Approximately 50% of this market use wood products with the primary choice being pine sawdust. The alternatives, straw and sand, are more difficult to handle and sand does not provide the warmth and comfort of a wood product. The waste bedding product of sawdust and manure is also easier to dispose of than manure and sand or straw due to its applicability as a fertiliser. In addition, straw can cause bowel problems when eaten by horses, is more expensive than sawdust and is not readily available in urban areas such as around Ascot.

Prices for woodchip / sawdust animal bedding can vary depending on availability and at the time of reporting were being delivered from between $12-$25/m^3. Whilst sand was traditionally only used on training tracks and yards, it has regained increased use by the market due to the variability and rising costs of wood products. In addition, sand does not need to be replenished as often as sawdust as it is less adhesive to manures. It is estimated that around 50% of the horse trainers currently use sand in their stables and 50% use sawdust.

It is noted that one of the largest horse trainers in Perth, Trevor Andrews, utilises woodchip bedding derived from recycled pine pallets. The product is produced to quality specifications by a local supplier and delivered at $7/m^3. Combined with the fact that 50% of the market utilise forestry woodchip bedding, and that the alternative use of sand is driven by economical consideration, it would indicate that there is a potential market for bedding derived from industrial wood waste.

All three trainers interviewed indicated that very strict requirements are necessary for a product processed from industrial wood waste for it to be competitive with the current supply of forestry sawdust and sand. The quality must be a fine chip with limited dust, no staples or chemical contaminants and preferably delivered at a lower cost than the current products available.

Industry Requirements	IWW Sawdust	Sawdust	Sand	Straw
Dust Free	**	**	***	*
Insulation and thermal store	**	***	*	**
End user efficiency	**	*	***	*
Easy to handle	***	***	**	**
Easy to dispose off	***	***	*	*
Fungal bacterial contaminations	***	**	***	*
Problems when eaten	***	***	***	*
Availability	**	**	***	*
Cost	***	**	***	**
TOTAL	23	21	22	12

The table above indicates a balance between sawdust and sand and the issues involved with the use of straw. Industrial wood waste sawdust may be able to be processed in such a way as to outperform the alternatives on dust free properties, cost and end user efficiency. Essentially the product could achieve the economics and efficiencies of sand and provide the thermal and lightweight handling properties of "clean and green" sawdust.

Feedstock availability

Specifications would need to be determined with both the poultry farm and horse training industry to process a product from industrial wood waste that meet market quality requirements.

Cost

Prices of local products in Perth range around \$70/tonne (\$22/m^3) for the "clean and green" sawdust sold to the poultry industry and \$90/ (\$27/m^3) to the horserace training industry. Respondents stated prices five year ago were approximately half that of current prices. Interviews with the EMRC indicate that woodchip processed from industrial wood waste could be expected to be priced at \$15 to \$20/m^3.

Product Prices	Price per m^3
Poultry	\$22
Horserace training	\$27
Horserace (sand)	\$20
IWW product	\$15-\$20[1]

The local surveys demonstrated the cost competitiveness of the industrial waste woodchip alternative.

[1] Freight additional

Product Potential Summary Score

Product Potential	Score	Comments
Fit for purpose	5	The industrial waste woodchip product when delivered without contaminants would meet expected quality standards of the industry. It has the potential to outperform current alternatives by being economically comparable to sand and having the properties of "clean and green" sawdust.
Cost	5	The industrial waste woodchip product can be offered at half or a third of the price of current alternatives.
Feedstock availability	2	The wood waste feedstock for bedding material is a fine chip or sawdust. The expected feedstock availability is medium; however, product must adhere to industry specifications for use.
End use efficiency	3	Desktop research presents expected higher end use efficiencies from the recycled timber product than current alternatives. Racehorse trainers experience higher end user efficiencies from sand.
Availability	5	Current demand for good quality animal bedding is outstripping supply and driving prices up.
Ease of handling	3	The recycled timber product is easier to handle in its application than alternatives straw and sand. There is little difference in handling between the recycled timber product and current supply of "clean and green" sawdust.

MARKET POTENTIAL

Demanding players and industries

Poultry Farmers

The WA Broiler Growers Association reported that 41 poultry farms are located within a radius of 50km of the Perth metropolitan area, farming a total area of 450,000m^2. One of the poultry farms uses 600m^3 of jarrah sawdust per batch and 5.85 batches per annum, covering a 15,000 m^2, 40mm deep layer of bedding. The farm uses a total of 3,510 m^3 of bedding per year and currently pays average of $22 per m^3 (including delivery). Although the size of the poultry farms vary, it was indicated that they all use similar amounts of animal bedding per square metre per year (0.23 m^3) and pay the average price of $22/$m^3$. The poultry farm market for animal bedding in Perth therefore is estimated at 105,300/m^3 per year amounting to $2.3m.

Racehorse trainers

Jeff Mercy of WA Racing Trainers Association stated that about 200 racehorse trainers are located in a radius of 20km around Perth city. Interviews with three of these trainers revealed that they operate an average of 10 to 15 stables using an average of 20 to 30m^3 of sawdust a month. Discussions with the industry indicated that approximately 50% of the racehorse trainers currently use sawdust and 50% use sand. The current price is approximately $25/$m^3$ for the sawdust depending on availability. The racehorse training industry is therefore estimated to use around 30,000m^3/annum of sawdust representing $750,000.

Competition intensity

In terms of wholesale providers to the market, competition is not based on product price but on the cost effectiveness of transport logistics. There is limited competition in the provision of industrial wood waste bedding with only one small supplier identified. There are limited products competing with the wood waste product for market space including sawdust and sand.

Market perceptions

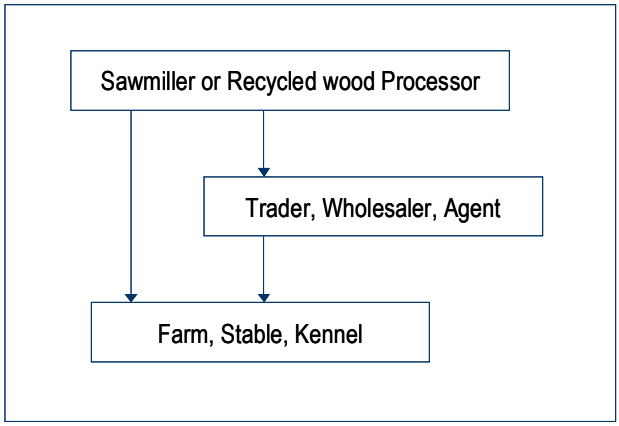
The potential end users of animal bedding derived from industrial wood waste are wary of using such a product. Trials previously conducted did not address contamination of the product from nails, glass and chemicals. However, as is the case with Trevor Andrews (one of the largest horse trainers in Perth, once contamination issues are addressed, the product offers an economical and practical alternative.

Regulations and standards

End user quality specifications will drive or prohibit market development. There are no regulations and standards in place for the production of animal bedding derived from industrial wood waste.

Distribution infrastructure

The distribution of animal bedding products around Perth operates in the manner below and can be expected to facilitate efficient bulk distribution of industrial woodchip bedding products.



For a wood waste recycling facility, opportunities exist to liaise with existing wholesalers and capitalise on established client relationships and experience in customer product requirements. Local wholesalers include JJ Hawkins, WA & J King and Depiazzi TJ & Sons. Interviews with the owners of these companies revealed that they source woodchip directly from sawmills around Perth at a cost of approximately $5-15/m^3 (excluding freight).

Other external drivers and barriers

Currently end users experience a shortfall in the affordable supply of good quality sawdust or woodchip. It is possible that this shortfall will be addressed by proposed pine plantations south of Perth, however, transport costs may prove prohibitive for this product to be economically used.

This is also competing sources for forestry woodchip, including:

- Increased use by the particleboard manufacturing industry due to high economic growth in Perth;
- Established agreements such as Western Power use of woodwaste form the largest sawmill in Perth (Pinetec) for power generation;
- Unquantified amounts of woodwaste shredded and used in the manufacture of compost.

Market Potential Summary Score

Market Potential	Score	Comments
Demanding players and industries	5	Two major local industries were identified that have a potential substantial demand for industrial waste woodchip bedding clustered around certain areas in Perth.
Competition intensity	5	Three wholesalers supply the market. All of them expressed an interest in trialing the industrial wood waste products.
Market perceptions	2	Previous industrial waste woodchip product trials have made the market sceptical towards new product development. Contamination by glass, nails and chemicals were the main issues.
Regulations and standards	2.5	There are no regulations and standards known to drive or block the market potential. Markets would demand quality specifications be addressed.
Distribution infrastructure	5	Industrial waste woodchip bedding could take advantage of existing client relationships and experience of customer product requirements.
Other external drivers and barriers	2.5	Competing industries were identified for forestry woodchip that may impact on availability of "clean and green" product thus creating market potential for industrial wood waste products.

Financial potential

Research in the UK demonstrated that recycled wood waste products currently make up 35 per cent of the wood-based products market in the UK, with the potential for further growth based on demand for dust-free properties and price competitiveness. The identified willingness of the local market in Perth to purchase cost effective alternatives indicates a similar outlook. Applying the 35% proportion of market penetration for the total of the Perth market of 135,000m^3 results in potential estimated market volume in Perth of 47,000m^3/year.

Financial potential	Score	Comments
Expected revenues	4	The estimated volume demand in this market is more than half 150% of the identified volumes of reusable wood waste in work stream 1 and would therefore be classified as high (=5). The uncertainty of the feedstock availability reduces this estimate to a significant expected revenue estimate (=4).
Expected investments	3	The estimated investments are medium and cover the regular but stringent quality control standards and processing technology that is needed to be able to provide a quality product that will meet industry standards.
Estimated financial impact	1.3	= 4/2

Sources

Desk top research

- The Waste and Resources Actions Programme (WRAP)
  - Guide to Marketing Recycled Wood Products (2006)
  - "Characterisation of Emerging Higher Value Markets for Recycled Wood Products (2004)

Local surveys

Farms and farmers:

- Len Brajkovich, immediate vice president, Western Australian Broiler Growers Association, 9274 1784
- Australian Lot Feeders Association, 02 9290 3700
- Cattle Council of Australia, 02 62733688
- Brownes Dairy Farm, 9441 7777
- Lucy Radzikowfka, West Australian Farmers Federation,

Racehorse trainers:

- Jeff Mercy, WA Racing Trainers Association, 94455371
- Wally Mitchell jr, racehorse trainer, Ascot
- John Price, racehorse trainer, Ascot
- Trevor Andrews, racehorse trainer, West Swan

Traders/wholesalers:

- David King, Owner, WA J King, 9398 2595
- David Hawkins, Owner, JJ Hawkins, 9409 7377
- David Depiazzi, Owner, Depiazzi TJ & Sons, 9728 1152

Sawmills:

- Hamilton Sawmills, 9302 2022
- Saunders Sawmills, 9734 1383

Other:

- Local Boarding Kennels and Catteries
- Grant Robbins, Australian Livestock Transporters Association, 98801329
- Forest Products Commission, 9475 8888

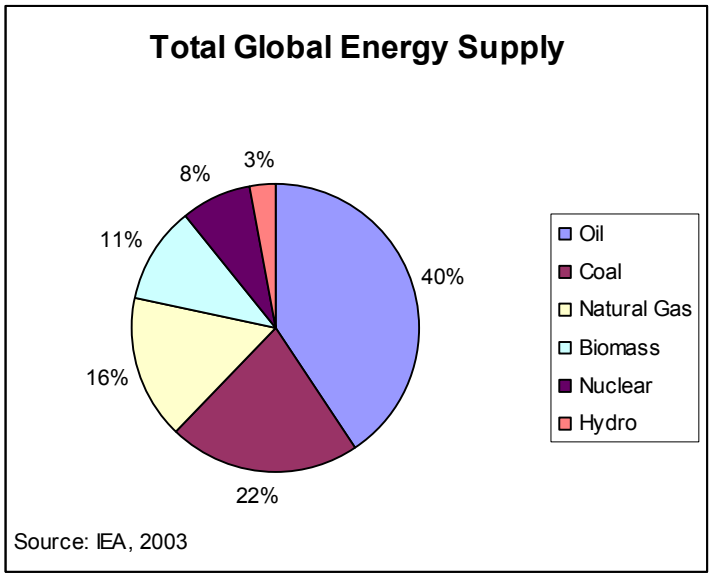
d. Market Details – Biomass Energy

Application

Bio energy is derived from biomass, which is the name given to plant or animal organic matter. Biomass energy can be produced from plants, wood, and residues such as sawdust or sugar cane, organic industrial, human and animal wastes. In nature, biomass decomposes and releases carbon dioxide and its store of energy slowly. Using biomass for energy production speeds up this natural process. Bio energy in the form of heat or electricity is produced by burning biomass directly as a fuel or by converting it to biogas or liquid bio fuels.

Traditional biomass use includes the burning of fossilised biomass such as coal and oil. Wood waste, as identified from various businesses surveyed for workstream one of this report, is still used as a fuel for burning. Whilst it is the primary fuel for many developing countries, this is not the case in developed countries. The advent of the industrial revolution resulted in the use of fossils fuels becoming less expensive. It is worth noting, however, that the environmental cost is not attributed to the price of fossil fuels. According to industry associations interviewed for this study, if the environmental cost of fossil fuels was incorporated into their price, it would level the playing field somewhat for the introduction of energy produced from renewable sources.

Increasing concern over global warming and rising oil fuel costs may also result in wood being viewed as an increasingly attractive energy source along with other forms of biomass. Approximately 11% of the world's energy now comes from biomass, and about half of this is wood.



In developing countries, biomass is primarily used as a fuel source. In the developed world biomass is being used for:

- Producing liquid bio fuels, for example, alcohol from sugar crops can replace petrol.
- Generating heat and energy for cooking, for example, by burning wood pellets.
- Generating electricity, for example, a generator can be established in close proximity to a sawmill and wood waste used to generate electricity to power the mill.

- Generating thermal energy, for example, by using wood waste from sawmills and other sources to provide fuel for kilns.
- Producing gas bio fuel that can be used instead of fossilised fuels, for example, bio gas can replace natural gas.

PRODUCT POTENTIAL

Fit for purpose (general)

The performance of waste wood to generate energy in terms of electricity is dependent on the calorific values it produces when burned. Typical calorific values of biomass and fossilised fuels are presented in the table below.

Table : Typical Calorific values of fuels

Product	Moisture content (mc)	Energy density by mass GJ/tonne
Wood chip	ED is dependent on mc	7-15
Log wood	20% mc	15
Solid wood	When oven dried	18-21
Wood pellets	Low	18
Baled Briquettes	Low	17
Coal	Dependent of mc, fossilised quality	20-30
Oil	Liquid	42
Natural gas	Gas	54

(source: Biomass Energy Centre)

Clearly natural gas and oil have the highest energy density by mass (GJ/tonne). Waste wood or waste wood products ranges from 15 to 21 GJ/tonne and are more comparable to the lower range calorific values gained from coal use.

Electricity

Electricity production from biomass can be an effective use of waste wood products however, as identified by interviewees, its low energy density in comparison to gas, oil and fuel combined with bulk transport and handling costs can make it uneconomical. This is particularly relevant in a country as vast as Australia.

According to John Jacobs from Pinetec, *"unless an energy plant is located in close proximity to sources of wood waste, transport and handling makes it uneconomical when compared with coal fired plants"*. Coal fired plants mine the coal on site and capital and infrastructure costs have been paid off. This creates a barrier to entry for biomass energy plants as capital and infrastructure costs will not be paid off for at least another 50 years. Thus, the cost of electricity from biomass energy plants will be higher than from coal fired plants have established infrastructure.

Thermal Energy

Fuel burned for thermal energy is not be as dependent on calorific values. The Cement Industry Federation is the national body representing the Australian cement industry, comprising of the three producers Adelaide Brighton Ltd, Blue Circle Southern Cement Ltd, Cement Australia Ltd. *"In an effort to reduce its reliance on fossil fuels and cut energy costs, Adelaide Brighton's Birkenhead plant trialled a number of alternative fuels before finding a solution, demolition timber"* (CIF, 2005 pg.12). The project technical manager, Michael Jones, stated that the plant utilises approximately 60,000 tons of demolition wood waste for thermal energy. Whilst the calorific value is important as adequate heat must be generated to fire the cement kiln, the reduced cost in utilising demolition wood waste in comparison to natural gas is more important. Furthermore, the residue ash is used as an input to the manufacture of cement thus reducing costs associated with supply of raw materials and making the use of demolition wood waste more economical.

There are quality specifications that must be met on the reuse of ash derived from demolition wood waste as an input to cement manufacture. The use of demolition wood waste at the Adelaide Brighton plant required permission from the Environmental Protection Authority (EPA) in South Australia. Trials on stack emissions had to be conducted before the wood waste could be burned to determine that emissions did not increase significantly from the baseline. The plants license conditions were changed to reflect the restrictions set on burning treated wood waste and plastics contamination. In discussions with Michael Jones, he noted that ash content is about 0.5% for every 4,000 tons of cement products produced.

Fit for purpose (local)

Electricity

In Western Australia, there are currently no energy power plants that utilise waste wood from industrial timbers as a supply source. To generate electricity, wood waste from industrial wood wastes has a higher calorific value than that generated from forestry. The moisture content is generally less and the energy density by mass will range among the higher range of 15 GJ/tonne. A consultant to the proposed biomass energy plant at Neerabup explained that if wood waste is mixed with other sources of wood supplies, it would produce adequate calorific value for power plant operations.

Pinetec supply forestry waste wood from their sawmill operation to the Western Power power grid in Collie. The operation is one of the largest cogeneration plants in Australia with approximately 80,000 tonnes of wood waste transferred via conveyor belts from the mill to the energy plant. The director of Pinetec stated that 98% of the energy generated is supplied to the power grid and sold by Verve Energy. Once you move away from direct supply to the plant, the transport costs render cogeneration uneconomical. The capital infrastructure for coal-fired plants has been paid off and the distribution infrastructure and networks are well established. The use of biomass needs to compete with the coal equivalent of $40/tonne. Processing industrial wood waste collected from the metropolitan area to woodchip is estimated to cost in the order of $40 to $50/tonne. Transport costs within a 20 kilometer radius are approximately $15/tonne. Assuming adequate quantities are generated, this equates to the use of industrial wood waste for electricity generation being in excess of $15/tonne in comparison to coal.

However, Gavan Troy from Beacons Consulting offers a contrasting opinion on transport costs. He considers that very competitive transport rates can be availed of providing guaranteed contracts can be established. This involves establishing regular collection and delivery regimes over period of at

least one year. He advised that the proposed biomass energy plant for Neerabup has identified 50% of biomass available from the Forest Products Commission, equating to approximately 100,000 tons. It is therefore likely that competitive transport rates could be achieved. Nevertheless, it is noted that the preferred radius of supply to the plant is within 50 kms. This would indicate that despite being able to achieve competitive rates, transport costs are still a significant factor for plant operating viability.

Industrial wood waste and forestry forest wood waste and residues provide a fit for purpose input to energy production in Western Australia. It would seem that utilising biomass is a viable market for electrical energy production in Western Australia providing the source of wood waste is in close proximity to a plant.

Thermal Energy

The Adelaide Brighton Birkenhead is the only plant that uses industrial timber wood waste as a source of thermal energy in Australia. It is one of the larger cement manufacturing plants in Australia. From a technical aspect, Mr. Jones iterated that for a smaller scale cement kiln and manufacture process to burn demolition wood waste, less than 5% contamination levels would have to be met. This would be necessary to adhere to environmental emissions limits and if the ash content was to be reused in the manufacture of cement. He noted that whilst they would be interested in assessing the possibility of their Cockburn Cement plant burning demolition waste, the quantities available and processing requirements to ensure contamination levels are less than 5% may prove it to be a financially uneconomical option.

Adelaide has more industrial centers than Perth and the Birkenhead plant receives a considerable amount of demolition wood waste and wood waste generated from the car manufacturing industry. However, the Cockburn cement plant is smaller than Birkenhead and industries that generate large volume of wood waste are located in close proximity, such as ship building.

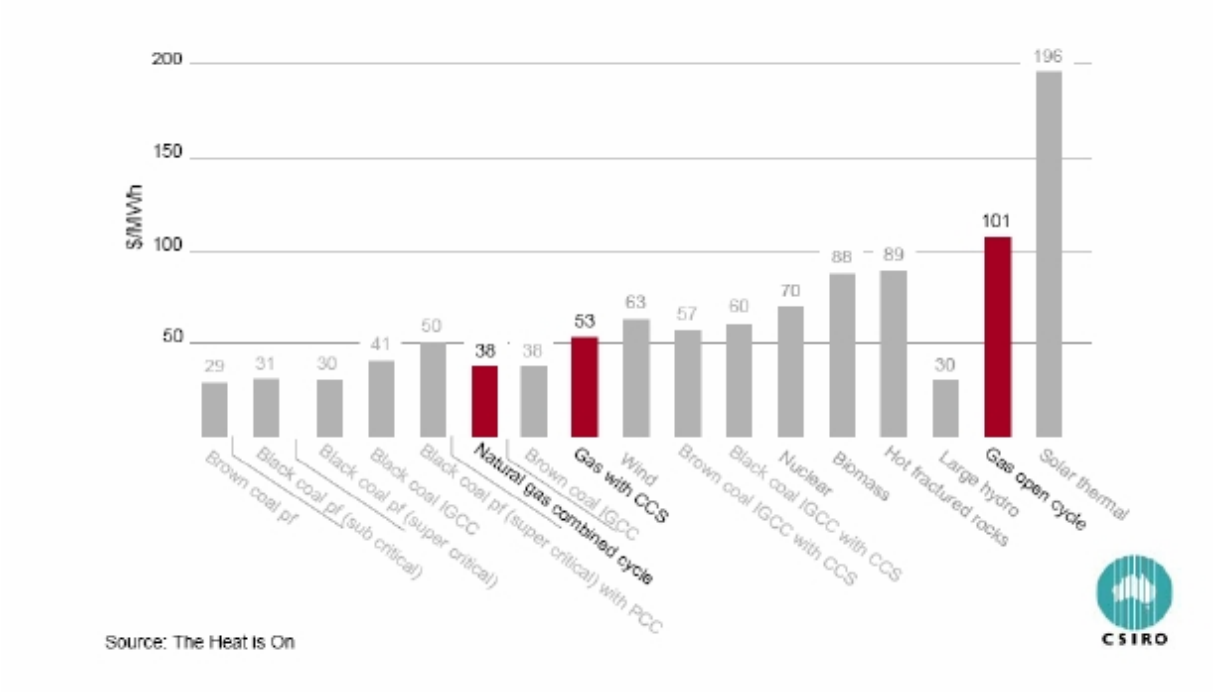
Plantation Energy located in Albany is pioneering the manufacture of wood pellets for export from Western Australia. Pellets are a biomass fuel made from plantation timber harvest residues. The manufacturing process involves reducing and compressing the raw material into cylindrical bars of compressed energy (www.plantationenergy.com.au).

In summary, industrial timber wood waste has the potential to be used as a source of thermal energy for the manufacture of cement. This is providing that adequate quantities are generated to cover the costs of processing and removing contaminants.

Cost

Producing Electricity

A recent study released by the CSIRO investigating the future of energy if Australia (CSIRO, Dec 2006) reported the following prices per MWh.



Prices for energy derived from biomass are among the most expensive and considerable more expensive than coal and natural gas. Prices are prone to significant variation with geographical region, order quantities, delivery distance and time. Furthermore, biomass prices can be particularly prone to external forces such as bush fires, forestry diseases, and wind and soil erosion.

The CSIRO report shows that biomass is one of the most costly supplies of energy in Australia. This is partially due to the fact that Australia has abundant supplies of coal and gas, the infrastructure is well established and many industries are dependent on it. Discussions with Kane Thornton from the Renewable Energy Generators of Australia, Joanna Gastevich from the WA Sustainable Energy Association and industry research iterated that energy produced from biomass will always be more expensive that from other sources. The determining factors for this are:

- Established and 'owned' capital infrastructure. Biomass energy plants are expensive, in the order of $30 million and it will be at least 30 years before the capital infrastructure is paid off. The capital infrastructure for coal has been paid back and thus it can afford to supply the energy source at a cheaper rate to biomass.
- The environmental cost of coal or oil is not attributed to their market price. The environmental cost of remediating land contaminated with hydrocarbons or wetlands destroyed by oil pollution is not factored into the market price. The environmental cost of occurrences associated with global warming is not attributed to air pollution caused by coal. If triple bottom line accounting was employed, biomass as a renewable energy would cost less.
- Lack of government policy on emissions reduction and trading.

Australia is not a signatory to the Kyoto Protocol which has been a driving force in reducing emissions and the introduction of emissions trading. In summary, a company is allowed to emit a certain level of greenhouse gases. If the company exceeds this level, they must either introduce or retrofit technologies to address these levels or they can buy carbon credits from other companies to offset their emissions.

Costs to end users

In Western Australia, the power retailer Synergy stated that domestic electricity supply is not currently sourced from biomass. It is however a supply source under investigation and one which will probably be available in the future. The domestic price for electricity generated from wind and solar source is $16.94/unit, which is 0.3c/unit higher than electricity generated from 90% coal and 10% gas sources. Synergy is assumed to be subsiding renewable energy options.

According to Grange Resources, the issue of reliability in being able to supply a consistent source of electricity generated from biomass still needs to be addressed. The reliability of using biomass as a power source is dependent on quantities of wood waste being available and securing those sources. There appears to be growing competition for wood waste sources in Australia which may limit the supply for its use as biomass. These developments affect the reliability of supply and price for use of biomass in the Australian market.

To summarise, alternatives such as natural gas and coal outperform industrial wood waste as a source of energy.

Product Potential Summary Score

Product Potential	Score	Comments
Fit for purpose	4	Contamination such as plastics, nails and CCA treated timbers must be minimal. Otherwise the product meets industry requirements as its calorific value compares to coal.
Cost	3	The use of industrial wood waste compares to the alternatives of coal and gas when located in close proximity to the reuse option. Supply of gas in WA inhibits further investments in Biomass Energy production.
Feedstock availability	5	Industrial wood waste must be chipped to market specifications. Output from a wood waste recycling facility is expected to meet Industry requirements.
End use efficiency	2.5	Not applicable.
Availability	2	A CSIRO report demonstrates that biomass is one of the most costly supplies of energy in Australia. With its abundant supplies of coal and gas, the infrastructure is well established, paid off, and many industries are dependent on it. Essentially, less expensive alternatives to wood waste are available for thermal and electricity generation.
Ease of handling	2.5	Handling of wood waste is comparable to the handling of coal.
Ease of disposal / recycling	4	The ash residues of biomass can be used in the manufacture of cement or compost. The ashes must adhere to certain specifications and be free from contaminations.

MARKET POTENTIAL

Demanding players and industries

Thermal energy and electricity

In Western Australia, the current demand for industrial wood waste as a source of thermal energy is non-existent but not unfeasible. In Australia less than 5% of energy is generated using biomass fuels (Australian Institute of Energy, 2007). There is growing interest in producing bio energy in Australia by burning biomass in power stations, including waste wood chip. Power stations at Isis in Bundaberg, Maryborough, Proserpine and Rocky Point all use wood chip as a supplementary fuel to increase capacity.

Electricity generation from residues

A NSW company Biomass Energy Services and Technology has established a demonstration biomass briquetting plant at Somersby (Bioenergy Beckons). A number of biomass residues are being tested for their suitability to briquetting including timber industry residues. It is proposed that briquettes could be used as a domestic fuel source. Increased market penetration into the use of waste wood fuel products such as pellets and briquettes is echoed by the Program leader at Texas Agricultural Extension Services who stated that as the prices of non-renewable energy sources such as oil continue to climb, residential consumption of bio fuel may not be far away.

"For Plantation Energy the major market for fuel pellets is Europe where the demand has increased rapidly since the adoption of the Kyoto Protocol. The projected total demand for DBF pellets in Europe is estimated to be 60 million tonnes per annum by 2015" (www.plantationenergy.com.au). Plantation Energy has located its manufacturing facility within a designated timber precinct and near an existing major woodchip operation. Forestry residue from the woodchip operation, such as tree tops, can be utilised in the production of pellets. This presents both a cost effective waste disposal and raw material supply solution.

In addition to the power generation market, pellets have become a popular domestic fuel source for residential heating in Europe. From work stream one, a number of businesses surveyed stated that wood waste was collected by the general public for use as a fuel. Combined with the fact that Plantation Energy is located in the South West which experiences colder winters than Perth, there is probably potential to open up a market for the domestic use for pellets.

Whilst these industries have no current plans to trial or utilise industrial wood waste in their production processes, they represent a competing source for forestry wood waste including woodchip. This in turn may drive other markets, including animal bedding, to source products derived from industrial wood waste as opposed to forestry wood waste.

Summary discussions

From discussions with industry and associations representing the bioenergy market, it appears that energy or fuel generated from biomass in Western Australia has the following characteristics:

- Synergies exist between different industries. For example, power plants that utilise biomass are located in close proximity to sawmills and to forestry plantations in Western Australia.
- The use of biomass is dependent on transport logistics. Interviewees suggested that biomass sources should be located within 50 kms to make its use economically viable when compared with other energy sources.

- Securing the supply of biomass is important and there are a number of competitors from various industry types.
- The reliability of its use as an energy source still has to be addressed, especially for mining operations. The high capital and operating costs of mining means that the production rate must be constant and the industry cannot afford to uptake an energy source where reliability of supply could be an issue.
- The use of forest residues is an emerging market and focused on exports. However, based on European trends, the rising cost of fuel and the outcome of a carbon emissions trading scheme in Australia, it may become a competitive energy and fuel source. This could have the effect of increasing demand for forestry wood waste and other industry types sourcing alternative products. For instance, the animal bedding market may source products derived from industrial wood waste as opposed to forestry wood waste.

Competition intensity

Competition for bioenergy resources is coming from both the demand and supply side. On the demand side the industrial wood waste is competing with cheaply and widely available fossilised fuels and forest residues. On the supply, there are competing sources for forestry wood waste including furniture, construction and domestic manufacture. The building supplier, Cemintel indicated that although construction trends have slowed from 2006 levels, the market is still buoyant and is likely to remain this way for the next few years. This assessment is echoed by the cabinet making industry and Midland Brick. Interviewees from workstream one forecated an increase in business of about 5% for the next two years. The Laminex Group has indicated that demand for its products is practically outstripping supply and it does not forecast this slowing down in the coming years.

The Japanese market demand for woodchip has increased from 2000 and Australia and the US are the largest suppliers of hardwood and softwood chip to this market. In addition, a new law introduced in 2002 in Japan requires substitution of 1% coal as a fuel source. This is driving a search for biomass fuels such as pellets in a market where there is a growing tightening to supply (Wood Resources International, 2003).

Plantation Energy aims to manufacture 145,000 tons per annum of pellets and will produce these from residues generated from harvesting the 120,000-plus hectare blue gum plantations in the Great Southern region of Western Australia. In addition, they will utilise residues from woodchip processing located in close proximity.

The competition on the supply side will affect quantities available for energy plants and could lead to increased market potential for industrial wood waste. Indeed, Beacons Consulting is hoping to ascertain quantities of industrial wood waste from Perth metropolitan councils and businesses.

Market perceptions

From workstream one, the overall market perception to using industrial wood waste as an energy source as opposed to land filling is positive. Consultation with community groups for the use of demolition wood waste as a fuel source instead of land filling was also received positively. Industry, however, is not generally proactively investing in energy generated from biomass. From discussions with industry associations, it is evident that a number of industries are waiting on outcomes and policies developed at a State and Federal government level in relation to carbon trading and emissions reductions.

Regulations and standards

Based on interviewee responses the use of industrial wood waste as a thermal or electrical energy source incurs considerable adherence to regulations and standards. These predominantly include meeting environmental and planning regulations. Both Adelaide Brighton and Beacons Consulting indicated that the entire process took approximately five years to establish, undertake community consultation and adhere to planning and environmental regulations.

Only as recently as December 2006, the Federal Government announced a Prime Ministerial Task Group on Emissions Trading whose task is *to advise on the nature and design of a workable global emissions trading system in which Australia would be able to participate* (http://pm.gov.au/media/Release/2006/media_Release2293.cfm, para 5). This followed the initiative of the State and Territories to establish the National Emissions Trading Taskforce. A goal of this taskforce is to investigate a national emissions trading scheme that could provide a mechanism for Australia to operate in a carbon constrained economy, and link to international carbon markets (http://www.emissionstrading.org.au/, para 2).

As yet, there is no established carbon trading scheme is Australia and the industry and stakeholders in the bioenergy market are playing a 'wait and see' game before investing further in the use of biomass as an energy source.

Distribution infrastructure

The economic viability of using industrial wood waste as an input to electrical or thermal energy is dependent on where the plant or re-use option is located and how cost effectively wood waste can be transported to the destination. Transport to electricity power stations from the Perth metropolitan area is prohibitive unless options of back-loading vehicles can be explored.

Other external drivers and barriers

Government Policy

In 1997, The Australian Biomass Taskforce was established to promote the use of biomass in manufacturing and electricity generation. Its members comprise a diverse range of stakeholders from the energy sector. One of the tasks of the Taskforce is to assist the electrical industry to achieve the hours generated by renewable energy by 2010 set by the Federal Government. One of the strategies put forward to achieve this is to introduce biomass fuels into existing coal fired power stations (cogeneration).

However, CSIRO Energy Technology division argue that cogeneration can only be economic when the biomass source is near the power station. Transport and handling costs can account for up to 40% of the electricity price.

Social Will

Electricity generation using biomass compares favourably to other 'green power' sources, however, it is more expensive than generation from coal or gas. A percentage of customers may be willing to pay a premium price for electricity generated from biomass. However, it is difficult to predict if the consumer in general will be willing to pay for an increase in electricity to stimulate the use of renewable energy. In WA, it is assumed that Synergy subsidise the cost of renewable electrical energy to households.

Environmental Cost

Biomass is a renewable source of energy. Provided biomass materials, such as wood, are replaced at the rate in which they are used, its use does not contribute to global warming. However, the question arises as to how this can be effectively monitored.

The economic environmental savings cannot be compared to current electricity generation that uses coal as the environmental cost of hydrocarbons is not included in their pricing structure. Until such time, the abundance and established infrastructure of coal fired power stations in Australia will remain cost competitive.

Market Potential Summary Score

Market Potential	Score	Comments
Demanding players and industries	2	Wood waste not regularly used in electrical or thermal energy generation on a local scale. Large-scale viable opportunities are limited but opportunities could be assessed in terms of a feasibility study. It is likely these options would take at least five years to establish.
Competition intensity	3	Industrial wood waste is not utilised as a source of biomass for thermal or electricity generation. Biomass offers a lower value market reuse option than other identified alternatives. Thus, available supply for biomass could be an issue.
Market perceptions	2	Positive in terms of utilising wood waste for energy or fuel as opposed to land filling but market option is slow.
Regulations and standards	1	The use of industrial wood waste as a thermal or electrical energy source incurs considerable adherence to regulations and standards. Processes can take five years to establish, undertake community consultation and adhere to planning and environmental regulations.
Distribution infrastructure	1	Depends on where energy plant is located or waste collection ventures that can be established. Transport to electricity power stations from the Perth metro area could be prohibitive.
Other external drivers and barriers	3	Government policies may stimulate future investment in renewable energy. It is unclear if society is willing to pay for the additional costs associated with using energy derived from biomass or whether electricity suppliers will continue to subsidise.

Financial potential

Financial potential	Score	Comments
Expected revenues	3	Short term expected revenue is minimal but potential revenues might be high as industrial wood waste can be a less expensive fuel source especially if located in close proximity.
Expected investments	5	Creating a viable market option requires the establishment of a wood waste processing facility in close proximity of a thermal or electricity producer including the processes for applying for appropriate planning and environmental permissions (=5).
Estimated financial impact	0.6	= 3/5

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- Joanna Gastevich, WA Sustainable Energy Association
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- Peter Sims, Cemintel

e. Market Details – Compost

Application

Composts are commonly and successfully applied in the fertilisation of turf in parks and road verges or as a soil structure improver and a nutrient source.

Product potential

Interviews with the three main local producers of compost and industry specialists revealed that wood waste is not considered as a preferred feedstock for the production of composts. Tree prunings, clippings, food and paper wastes, animal manures and sewerage sludge have the following benefits compared to the use of wood waste in the compost production process:

- Less processing requirements;
- Shorter decomposing times;
- Better Carbon/Nitrogen ratios;
- Lower possibility of chemical, biological and physical contaminants; and
- Higher volumes available at lower costs.

Product potential summary score

Product Potential	Score	Comments
Fit for purpose	1	Industrial wood waste is not the preferred feedstock
Cost	1	Other raw materials are more widely available and less expensive
Feedstock availability	1	Industrial wood waste is not the preferred feedstock, although some composters use material shredded from waste wood collected at landfills
End use efficiency	1	Industrial wood waste takes longer to decompose than alternative feedstock materials, and thus increases processing time.
Availability	1	Other sources are more readily available and some composters offer less expensive waste disposal alternatives to landfill
Ease of handling	2.5	Depends on the source. Liquid wastes and sludges may be more difficult to handle than industrial wood waste due to transport licensing requirements.

Market potential

Industrial wood waste is not the preferred feedstock for compost producers in Perth. Through the course of study for workstream one, it was determined that landfills in the Perth metropolitan area are increasingly preventing disposal of industrial wood waste. In addition, the Department of Environment and Conservation has decreed that stockpiles of wood waste are no longer able to be burned. Whilst this will lead to an increase in the availability of wood waste, its use as a component in compost manufacture requires source separated material. The costs involved in processing this wood waste could therefore prove too expensive to use it as a raw material.

It is noted that the largest compost processors in New South Wales and South Australia all utilise industrial wood waste as a component in manufacturing compost. Observations from site visits conducted at Australian Native Landscapes (Eastern Creek, NSW), Jeffries and Peatssoil (SA) indicated that chipped industrial wood waste comprises at least 10% of the compost feedstock. Combined, these companies manufacture approximately 450,000 tonnes of composted products equating to an approximate market use of 45,000 tonnes of industrial wood waste.

In addition to reasons given for alternative feedstock in comparison to industrial wood waste, the following factors may encourage its use in NSW and SA and limit its use in WA:

- Higher costs of landfill in NSW

Source separated, light or pine wood only is accepted by all companies visited. Providing this comprises a companies wood waste, it likely proves a more cost effective disposal option as landfill prices are in excess of $100/tonne in NSW.

- Established market networks

It could simply be a case that wood waste generators in NSW and SA are more aware of their options for disposal of wood waste. As landfilling of wood waste becomes increasingly difficult in Perth, wood waste generators may actively seek out other alternatives thus providing a more economical feedstock to compost processors.

- Less availability of forestry woodchip

South Australia in particular has considerably less access to forestry woodchip than Western Australia. This may have given rise to the alternative use of source separated industrial wood waste as a carbon source.

The local market assessment potential for Perth was indicated a lower potential that has been identified in the Eastern States possibly due to the factors mentioned above.

Considering the use of industrial wood waste by composters in NSW and SA, it is possible that a facility dedicated to recycling wood waste for end market use may provide an economical source of carbon feedstock for processors in WA. The costs of processing and the price this market is willing to pay for the chipped wood waste needs to be determined. However the current market conditions in Perth incur a limited demand for the product.

Market potential summary score

Market Potential	Score	Comments
Demanding players and industries	1	No industry players demanding the product.
Competition intensity	1	Many product alternatives and many players locally offering services and products.
Market perceptions	1	Negative perception towards quality industrial wood waste products.
Regulations and standards	1	In general, regulations and standards stimulate the use of recycled products but have not been identified as a driver of local demand.
Distribution infrastructure	5	There is an existing distribution infrastructure supplying compost products to bulk and retail markets.
Other external drivers and barriers	2.5	Increasingly, Perth metropolitan landfills are preventing disposal of industrial waste wood.

Financial potential

No revenues are expected from the supply of wood waste to the compost producing industry and its end user markets.

Financial potential	Score	Comments
Expected revenues	1	No revenues are expected from the supply of wood waste to compost producers.
Expected investments	3	No extra capital investments needed, on top of regular investments to remove contaminants, to be able to supply the compost industry with wood waste feedstock material, if required.
Estimated financial impact	0.3	= 1/3

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f. Market Details – Fibre Cement Products

Application

Fibre reinforced cement building materials were developed in the early 1980s and pioneered the use of alternative reinforcing materials to create asbestos-free cement-based building products. Fibre cement products (FCP) are manufactured by a number of companies in Australia including James Hardie, Cemintel, BGC and Timbercrete. These companies manufacture a range of planks, pipes, columns and sheets that can be used in renovations, and the construction of commercial buildings and new homes.

Products applications include being used for:

- External Cladding;
- Internal Lining;
- Floors and Walls;
- Wet Area Lining – Bathroom;
- Eaves, Verandas & Carports;
- Fire and acoustic walls;
- Bracing;
- Fencing;
- Decorative elements.

PRODUCT POTENTIAL

Fit for purpose (general)

The FCP manufacturing process produces a durable, easily worked, aesthetically pleasing product by a process that substantially reduces the curing time compared to air-cured concrete products. The FCP building materials will not burn, are resistant to permanent water and termite damage, and, when installed as directed, resistant to rotting and warping (www.jameshardie.com.au). A review of material data safety sheets, manufacturers websites and discussions with BGC in Western Australia detail that FCP products are a mixture of cellulose fibre, from plantation-grown Radiata Pine trees, cement, sand and water. Building Codes Australia licenses fibre cement products under Standards Australia®.

Fit for purpose (local)

Local performance requirements are no different from the general performance requirements.

Cost

The building industry is a competitive, cyclical industry and FCP manufactures are guarded about providing information pertaining to costs associated with supply and manufacture. Thus, production and supply costs were not provided to the research for this study.

Feedstock availability

The preferred feedstock for the production of FCP is plantation forestry, high quality timber currently used as a source of cellulose. Availability as an input to and output from a wood waste processing facility is not expected based on the research findings of workstream one.

Product Potential Summary Score

Product Potential	Score	Comments
Fit for purpose	1	Recycled wood waste has not been considered and there are no plans by the major manufactures to consider it as an input. Extensive trials would need to be conducted to comply with Australian Standards®.
Cost	1	Not applicable as wood waste is not used as a feedstock.
Feedstock availability	1	Forestry, high quality timber currently used as a source of cellulose. Not expected to become available to a facility based on the research findings of workstream one.
End use efficiency	1	Unknown as wood waste would need to be trialled as an input to FCP.
Availability	1	No expected shortage of current supply of timber. Timber obtained from plantations.
Ease of handling	1	Whilst the handling process in comparison to plantation timber would differ, it is expected that the cost and logistics would be comparable.

MARKET POTENTIAL

Demanding players and industries

Discussions with members of the Cement Industry Association, BGC and Cemintel revealed that recycled wood waste is not used in the manufacture of fibre cement products. BGC explained that the cellulose fibre had to be sourced from timber plantations and be of the highest quality to meet structural building requirements. Timber from radiata pine is predominantly used. Furthermore, there are no current or proposed plans by any of these companies to trial the use of wood waste as an input to the manufacture of fibre cement products.

Feedback from one company, Timbercrete, indicated that there may be the potential to trial wood waste as an input to the manufacturing process. Timbercrete product currently sells to a niche market focused on the environmental benefits of using this product. The company operates on a franchise basis and bricks are hand-made and air-dried. Competition for and the variable supply of wood chip from sawmills, combined with the fact that bricks are hand-made, allow the company to trial alternative inputs. There is a Timbercrete franchise based in Donnybrook, Western Australia. Depending on the success of the use of wood waste in a trial, manufacture would present a number of concerns:

- A wood waste processing facility would need to be located in close proximity as otherwise transport costs could render the use of the wood waste uneconomical.
- Storing the product to avail of back-loading or bulk loading opportunities could render the product unsuitable to use. If the product is too old, bacteria can thrive. If the product gets wet, it will start to compost.
- The ability to cost effectively process wood waste to manufacturer specifications. The 'first cut' from a mill is optimum particle size, that is, about 10mm. Increased shredding and screening of wood waste incurs increasing costs that would probably make it too expensive as a raw material input.
- The industry is in its infancy in Western Australia and as such would not have extensive cash-flow to fund structural and thermal trials to assess if wood waste complies with Australian Building Code regulations.

Despite these obstacles, David Leathard from Timbercrete in Donnybrook is interested in trailing the product to initially assess if it is a viable input. It is possible that the market for Timbercrete products will expand in the future especially considering that consumers are becoming more aware, educated and concerned about global environmental issues and sustainable practices. Indeed, organisers of the Perth SunFair reported that audience representation was more "mainstream" than "greenie" at this year's event.

Wood waste processing facilities may consider opening in fast growing areas such as Bunbury and Busselton to take advantage of these potential opportunities. Some of the barriers to the use of wood waste may therefore be overcome in the future for Timbercrete and trialing the use of wood waste as an input may be viewed as a good investment of time.

Competition intensity

Overall, there is currently no market for the use of wood waste in concrete composites and the market potential is very limited.

Market perceptions

The WA building industry is in a period of growth and the market is not interested in trialing new products.

Western Australian homes are predominantly built from 'brick and tile'. Resources would need to be dedicated to marketing efforts to persuade the marketplace to use a different product especially one partially derived from wood waste.

Regulations and standards

Building Codes Australia licenses fibre cement products under Standards Australia®. Any product to be used for structural purposes that plans to utilise wood waste would need to adhere to license conditions.

Distribution infrastructure

If a FCP utilising wood waste was developed, cement manufactures would utilise existing distribution and supply chains and marketing channels.

Other external drivers and barriers

Waste wood is viewed as an increasingly valued resource as competition for plantation wood increases and strategies and targets concerning emissions trading and carbon reductions are bandied around by State and Federal governments. Competition for plantation timber may encourage market development of alternative raw material use.

Market Potential Summary Score

Market Potential	Score	Comments
Demanding players and industries	1	Wood waste is not currently utilised in fibre cement products. Only small niche players are willing to experiment and trail wood waste product.
Competition intensity	1	A wide range of local manufacturers and products compete with new initiatives.
Market perceptions	1	The WA building industry is booming and the market is not interested in trailing new products. Would take considerable marketing resources to change attitudes towards housing building standards of 'brick and tile'.
Regulations and standards	1	Fibre cement products utilising wood waste would need to comply with Australian Standards®. One structural test can be in the order of $20,000.
Distribution infrastructure	5	If a FCP utilising wood waste were developed, cement manufactures would utilise existing distribution and supply chains and marketing channels.
Other external drivers and barriers	2.5	Increasing competition for availability of plantation timber. Building contractors may have negative perceptions of using products partially derived from wood waste.

Financial potential

Short-term revenue is expected to be low in this market and expected investments medium to high due to extra processing and trailing requirements related to standards accreditation.

Financial potential	Score	Comments
Expected revenues	1	Current expected revenue is minimal. If a FPC product was developed using wood waste, potential revenues can be medium to high. Dependent on housing industry and economic climate for building.
Expected investments	4	Trials, processing and handling of wood waste and achieving standards accreditation would contribute to high investment costs.
Estimated financial impact	0.25	= 1/4

Sources

Desk top research

- www.jameshardie.com.au
- www.cemintel.com.au
- www.abcb.gov.au

Local surveys

- David Leathard, Timbercrete
- Neil Meakins, Manufacturing Manager, BGC, 08 9334 4900
- Simon Blow, Cockburn Cement, Technologist, 08 9411 1033
- Peter Sims, Cemintel, 08 9365 1652
- Mirvac Fini
- Cement Industry Federation, 02 6260 7222

g. Market Details – Particleboard

Application

Particleboard is an engineered wood product manufactured from wood particles such as wood chips, sawmill shavings, sawdust, industrial wood waste and a resin or binder that is pressed and extruded.

Plywood, as an alternative to natural wood, was invented during the Second World War, however, by the end of the 1940s it became apparent that there was not enough lumber to manufacture plywood economically. Particle board was engineered as a replacement and commercially produced in Bremen, Germany during the war.

In the early 1950s, particleboard kitchens started to be used in furniture construction and came into widespread use once technology had progressed. Particle board is now less expensive than wood or plywood and is substituted for them when appearance and strength are less important than cost. Particle board panels are either sold in their raw from with a sanded surface or can be made more attractive with a surface decorative overlay such as bonded melamine papers, vinyl or wood veneers.

Particleboard has had a huge impact on furniture design. Large companies such as Freedom and Ikea base their strategies around providing functionally designed furniture at a low cost price. Generally, particleboard is used. This strategy is echoed by cabinetmakers in Perth's Eastern Region. During site visits for research into workstream one, it was noted that particleboard is predominantly used for furniture manufacture by this sector. Furthermore, cabinetmakers stated that solid wood furniture has become an expensive item and particleboard the norm. This sentiment is also iterated by Western Australia's only particleboard manufacturer, in that, the issue is not market demand but raw material supply for particleboard use.

Apart from furniture design, particleboard is used in shop fittings, built-in units, kitchen cabinets, shelving and toilet partitions. The Australian Wood Panels Association states that particleboard can be used for structural applications including access flooring, commercial and domestic flooring, and concrete formwork (http://www.woodpanels.org.au/productinfo/structural/formwork.asp).

PRODUCT POTENTIAL

Fit for purpose (general)

Particle board is a composite material but is made up of larger pieces of wood than medium-density fibreboard and hardboard. "Particleboard uses wood reduced to flakes or similar particles of varying size and shape depending on its application. Boards required for veneering or laminating with a decorative overlay are manufactured to have a dense stable surface made from finely ground particles with high resin content. When higher strength is required, flakes which are relatively large and thin are used" (http://www.woodpanels.org.au/manufacture.asp, para 2).

Table : Uses for particleboard and competing products

Use	Product	Rating	Comments (for particleboard)
Furniture manufacture	Particleboard Medium Fibre Density Board (MDF)	*****	Functional design, appearance, easy maintenance
Partitions	Particleboard MDF Plywood	******	For application as toilet partitions, moisture resistant particleboard should be used
Shelving	Particleboard	***	
Wood veneers	Particleboard MDF Plywood	*******	Ideal substrates because of their stability, smooth flat surfaces and accurate thickness
Access flooring	Particleboard	***	
Commercial flooring	Particleboard	***	Lighter construction of particleboard provides reduced foundation costs
Domestic flooring	Particleboard Laminated plywood	*****	Long periods of rain and / or hot sun will cause surface roughness and excessive particleboard sheet expansion and contraction
Concrete formwork	Particleboard Plywood	*****	The properties of Particleboard enable it to be used without regard to grain direction. This optimises the use of off cuts and avoids incorrect structural application (http://www.woodpanels.org.au/productinfo/structural/formwork.asp, para 1).
Furniture manufacture	Particleboard MDF	*****	Functional design, appearance, easy maintenance
Partitions	Particleboard MDF Plywood	******	For application as toilet partitions, moisture resistant particleboard should be used
Shelving	Particleboard	***	
Wood veneers	Particleboard MDF Plywood	*******	Ideal substrates because of their stability, smooth flat surfaces and accurate thickness
Access flooring	Particleboard	***	
Commercial flooring	Particleboard	***	Lighter construction of particleboard provides reduced foundation costs
Domestic flooring	Particleboard Laminated plywood	*****	Long periods of rain and / or hot sun will cause surface roughness and excessive particleboard sheet expansion and contraction
Concrete formwork	Particleboard Plywood	*****	The properties of Particleboard enable it to be used without regard to grain direction. This optimises the use of off cuts and avoids incorrect structural application (http://www.woodpanels.org.au/productinfo/structural/formwork.asp, para 1).
Furniture manufacture	Particleboard MDF	*****	Functional design, appearance, easy maintenance

The Australian Wood Panel Association (AWPA) advises that product quality is tested on a regular basis on production samples. The tests include density, internal bond, bending properties, formaldehyde emission, moisture resistance and long term durability. Australian and Industry Standards (AS/NZS 1859.1 and 1860.1) detail testing methods and give value limits for the mechanical and physical properties resulting from these tests. Surface properties for decorative overlaid panels are described in AS/NZS 1859.3. The AWPA members comprise all manufacturers of plywood, medium fibre density board, and particleboard. The AWPA provides material data sheets for all products produced by their members that can be downloaded from their website.

Industrial wood waste is currently used in the manufacture of particleboard. Discussions with the AWPA indicate that three of its five members who manufacture particleboard utilise industrial wood waste in their operations. As with wood waste from the forestry sector, particleboard containing industrial wood waste must be manufactured as fit for purpose and to quality standards. Furthermore, manufacturers detail specifications for the use of wood chip from industrial wood waste incorporating the presence of plastics, metals and grit.

Fit for purpose (local)

In terms of manufacture, local operations and requirements do not differ from general manufacture operations. Discussions with particleboard manufacturers in Australia note that whilst contamination can affect the plant operations, the major issue derives from the markets unwillingness to accept anything but very minimal levels. In Europe, the marketplace is willing to accept a higher level of contamination in particleboard than in Australia.

Cost

Discussions with stakeholders in the particleboard market and indicative figures from the Australian National University (ANU) indicated that wood waste is a less expensive input than forestry wood chip. In European markets, alternatives to wood chip are utilised for the manufacture of particle board and a comparison of prices is detailed in the table below. It is noted however that these alternatives are not used in Australia and no manufacturer has plans to trial them presently.

Product Alternatives	$/Tonne
Industrial wood waste chip	$42
Forestry pine sawlog(unchipped)	$63 to $227
Cereal straw	$300
Cane	$300
Flax	$8,000
Rice straw	na
Sugar cane bagasse	$300

Product Potential Summary Score

Product Potential	Score	Comments
Fit for purpose	5	Industrial wood waste meets industry requirements
Cost	5	Compares favourable to forestry wood chip
Feedstock availability	5	Industrial wood waste must be chipped to market specifications
End use efficiency	2.5	There is no gain in end use efficiency expected from the use of industrial wood waste in particleboard manufacturing. That is, the use of industrial wood waste as opposed to forestry woodchip or alternatives does not alter the product properties of particleboard.
Availability	4	Discussions with various industries suggests there is increasing demand for wood resources. Industrial wood waste can be a cost effective, available option.
Ease of handling	2	High investment on plant and equipment must be made to manufacture particleboard from industrial wood waste and forestry wood chip.
Ease of disposal / recycling	5	Particleboard off cuts can be reused in the manufacture process. The potential to use as animal bedding and as a raw material to compost has to be investigated.

MARKET POTENTIAL

Demanding players and industries

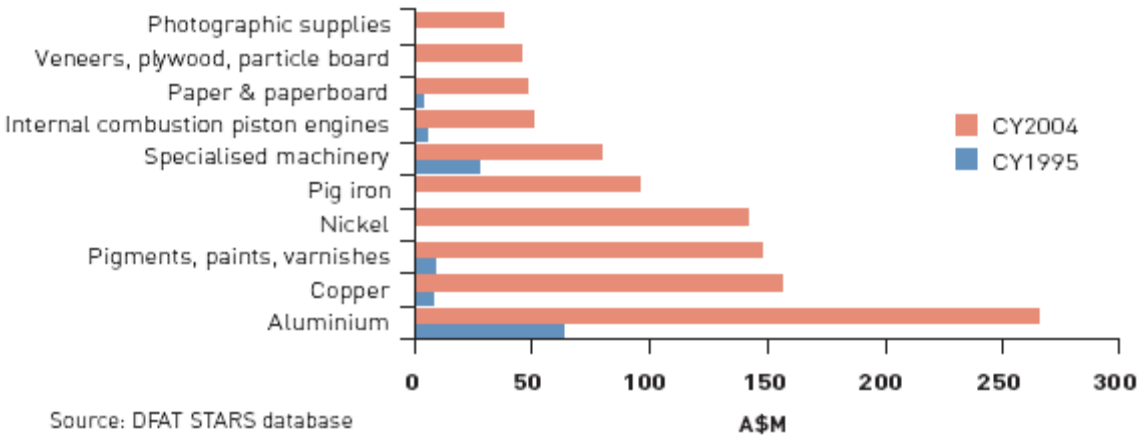
There are five particleboard manufacturers in Australia, namely Carter Holt Harvey, The Laminex Group, D&R Henderson Pty Ltd, Brims Wood Panels Pty Ltd and Tasmanian Wood Panels (Aust). The Laminex Group is the only producer of particleboard in Western Australian and site visits to major retailers including Bunnings and Mitre 10 revealed that particleboard is purchased from The Laminex Group or imported from China.

The Laminex Group's Dardanup plant utilises 7% recycled wood waste in its 400,000 tonnes usage of wood per annum. Of this, approximately 60,000m^3 is industrial wood waste[2]. The facility has the current capacity to utilise an additional 240,000m^3. Considering that workstream one identified 30,000m^3 of re-useable wood waste, the manufacture of particleboard presents a viable market opportunity.

Competition intensity

Discussions with Bruce Steenson from the Australian Wood Panel Association revealed that as it costs around $100m to establish a particleboard plant, there are not sufficient quantities of available wood material in WA to justify another manufacturer investing in a plant. He also related that there is increasing competition from Chinese imports of particleboard. In particular, Bunnings import large quantities of particleboard from China for their 'knock-down' kitchen market. ('Knock-down' kitchens are pre-packaged kitchens where consumers can choose particleboard panel sizes). Chinese imported particleboard does not comply with Australian standards for formaldehyde. However, consumers are not necessarily aware of this and will generally purchase particleboard on a cost basis. Chinese imports may therefore represent a threat to the market for WA produced particleboard. It is interesting to note that plants have been built in China to use rice straw as a basis for manufacturing (Forest Products Journal, 2006).

In contrast, the Department of Foreign Affairs and Trade states that "Australia's manufacturing exports to China have experienced rapid growth across the board" (DFAT, 2005).



[2] Based on 1 tonne of industrial woodchip equating to 4m^3

The above figure indicates that particleboard, plywood and veneers exports to China increased by $50m from 1995 to 2004. As China's economy continues to develop, it is possible that large quantities of particleboard will be consumed for the domestic market and thus constrict the volumes available for export.

Market perceptions

Interviews with The Laminex Group indicate that the Australian marketplace is less susceptible and willing to purchase particleboard with levels of contamination comparable to markets in Europe. Store managers at Bunnings and Mitre 10 revealed that grit in cutting particleboard reduces market sales as a result of the increased wear on tradesmen tools. Essentially, the European market is more accustomed to working with products derived from industrial wood waste, and construction tools and techniques are designed to handle these products.

Through the course of research for workstream two, the overall response was positive for industrial wood waste to be used as an input to a manufacturing process as opposed of being disposed of to landfill.

Regulations and standards

As stated above, manufacturers of particleboard in Australia complies with Australian and Industry Standards (AS/NZS 1859.1 and 1860.1) for the mechanical and physical properties and AS/NZS 1859.3 for surface decorative properties of particleboard. Australian Standards must be complied with in the use of industrial wood waste, however, plant operations are already established to meet this standard in WA.

Distribution infrastructure

Distribution of particleboard is well established in WA. Particleboard is exported and the domestic market is strong.

Other external drivers and barriers

Environmental Disasters.

Forestry fires would have a major impact on source supplies for the particleboard manufacturing industry. Currently, particleboard plants across Australia operate at 85 to 100% capacity and discussions with The Laminex Group in WA indicated that market demand equates to supply. Destruction of forestry raw material could therefore cause market supply shortages.

Market Potential Summary Score

Market Potential	Score	Comments
Demanding players and industries	5	One key but significant player in WA.
Competition intensity	4	International competition is driving the higher levels of recycled wood material in particleboard, producing a lower cost product.
Market perceptions	3	Australian market is less susceptible to high levels of recycled wood in particleboard than European markets.
Regulations and standards	4	Australian Standards must be complied with but plant and process well established and capable of meeting these standards
Distribution infrastructure	4	Well established in WA.
Other external drivers and barriers	3	Forest fires have the potential to positively impact on demand for wood waste material.

Financial potential

Financial potential	Score	Comments
Expected revenues	5	The current demand for industrial wood waste is more than 150% of the total regional supply potential of 30,000m3 of wood waste and is estimated to grow a magnitude above that. Expected revenues are therefore expected to be high (=5)
Expected investments	3	Apart from regular and tight quality control standards and processing technology to extrude contaminants there are no additional investments expected to meet the quality requirements of the industry. Expected capital investments are expected to be medium (=3).
Estimated financial impact	5/3	= 1.7

Sources

Desk top research:

- Australian Wood Panel Association (www.woodpanels.org.au)
- Department of Foreign Affairs and Trading, Australia-China Free Trade Agreement Potential Benefits, Available: http://www.dfat.gov.au/geo/china/fta/facts/manufacturing.pdf (2005)
- Guler, Cengiz; Bektas, Ibrahim; Kalaycioglu, Hulya
- , The experimental particleboard manufacture from sunflower stalks (Helianthus annuus L.) and Calabrian pine (Pinus brutia Ten.), Forest Products Journal (April 2006) Vol: 56, Issue: 4

Local surveys:

- Joe Cullity, The Laminex Group
- Hardy Deinham, The Laminex Group
- Bruce Steenson, AWPA
- Store Manager, Bunnings, Belmont
- Store Manager, Mitre 10, Guildford

h. Market Details – Spillage Absorbents

Application

A spillage absorbent may be used for any application where liquids need to be absorbed, including absorbing and/or removing liquids from a floor or other surfaces. Absorbents can be generally classed into three categories: organic, inorganic and synthetic. With the rise of environmental awareness and responsibility, absorbents of choice have moved towards greener options. By comparison, organic absorbents are now seen as the preferred option from an eco-friendly perspective, although inorganic and synthetic absorbents still have their roles to play in certain situations.

PRODUCT POTENTIAL

Fit for purpose (general)

Absorbents can be generally classed into three categories, organic, inorganic and synthetic. Increased environmental awareness and responsibility has led to an increase in the use of organic absorbents. Products derived from waste by-products are preferred as they offer both a waste disposal and pollution cleanup solution. Furthermore, the resulting residue waste material can often be biodegraded into natural and useful compounds (www.wastestreams.com.au).

A patented wood waste based absorbent has been listed by the US Patent Office and has displayed successful absorbent capacity when applied on petroleum and petroleum derivatives. It can also be used for various other liquids including antifreeze.

Fit for purpose (local)

The general performance criteria for an absorbent identified by local product suppliers are listed below and in order of importance.

Performance Requirements	Comments
Absorbency	Grams of fluid adsorbed per grams of absorbent (g/g) or the number of times a product can absorb its own weight.
Hydrophobic	Whether the product still work when water is involved, that is, when it's raining, or on water surfaces.
Clean	Can the product be used indoors or is cleanliness an issue in handling.
Fixing of the spillage	Whether the absorbent material can be easily transported once the spillage has been absorbed.
Easy to dispose	Whether the absorbent material can be readily disposed of once the spillage has been absorbed.
Can be used more than once	Whether the absorbent material can be reused once the spillage has been absorbed.
Cost	Price of the product (per kg of liquid absorbed)

Different feedstock materials are used to produce spillage absorbents. Each material has its own performance characteristics.

Performance Requirements	Timber	Clay	Recycled Paper	Cotton Blend	Synthetic
Absorbency	*	*	**	***	***
Hydrophobic	*	*	*	*	***
Clean	*	**	**	***	***
Fixing of the spillage	**	**	*	**	***
Easy to dispose	***	*	***	***	*
Can be used more than once	*	*	*	*	***
Cost	***	**	**	*	*
Total	12	10	12	14	17

For outdoor oil spillages on dry surfaces, a wood fibre based absorbent can offer a low cost, easy to handle and dispose of solution. For indoor spillages, the more expensive options are better are generally used as cleanliness is usually an issue. Synthetic non-organic products are generally more effective for chemical spillages on wet surfaces or if conditions are wet.

Feedstock availability

According to the only one manufacturer of spillage absorbents in Australia, Envirosmart, the feedstock for wood fibre based absorbents is very fine, clean, uncontaminated wood flour. Based on the research findings from workstream one, the availability of this wood flour feedstock as an input to, or an output from wood waste processing facility is expected to be minimal or non-existent. No sources were identified during the course of the study.

Cost

Wood based absorbent products are cost $20 per 10kg bag whilst alternatives are priced from $30 to $100 per 10kg bag.

Products	Price 10kg bags	Comments
Cotton / Kapok	$50	The cleanest product that absorbs almost 20 times its own weight.
Recycled Paper	$30	Still clean enough for indoor use and absorbs around 10 times its own weight.
Timber / Peat	$20	Low cost option for outdoor use, absorbs 2 to 3 times its own weight.
Synthetic	$30-$100	Not the preferred low cost option because of disposal issues. Currently the only option for the removal of complex chemical spillages from wet surfaces or in wet conditions.

Product Potential Summary Score

Product Potential	Score	Comments
Fit for purpose	4	A cost effective product for outdoor use.
Cost	4	Low cost option for specific purposes
Feedstock availability	1	Bulk availability of feedstock is expected to be minimal
End use efficiency	2	Lower absorbency efficiency than more expensive products. Not reusable like synthetic products
Availability	2	A range of other alternative products are widely available. The range of wood based fibre products is limited.
Ease of handling	2	Wood based fibre products are more difficult to handle in terms of cleanliness than alternatives, for example, than pelletised recycled paper products.
Ease of disposal / recycling	5	Easy to dispose of. Can be incinerated or in some cases composted.

MARKET POTENTIAL

Demanding players and industries

In an industrial setting, the nature of spillages is generally petrol, diesel, kerosene, turpentine, lubrication oils, hydraulic fluids and mineral oil sources. The US National Research Council has estimated a worldwide annual total of 960,000 tonnes of oil entering the sea from urban and industrial spillages (www.wastestreams.com.au).

In the public domain there was no further identified market information available on the size and volume of the market for absorbents. American Wood Fibres is a large supplier of industrial grade wood flour in the United States. Their product is used in the manufacturing of absorbents, adhesives, cleaning products, putty and caulk, rubber, plastics and soil extenders. Local Peth suppliers indicated that wood fibre based absorbents are used commercially, however, market uptake has been slow.

Demanding players and industries (Perth)

Sensis lists seven retailers of industrial cleaning absorbents in Perth servicing mining and general industry. There are no local manufacturers in Western Australia of a cleaning product incorporating wood fibres and only one manufacturer in Australia, Envirosmart. Current absorbent manufacturers indicated that they have no plans to open manufacturing plants in Western Australia. Essentially, the local market is too small to warrant the expenditure on plant and resources.

Competition intensity

The market for absorbents is highly competitive and tends to be price sensitive and marketing intensive. There are a variety of organic and non-organic products available for a wide range of applications.

Market perceptions

Organic absorbents are increasingly viewed as the preferred option from an environmental perspective. However, the market uptake and move away from inorganic and synthetic absorbents is slow. *"Ten years ago and even still today, mineral absorbents like "kitty litter" or diatomaceous earth were predominately used as oil absorbents. This is despite such material being unsustainable, costly to dispose of, unsuitable for landfill and in some cases carcinogenic. Old habits die hard and there has been a resistance to change from inorganic and synthetic absorbents, even though both cost and environmental benefits could be shown"* (www.wastestreams.com.au).

Regulations and standards

The Australian Standard 1940:2004, which is relevant for the storage and handling of flammable and combustible liquids, specifies that spillage response equipment should be available and staff trained in the correct procedures to handle spills and other emergencies. These standards do not provide detail about spillage response, containment or cleaning up of a spill. There is also no regulation or legislation in Australia as to how someone should respond to a spill (www.wastestreams.com.au).

Distribution infrastructure

There is no existing distribution infrastructure for the supply of wood fibre to the manufacturing process for absorbent products. Pending the opening and operation of a wood waste recovery facility, Envirosmart are interested in investigating the possibility to back load wood fibre from Perth to Queensland. However, the economic viability of this will depend on whether appropriate wood fibre material is received or produced by the facility and whether the volumes justify transport and handling costs.

Other external drivers and barriers

Sustainable industrial applications such as organic absorbent are tending to attract broader interest from commercial end users due to the 'environmentally friendly' promotional opportunities they create.

Market Potential Summary Score

Market Potential	Score	Comments
Demanding players and industries	2	A small, specialised local industry supplying a range of cleaning absorbents in which wood fibre products represent a small share.
Competition intensity	1	The market is highly competitive and tends to be price sensitive.
Market perceptions	2	A positive bias towards the use of organic aborbents although local market adoption has been slow.
Regulations and standards	2.5	Regulations and standards in place for handling and storage. No stimulation for the use stimulate of a product containing recycled materials.
Distribution infrastructure	1	There is no existing distribution infrastructure for the supply of timber fibres to the only manufacturer in Australia. Depending on whether wood fibre is received or processed by a wood waste recovery facility, this manufacture may investigate the quality of the material and the economics of transporting it.
Other external drivers and barriers	3	Industrial commercial interest for sustainable development.

Financial potential

The market is receptive to the introduction of a wood fibre based product, however, local market uptake has been slow. Envirosmart indicated that approximately 80 tonnes per month (320 m^3) of clean wood flour would make transportation to Queensland from Perth viable. It is estimated that at this tonnage, the product could be purchase for between \$5 - \$10/m^3. Pending receipt and / or processing of the appropriate quality material, a tentative revenue potential from wood fibre delivered to Envirosmart would be approximately \$28,800.

For a processing facility, capital investment would be required to store and / or process the industrial wood waste into a fine wood flour. It is envisioned that the product would be stored in underground bunkers at a building cost of around \$40,000 per bunker. The product will be accepted at the gate in 400kg bulk-a-bags and transferred into transit depot (dry storage) waiting for transport.

Financial potential	Score	Comments
Expected revenues	1	Due to expected lack of good quality supply feedstock in substantial quantities, expected revenues from this application are minimal.
Expected investments	3	For storage capital investments of approximately \$40,000 per bunker would be required. Trials would have to be conducted to determine whether a wood waste processing facility could process the required raw material wood flour for absorbents and at what processing costs.
Estimated financial impact	0.3	= 1/3

Sources

Desk top research

- Griffith University Office of Facility Management
- Lismore City Council
- American Wood Fibers
- US Patent Office
- www.wastestreams.com.au
- Forest Products Laboratory

Local surveys

- Australian Institute of Petroleum, 02 6247 3044
- Service Station Association, 02 9420 5599
- Coles Express Service Stations, 03 9829 3111
- Robert Bulldog, Owner, Perth Petroleum Services, 9258 5877
- Oilchem Spill Systems, 0407 975 486
- Ben Nichol, Product Manager, Matthews New Pig, 03 9763 0533
- Steve Clark,, Owner, Envirosmart, 07 3889 6677

i. Market Details – Surface Mulch

Application

Surface mulch is used to help stabilise surfaces, prevent erosion, retain moisture, or to enhance landscaping. It is also applied to assist the establishment of crops and to create conditions where vegetation can be re-established in the creation of parks, gardens, golf courses, urban renewal projects and restoration of industrial sites.

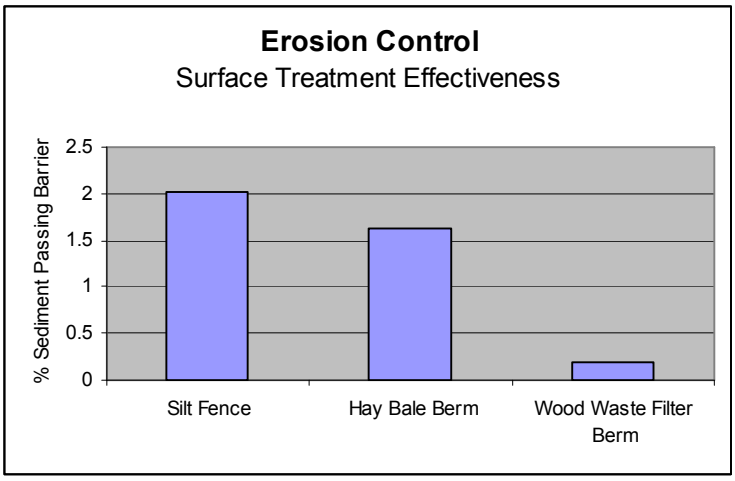
PRODUCT POTENTIAL

Fit for purpose (general)

Research of the Waste & Resources Action Programme (WRAP) in the UK lists the general performance requirements for wood chips used as surface mulches:

- Available at short notice in large quantities for one-off projects;
- Of a chip size suitable to add structure and allow air to circulate within the soil;
- Contamination, especially glass and sharp metal fragments must be avoided as surface mulches could either be used at playgrounds or in landscaping and thus present a health risk to persons who come into contact with the material;
- Shards from chipped wood should also be avoided for similar reasons.

Research conducted by the University of Connecticut in the US found that industrial wood waste products were more effective in controlling erosion than hay (straw) or sand and silt barriers.



In addition to the well-known markets of landscaping and agriculture markets, less well known markets for surface mulch include hydro seeding. Hydro seeding is a mixture of woodchip, seed, fertiliser, and a stabilising emulsion spread by hydro mulch equipment. Hydro seeding spreads seed to temporarily protect exposed soils from erosion by water and wind.

Fit for purpose (local)

Locally in Perth commercial and public landscaping architects and contractors specify the industry standards for the mulching material used in landscaping activities.

Main Roads Western Australia defines mulch as any chipped site vegetation, composted organic materials or inorganic materials such as crushed rock, coarse aggregate, river pebbles, or pea gravel, spread as a soil surface protection measure or decorative surface treatment.

The Australian Standards *AS 4454 (2003) for composts, soil conditioners and mulches* defines mulch as any pasteurised organic product that is suitable for placing on soil surfaces. The mulch should be pasteurised to eradicate any harmful bacteria and plant pathogens. At least 70% by mass of particle size should be greater than 15 mm. Shredded garden organics (sometimes referred to as raw mulch, leaf mulch or chipped garden waste) are excluded from the standards, unless they have been subjected to a pasteurisation or composting process.

The performance criteria for surface mulch detailed by local commercial landscape architects and contractors are listed below and in order of importance.

Performance Requirements	Comments
Fire retardency	Mulches are preferred that are fire retardant, especially when applied to road verges where cigarettes often set "mulch on fire".
No biological contaminants (one year old or pasteurised)	Before organic materials are used as mulches, they should be pasteurised to eradicate any harmful bacteria, plant pathogens and weed seeds.
Dust properties	Surface mulch should be coarse and therefore not easily disturbed by the wind. Surface mulch should also not be too dusty.
Durability	Mulch should not degrade completely for between 3 to 4 years.
Drainage	It is important that surface area continues to be permeable to ensure adequate drainage.
Colour	The market preference is for dark, rich looking mulches or coloured mulch (jarrah red, brown or black).
No plastics, nails, splinters	Minimal contamination, aesthetically suitable for placing on surfaces.
Coarse particles	Nominal between 15mm to 80mm range (90% passing 80mm, 20% passing 40mm
Water efficiency	Ability to retain moisture in the soil and prevent excessive evaporation.
Maintenance costs	Easy to apply and to maintain.
Added manure/composting	Ability to improve soil structure and fertility.
Availability	Large quantities for large projects and consistent bulk supply for smaller projects
Cost	Current pricing ranges from \$40 to \$60/m^3 depending on quantities ordered and types of mulch (coarse wood, pine bark, composted mulch).

The local industry described the expected properties of surface mulch processed from industrial wood waste compared with alternatives available on the market as follows:

Performance Requirements	IWW Mulch	Coarse Wood	Pine Bark	Green Waste	Straw
Fire retardency	*	*	***	**	**
No biological contaminants	***	***	***	*	*
Dust Properties	*	**	***	***	*
Durability	**	**	***	**	*
Drainage	***	***	***	*	**
Colour	**	**	***	**	**
No plastics, nails, splinters, sand	*	**	***	***	***
Coarse particles	***	***	***	***	**
Water efficiency	***	***	***	*	**
Maintenance costs	**	**	***	*	*
Added manure/composting	**	**	**	**	**
Availability	**	**	*	***	*
Cost	**	**	*	***	*
Total	27	29	34	27	22

The preferred feedstock for surface mulches is pine bark due to fire retardency, colour and durability properties. Forestry woodchip is becoming increasingly popular due to its durability, lack of biological contaminants, and reduced supply of pine bark. Surface mulch processed from industrial woodchip must be able to compete on the properties of pine bark and forestry woodchip whilst being cost effective. For example, to develop the surface mulch market for industrial waste woodchip, processed chip may be sprayed or dipped in fire retardant solution. Woodchip may be coloured black, brown or jarrah red to make the product more acceptable to end users.

Feedstock availability

A coarse clean chip greater than 15mm is expected to be one of the main products of a wood waste processing facility. Therefore feedstock is expected to be available.

Cost

Local current alternatives are priced from $40 to $60/m^3 (including delivery) with delivery of approximately $17/m^3 within a 30kms radius from source supply. Interviews with the EMRC indicated that industrial waste woodchip could be expected to be priced at around $42 per tonne ([3]approx. $10/m^3) depending on volumes of wood waste received.

Products	Price m³ + freight w/n 30kms	Comments
Pine Bark	$35	Preferred product. Prices are increasing due to reduction in supplies.
Forestry Mulch	$40-$60	Prices are increasing, two years ago prices were $10/m^3.
Shredded Green Waste	$10 (generally freight only)	Greenwaste has previously been shredded and applied directly as a surface mulch. Processors, State government and impending introduction of revised AS 4454 standards are contributing to the reduction in this practice.
Straw	-	Not locally available in affordable bulk quantities.
Recycled Timber Product	$10 $20 to $25	Not delivered and not coloured. Coloured

[3] 1 tonne of chipped industrial wood waste equates to approximately 4m^3

Product Potential Summary Score

Product Potential	Score	Comments
Fit for purpose	3	Industrial wood waste when delivered without contaminants in coarse particles meets most of the importance properties for surface mulches as outlined by the processing industry. To effectively penetrate the market it may need to be coloured, dipped in fire retardant solution and be as cost effective as pine park and forestry woodchip.
Cost	5	Current alternatives are priced at \$40 to \$60/m^3. The industrial wood waste product can be offered at \$10 to \$15/m^3 prior to colouring and depending on volumes processed. Green waste has been offered at \$10/m^3 but is expected to be edged out of the market by increased industry education and marketing to end users, and revised AS 4454 standards.
Feedstock availability	5	Can be produced from a wood waste processing facility.
End use efficiency	3	Use in the environments outside has to date shown that higher end use efficiency from bark than from coarse wood or industrial wood waste can be expected. Industrial wood waste is expected to perform better and last longer than green waste and straw.
Availability	4	Availability of pine bark is reducing. Shredded green waste is still used as a low cost option but is expected to be marginalised for reasons stated previously.
Ease of handling	3	Pine bark and coloured coarse wood mulch seems to be easier to handle dust to less dust generated.
Ease of disposal / recycling	3	No disposal required, industrial woodchip will decompose.

MARKET POTENTIAL

Demanding players and industries (UK)

A WRAP (the Waste & Resources Action Programme) marketing campaign aimed at informing the landscaping sector of the benefits of recycled woodchip for use as an effective surface mulch led to more than 11,500 tonnes of additional material being sold in 12 months. Sixty per cent of wood recyclers witnessed sales increase as a result of the *'Recycled Wood Works Wonders'* campaign, which targeted local authorities, commercial procurers and specifiers, together with landscape architects and contractors.

Prior to the campaign, market research showed that awareness in local authorities of recycled wood products for use in landscaping was just 2%. As a result of the marketing activity, subsequent research showed that awareness increased to 18%. In addition, 33 local authorities introduced trials of industrial waste woodchip surface mulch view to learning more about the known performance benefits of durability, maintenance reduction and the ability to adhere to slopes in all weather conditions (HUB Materials Handling Recycling, Sarah Dunn).

It is postulated that the use of surface mulches processed from industrial wood waste and also organic material in Western Australia would also benefit from such a marketing campaign.

Demanding players and industries (Perth)

The reported number of industry processors of composted materials in Perth is 25 (Compost Australia, 2006). The table below presents the quantities of materials sold in 2006 with the total market estimate for recycled organic mulch sold being 491,995m^3. According to Compost Australia, the market has increased by approximately 7% from 2005. The markets for urban amenity, rehabilitation and enviro-rehabilitation would represent surface mulch applications.

The markets for surface mulch in Perth are quite well established. Property developers outsource their landscaping activities to landscape architects and landscape contractors and those businesses decide upon the types of surface mulches that will be used. Landscaping suppliers or surface mulch processors advise the landscape market of products to use for specific applications. Sensis details 550 landscape designers, contractors and architects in Perth and 40 surface mulch wholesalers. This established market seems to be reflected by the quantities of mulch sold for urban amenity applications (refer to table below).

Product Type	Market Application	Quantity Sold (m^3)
Composted mulch	**Total**	**240,745**
	Intensive agriculture	7,296
	Extensive agriculture	1,000
	Urban amenity	225,449
	Rehabilitation	6,000
	Enviro-remediation	1,000
Pasteurised mulch	**Total**	**18,800**
	Intensive agriculture	100
	Extensive agriculture	na
	Urban amenity	13,800
	Rehabilitation	na
	Enviro-remediation	na
Raw mulch	**Total**	**232,450**
	Intensive agriculture	12,000
	Extensive agriculture	na
	Urban amenity	211,950
	Rehabilitation	na
	Enviro-remediation	na

Based on the table above the total market volume in Perth for surface mulch based on recycled organics is 400,000m^3.

Council landscaping operations represents another market outlet for urban amenity. An analysis of two Councils and landscape wholesalers activities provides an indication of product use.

The City of Swan has planned to develop 5 to 10ha of parks and gardens in 2007 with the proposed increase of surface mulches as opposed to turf surfaces. Traditionally, parks and gardens development has comprised 30% planting/mulching and 70% turf. Currently, planting/mulching represents 40% and turf 60%. The Council's landscape architect has projected that the parks and gardens will be covered with a 1cm layer of mulch. Therefore, the City is expected to need 200 to 400/m^3 of mulch for 2007. Landscaping coordinators with the City of Gosnells indicated that 'Packer Park' would require 400 to 450m^3 of surface mulch for 2007.

David King, owner of WA J King, estimates the market demand to be more than 1,500m^3/week of pine bark a week, equating 75,000m^3 per annum. The current supply covers an estimated 750ha of new developments and "topping up" maintenance. It is noted that Mr. King remarked "if there was

more pine bark available, the market would utilise it". There might therefore be a potential for competing products to make up this shortfall.

Hydro seeding, an advanced method of landscape enhancement (where timber is mixed with fertiliser and seeds) represents a small market in Perth and is tested on trial basis. There are limited suppliers that offering this service. One of these suppliers, Rainstorm, indicated that they would be e willing to trial a recycled woodchip but are not expected to become a bulk-demanding player in the short to medium term.

Competition intensity

Sensis counts 40 wholesalers of surface mulch. Discussions with industry indicated that competition is not based on product price but on the efficiency of processing costs and transport logistics. There is limited competition in the provision of the recycled wood product.

Market perceptions

The industry perceives that it would be difficult to cost effectively process a surface mulch from recycled timber that is free from contaminants such as plastics, nails and splinters.

Regulations and standards

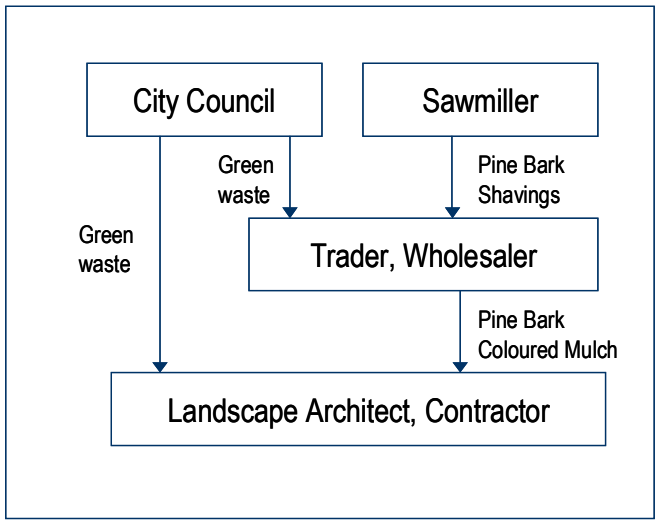
There are a number of developments occurring among processors of quality composts and mulches to encourage the marketplace to apply quality products as opposed to shredded green waste or poorly processed alternatives. The WA Department of Environment and Conservation is encouraging the community to purchase quality products and supporting the industry in relaying the quality message.

The widely recognised '5 tick' AS 4454 standard is being revised and Compost Australia will promote and inform the marketplace with respect to quality issues (Earthmover & Civil Contractor, 2007). The marketplace will be encouraged to look for quality symbols which included the Compost Australia newly released 'leaf brand', the '5 ticks', NASAA accreditation.

It is expected that these efforts will educate and inform the marketplace with respect to quality issues and also stimulate market development.

Distribution infrastructure

The figure below depicts the distribution infrastructure for surface mulches in Perth. Some councils provide landscapers, contractors and processors with green waste. Sawmills provide wholesalers with pine bark and shavings. Wholesalers add value through sieving (the right particle size) and colouring (light timbers) and delivering on site to landscapers and contractors. Efficient bulk distribution for a product processed from industrial wood waste could avail of already established wholesaler relationships and networks with clients.



Other external drivers and barriers

There is a growing trend to replace turf as a landscaping enhancement with native plants in mulched planting beds. It enhances aesthetic value and retains moisture in the soils thus increasing water efficiency and reducing maintenance costs.

More and more larger players come into play demanding the best clean and green quality product off the market. The Laminex Group taking on more and more lower grade industrial wood waste for their particle board processing. The Western Power power plant is taking on all the industrial wood waste from the largest pine saw miller in Western Australia Pinetec substituting coal for a renewable energy source (industrial wood waste).

Market Potential Summary Score

Market Potential	Score	Comments
Demanding players and industries	4	A well-established industry and many players demanding the product on a continual basis. Although scattered around Perth and per entity probably using smaller quantities.
Competition intensity	2	Four different products are competing for a substantial market. IWW has to prove itself on key performance attributes.
Market perceptions	2	Negative experiences with prior products made out of recycled timber made the market sceptical towards new IWW introductions
Regulations and standards	4	Regulations and standards stimulate the use of a good quality product and is expected to force – once more applied – contractors to avoid using the widely and cheaply available green waste. Wide marketing and extension of those standards is needed.
Distribution infrastructure	5	The existing distribution infrastructure is open to the introduction, trial and testing of a recycled timber product. In effect existing client relationships and product development experiences can be built upon in introducing a new product.
Other external drivers and barriers	4	A growing trend to use water efficient surface mulches compared to turf. The introduction of larger players in the market (Laminex and Western Power) have increased the pressure on the demand of timber products. The high productivity of existing and new pine plantations are expected to balance this increasing market pressure.

Financial potential

Although local circumstances can vary widely experiences in the UK demonstrate that the market is receptive to the introduction of a recycled wood product as surface mulch. Market penetration of a product processed from industrial wood waste would require undertaking processes such as colouring of the product to meet market demand, intensive marketing and most likely distribution through already established wholesale networks.

A low cost good quality industrial wood waste solution marketed in collaboration with existing suppliers is expected to generate an annual local demand of 7,500 m^3 (10% of the size of the current market for pine bark). The market uptake of industrial wood waste as a surface mulch is expected to be slow due to identified potential quality issues..

A wood waste processing facility is able to provide the product at $17 a m^3 (including freight) of which $10 to $12 is paid for the product. The total estimated short term revenue potential from surface mulch delivered in bulk demanding markets like landscape enhancement is 7,500 * $12= $90,000 (excluding freight). Future revenue potential based on the market growth potential and expected rises in prices is expected to be higher. The conservative expected potential supply of 7,500 m^3 is 25% of the identified volumes of reusable wood waste in work stream 1.

Financial potential	Score	Comments
Expected revenues	3	The estimated local demand is a substantial 25% of the identified volumes of reusable wood waste in work stream 1.
Expected investments	3	The estimated investments is medium because stringent quality control standards and technology is needed to be able to provide a quality product that will meet industry standards, assuming that colouring is done by the existing suppliers.
Estimated financial impact	1	= 3/3

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Local surveys

Landscape architects, contractors and coordinators:

- Ted Blythe, Landscape Architect, City of Swan, 9267 9191
- Joseph Filia, Landscape Architect, Main Roads WA, 9323 4151
- Graig Barker, Coordinator Landscape Construction, City of Gosnells
- Lesley Dunn, Technical officer landscape design and construction, City of Gosnells, 9492 0147
- Kerry Smith, Principal Coordinator Parks Operations, City of Gosnells,
- Nelson Hinscliphe, developer, Peet Limited, 9420 1111
- Investa, property developer, 9481 5900
- McNelly Newton, landscape architect, 9228 4511
- IBIS, landscape architect, 9383 2915
- Landscape Industry Association, 9476 9800

Landscape suppliers:

- David King, WA J King, 9398 2595
- John Pollack, Soils ain't soils, regional manager, 9453 3377
- Tim Richard, Amazon, regional manager, 9455 1323
- David Depiazzi, Owner, Depiazzi TJ & Sons, 9728 1152
- Roy McInnes, Rainstorm, 9459 2785

j. Market Details – Water Filters

Application

Water filters using waste wood chip or saw dust can be used to improve water quality by removing contaminants such as particles, oil or grease, heavy metal ions, pesticides, nitrogen and phosphorous. In Australia water filters are increasingly used in Water Sensitive Urban Design (WSUD). WSUD provides for the sustainable management and improvement of water quality entering waterways from urban regions, opportunities for Stormwater and greywater harvesting and reuse; and innovative reductions in potable water demand.

Discussions with the Department of Water (DoW), Water Corporation and Swan River Trust (SRT) revealed that the construction and implementation of WSUD in Western Australia currently occurs on a site specific and experimental basis. However, as indicated by the Water Corporation, Western Australia's increasingly drier climate and water shortages will necessitate more rapid implementation of WSUD. "*The value of water is increasing*" (Mark Tonti, Water Corporation).

WSUD Application

WSUD applications can provide water based or natural vegetated features that add community value, while performing a treatment function through filtering of Stormwater runoff. Applications that can utilise wood waste include but are not limited to:

- Grassed or landscaped swales;
- Infiltrations trenches and bio retention systems;
- Wetlands; and
- Porous pavements.

PRODUCT POTENTIAL

Fit for purpose (general)

WSUD applications can be sized up or down to suit the individual site, from a standard house block through to a whole subdivision. The DoW indicated that if the design is appropriate then maintenance costs will be low. Furthermore, the Water Corporation indicated that once a system is installed, it can be left in-situ for 10 to 15 years without incurring maintenance costs. WSUD using wood chips or sawdust as filter mediums can be applied in the following areas:

- New road / streets in large or small development areas;
- Existing streets and roadways;
- Where drainage systems or pavements are to be substantially upgraded;
- On publicly owned land;
- In new residential development – detached housing, medium density or integrated housing;
- In existing residential developments – redevelopments and infill areas;
- Commercial or industrial properties / estates; and
- Carparks / driveways / access routes – public or private property.

Fit for purpose (local)

The above-identified areas of WSUD can be applied to Western Australia, however, the difference in parameters to pollutant treatment and soil mechanisms must be taken into account. Water filters in WSUD in the Eastern States are predominantly used to treat heavy metals from previous industrial land use. In Western Australia filters in WSUD are used to treat nitrogen and phosphorous. Past and current agricultural and horticultural land practices have led to a need to assess nutrient management in areas such as the Avon Valley. In addition, urban drains discharge significant quantities of nutrients to the Swan-Canning Estuary. *"On the Swan Coastal Plain groundwater intercepted by lengths of unlined open drains is a major source of nutrients and other contaminants"* (GHD, 2006). Therefore whilst WSUD may be implemented more widely in the Eastern States, design specifications, treatment filters, maintenance and implementation costs may not be easily transferable to Western Australia. This likely contributes to the market being in experimental stages and site specific.

As a filter medium, sawdust and woodchip have been proven to successfully remove nitrates. Treatment media for the removal of nitrogen require a carbon source, such as a mix of sawdust or woodchip with sand (Fahrner, 2002; Schipper and Vojvodic-Vukovic, 2001). Mark Tonti at the Water Corporation considers that wood chip from industrial wood waste could prove to be an effective treatment media for the removal of nitrogen. As with the use of forestry wood chip, experimental trials would need to be established to prove the effectiveness of industrial wood waste as a treatment media. This is particularly relevant, as the DoW has found local Government are somewhat reluctant to change current Stormwater management practices to a treatment system that is not widely used or proven in Western Australia.

Feedstock availability

The feedstock in demand for this application is a coarse clean wood chip. This type of feedstock is expected to become one of the major outputs of wood waste processing facility. Further development of specifications need to be trialled and tested.

Cost

The costs below are based on a comparison of using forestry woodchip and sawdust to industrial wood waste woodchip and sawdust.

Products	Price m3 + freight	Comments
Forestry woodchip	$40-60 / m3	Depends on treatment methods.
Forestry sawdust	$22 / m3	Depends on treatment methods.
Industrial wood waste woodchip	$10 to $12/ m3	Depends on volumes.
Industrial wood waste sawdust	$10 / m3	Depends on volumes, storage and handling requirements.

Product Potential Summary Score

Product Potential	Score	Comments
Fit for purpose	4	Forestry wood chip and sawdust technically proven as a filter to remove nutrient contamination from water. The use of woodchip from industrial wood waste would need to be trailed in WA but is expected to perform well on removal of nitrogen.
Cost	5	Industrial wood waste is a cost effective option compared to forestry wood chip and sawdust.
Feedstock availability	4	A coarse clean wood chip is expected to be one of the major outputs of wood waste processing facility. Further development of specifications need to be trailed and tested.
End use efficiency	5	Filter mediums need to be replaced after a period of between 10 to 20 years.
Availability	4	Forestry wood chip and sawdust from sawmills is used for a number of purposes including thermal and power generation, animal bedding and litter, compost and mulch processing. Availability of this feedstock might become an issue considering rising demands, creating a gap for an industrial wood waste cost effective option.
Ease of handling	2	Handling is comparable to that for forestry woodchip.
Ease of disposal / recycling	5	Following replacement as a filter in WSUD, chipped wood waste or sawdust could be effectively used as a nutrient rich input to compost or mulch manufacture.

MARKET POTENTIAL

Demanding players and industries

Market implementation of WSUD is dependent on local Government, land developers, the Water Corporation, DoW and regionally through the Department of Planning and Infrastructure. Through collaborative efforts between councils, developers and relevant regulatory authorities, WSUD is being incorporated into urban developments and road designs across Victoria (*Water Sensitive Urban Design*, Melbourne Water).

Implementation of WSUD appears to be evolving in Western Australia. Mark Tonti from the Water Corporation advised that WSUD has been proposed since the 1980s. In 1995, an area identified for further study in the Water Authority's *A Supply Strategy for Perth to Mandurah to 2021* was to work with the Department of Urban Development to promote the application of WSUD principles (Water Authority, 1995). The Department of Water are finalising guidelines for the *Drainage and Management Strategy for Structural Controls* including specifications for the use of filter mediums such as wood chip.

In 2006, the Water Corporation commissioned GHD Pty Ltd to construct a prototype WSUD groundwater treatment curtain to assess the improvement of water quality in open drains. The prototype was installed at the Mills Street Main Drain. The Mills Street catchment is an urban catchment of 12km^2 located between the Swan and Canning Rivers, draining towards the Canning River to the south. Filter mediums including sawdust/sand and woodchips/sand are being evaluated for the removal of nitrogen and monitoring is to continue for at least 10 years (GHD, 2006). The Water Corporation indicates that preliminary results show a 95% effective rate of contaminant removal. Houghtons Winery in the Swan Valley has constructed wetlands for environmental and social amenity purposes (Craig Wansborough, EMRC). The Swan River Trust has stated that WSUD are included in future water quality management proposals and they are considering the use of woodchips in proposed designs for the restoration of a pond located at the top of a drainage catchment.

As stated previously projects to date in Western Australia have been experimental and site specific. The DoW has stated that unless local Government adopt the use of WSUD the market will remain experimental and site specific for quite some time. The DoW indicated that local Government are careful to adopt WSUD as it is perceived that maintenance costs will be increased. However, they consider that if local Government accounted for triple bottom line accounting, maintenance costs would actually be lower than current water management practices.

Considering the market for WSUD is local Government, land developers and the Water Corporation, it represents a potentially large market use of for the use of waste wood chip and sawdust as filter media.

Competition intensity

As the market is experimental and site specific, no competition exists in terms of industry competing to install WSUD. However, competition exists between environmental and engineering companies to construct, monitor and project manage site specific WSUD and trials.

Market perceptions

For those companies who have trialled the used of wood chip and sawdust as a filter media, it is viewed as an effective mechanism to remove nitrogen. Discussions with all interviewees revealed positive and negative market perceptions to the overall use of WSUD.

Maintenance Costs

The DoW indicated that local Government has been cautious to adopt WSUD due to the perception of increased maintenance costs and limited budget to address these costs. However both the DoW and Water Corporation are of the view that WSUD actually reduces or eliminates some maintenance costs. If systems are designed and installed properly, no maintenance should be required until filter media requires replacement.

'Unproven' Technology in WA

The market including land developers and local Government has also been slow to adopt WSUD as it is an 'unproven' and not widely used technology in Western Australia. In addition, Western Australia really does not have water treatment technology currently in place. The usual methods of treating water quantity and quality are detention basins and sumps that concentrate pollutants at source, that is, gross pollutant traps.

Utilising WSUD will require demonstrations of systems in use in Western Australia, an analysis of the economic costs of installing and maintaining the systems over a period of at least 10 years and design specifications particular to implementation of systems to the Swan Coastal Plain sandy soils. Although trials are in place and the DoW are developing structural design guidelines, this information is currently not available and it will take some time for the market to change practices.

Regulations and standards

The DoW is currently finalising guidelines for the *Drainage and Management Strategy for Structural Controls* including specifications for the use of filter mediums such as wood chip.

The Water Corporation considers that WSUD will soon be designed into water quality management systems for new sub-divisions as a requirement from the Department of Planning and Infrastructure.

Distribution infrastructure

At present there is no infrastructure in place to provide the Water Corporation, Land developers, Local and State Governments with the wood chip and sawdust as filter media in WSUD systems. However it can be expected that the same traders and wholesalers currently supplying sawdust and woodchips as animal bedding and surface mulches to farmers, racehorse trainers, landscape architects and contractors are called upon to provide their products and services in supplying the demand for wood chips and sawdust generated by the implementation of WSUD systems.

Other external drivers and barriers

Drying Climate

The increasing scarcity of water supplies for the Perth metropolitan region will continue to increase the value of water. The Water Corporation indicates that this will force an assessment and treatment of water quality where Stormwater drainage flows to waterways or groundwater. In the past, due to the Swan Coastal Plain sandy soils, Stormwater drainage permeated and recharged Perth's aquifers quite quickly. However, as less and less water is available, better practice water quality management techniques such as WSUD must be implemented so that Stormwater runoff can be used for

environmental and human purposes. Systems must now be implemented that reuse water whereas previously water simply permeated to the aquifer and was pumped back.

Triple bottom line

A barrier to the use of WSUD may be the exclusion of environmental costs in economic accounting practices. According to DoW, the costs of maintaining WSUD are viewed as prohibitive by some council. However, if triple bottom line accounting was employed, costs associated with waste reduction and disposal could make WSUD a more cost effective drainage management system. In addition, where pipes extrude contaminated water to waterway or wetlands, the associated environmental costs are not attributed to current drainage management systems. It would likely make them less cost effective than WSUD better practice techniques.

Market Potential Summary Score

Market Potential	Score	Comments
Demanding players and industries	3	Market comprises of local Governmental, land developers and Water Corporation. Currently no large structural demand from those industries expected due to slow market adoption of WSUD and experimental stages in trials and product development. Substantial future market potential expected.
Competition intensity	4	Market still site specific and experimental. No current competition in supply of feedstock and techniques leaving a gap for the introduction of the industrial wood waste option.
Market perceptions	2	WSUD demonstrations and presentation of life cycle cost analysis in comparison to current practices would assuage market perception of high maintenance costs and 'unproven' technology in WA.
Regulations and standards	4	Impending DoW guidelines and DPI requirements to utilise WSUD should stimulate the market.
Distribution infrastructure	4	Land developers would probably organise construction and distribution through already established supplier networks.
Other external drivers and barriers	4	Ultimately the drying climate and demand for water resources, especially considering Perth's urban sprawl and increasing population will drive more effective use of water resources and thus WSUD and its demand for timber fibres as filter media.

Financial potential

It is difficult to estimate the financial potential for WSUD in WA as it is currently not widely priced and implemented. In addition, implementation would be included with the financial potential for redeveloped land and it would be therefore difficult to obtain financial revenue pertaining specifically to WSUD.

The financial potential for the use of waste wood chip or sawdust may be high providing that waste wood is proved to be an effective filter media.

Financial potential	Score	Comments
Expected revenues	3	Present market potential is minimal. However future potential revenues can be medium to high. Current expected revenues are minimal due to WSUD being still a site specific and experimental market.
Expected investments	3	Processing wood waste into wood chip or sawdust for this market would generate no extra investments on top of regular screening and removal of contaminants.
Estimated financial impact	1	= 3/3

Sources

Desk top research

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Local surveys

- Mark Tonti, Water Cycle Project, Water Corporation, 08 9420 2420
- Rachel Spencer, Drainage Nutrient Intervention Program, Swan River Trust, 08 9278 0970
- Bill Till, Department of Water, 08 6364 7600
- Stephen Lloyd, Eastern Hill NRM Coordinator, EMRC, 08 9424 2220
- Halinka Lamparski, Environmental Engineer, GHD, 08 6222 8733

k. Market Details – Wood Plastic Composites

It is noted this market assessment reflects an assessment of the WPC option compared to forestry timber, and not the viability of industrial wood waste as a feedstock material to this market. The results of the survey provide clarity of a sustainable market in development and it was felt that results would be useful for inclusion in this study.

Application

Wood Plastic Composites (WPC's) are made by combining wood waste (sawdust, fibres, flakes or flour) and plastic which results in a compound product that combines the best properties of both pure wood and high-grade plastic.

Applications include in building construction, automotive applications, residential, outdoor and marine. Decking, docks, and railings, door and window, door frame and components, exterior vertical and horizontal cladding, fencing and fence posts, garden furniture and architecture, Profiles, Roofing, Shutters, Siding, Stairs and hand rails, Dashboards, Door panels, Headlining, Sidings, Wall lining, Pallets, Panels and sheets, Signs and plaques, Balustrades, docks, and railings, Flooring and porches, Furniture, Kitchen cabinets and worktops, lanking and pre-finished floorboards, Roofing, Shelving and Siding. Residential, industrial decking, foundation elements and shoreline structures.

PRODUCT POTENTIAL

Fit for purpose (general)

The wood fibre plays an important part of the composite product, as it is a filler to reduce the production costs.The ratio of filler to plastics in composites should not exceed 55% otherwise the integrity of the product may be affected (The Network Group for Composites in Construction).

In light of rising petroleum costs, there is an increasing interest in maximizing the use of renewable materials. Several billion pounds of fillers and reinforcements are used annually in the plastic industry. The use of additives in plastics is likely to grow with the introduction of improved compounding technology and new coupling agents that permit the use of high filler/reinforcement content. This could have a tremendous impact in lowering the usage of petroleum based plastics (Wood Materials and Engineering Laboratory).

The advantages of Wood Plastic Composites are:

- It can be extruded to make continuous profiles of any desired cross-section with great dimensional constancy and accuracy and very little waste, unlike real wood.
- Outdoor maintenance requirements for wood plastics composites are very low, although it can be machined and worked in the same way as wood.
- Painting is not necessary but paint can be applied to WPC, if desired for aesthetic reasons, much more easily than to most plastics.
- Outdoor durability of WPC is better than that of softwood, and lifetimes of 25 to 30 years are expected.
- WPC possesses some important environmental advantages that make it attractive to those who have opposed the use of PVC or forestry hard woods in building.

- The composite provides superior resistance to rot, excellent dimensional stability and strong thermal properties.
- A wood plastic panel board does not rot, has very minimal warping with moisture, saves on heating costs, can be nailed or painted just like pure wood and is lighter and easier to work with.
- The WPC is the preferable alternative to pure wood, plywood and MDF.

Requirements WPC	WPC	Timber	MDF	Plastic
Easy to work with	***	**	***	**
Easy to dispose / recycle	***	***	*	*
Durability	***	*	**	***
Moisture warping	***	*	**	***
Cost	**	*	**	***
Total	14	8	10	12

In general wood plastic composites are perceived by the market as an excellent product across several properties and outperform many of the alternatives.

Fit for purpose (local)

Local performance requirements are no different from the general performance requirements.

Feedstock availability

The preferred feedstock for the production of wood plastic composites is a very fine kiln dried wood flour derived from contaminant free sources, for example, the end product of the sanding of light wood products is plantation forestry, high quality timber currently used as a source of cellulose. Availability as an input to and output from a wood waste processing facility is expected to be minimal or non existent based on the research findings of workstream one.

Cost

Prices and performances of the alternatives to wood plastic composite are presented below (in the Canadian market (AUD):

Product	Costs	Lasts	Life Cycle	Disposal
Timber / plastic board	$19	50 yrs	$19	Recycled
Plywood	$48	10 yrs	$239	Burning
MDF	$18	10 yrs	$90	Not easily
Hardiflex cement panel	$39	50 yrs	$39	Not

There is limited supply from the only manufacturer in Australia and a small number of manufactures in the United States and Canada, thus manufacturers cannot pass on costs savings from selling in bulk quantities. Consequently, in Perth, retail prices are two to three times more expensive than the alternatives.

Prices	Price per Meter
Treated Pine	$2
Jarrah	$5.50
Timber/plastic	$6.25

Product Potential Summary Score

Product Potential	Score	Comments
Fit for purpose	5	Excellent product compared to available alternatives.
Cost	2	Relatively high local product prices
Feedstock availability	1	Fine kiln dried wood flour. Expected to be minimal.
End use efficiency	5	Minimal waste in working processes and high durability in end use.
Availability	2	Limited availability compared to other competitive products.
Ease of handling	5	Easy to process and work with compared to alternatives
Ease of disposal / recycling	5	Easy to recycle.

MARKET POTENTIAL

Demanding players and industries

Wood Plastic Composites - Market Overview:

- 1950's - 80's: rapid growth in structural and nonstructural wood-based composites
- 1990's: rapid development with gypsum, cement, and plastics
- WPC North American Sales <US$100 million tripled over the past 5 years

From the mid 1980's WPC decking sales have grown to now occupy to around 19% of the US decking market and set to grow in excess of 42% by 2010 (Wood Materials and Engineering Laboratory). The market for WPC is expanding and it is expected that companies that are already selling WPC in Australia will also experience similar growth.

According to the latest research from AMI Consulting European production of wood plastic composites reached almost 30,000 tonnes in 2003, having grown from less than 3,000 tonnes since 2000. The current European WPC producers come from a variety of backgrounds, with 28% being completely new companies, 22% having their core business in PVC profiles, 22% being timber companies and 11% being recycling companies. Some of the identified European suppliers are small scale and many barely beyond experimental stage in terms of WPC processing. The need for companies with larger scale operations, influence and trade routes to market is needed to create aware, foster credibility and enable significant substitution challenges to be addressed.

It is estimated that wood fibre-plastic composites currently have an eight percent market share of the decking market, which translates into an estimated $65 million business in the US alone. With an increase in demand for such decking products and a widening of the product range produced using woodfibre-plastic composites, market growth for the material is expected to be significant (AMI).

Globally many companies are selling WPC commercially, including Timbertec, JER Envirotech, Trex, Brite, CorrectDeck, LP Building products, The Network Group for Composites in Construction. In Australia ModWod based in Queensland is the only manufacturer retailing in Western Australia. Exporters to Australia are the Perth Wood Plastic Composite Manufacturer (based in China), Brite Manufacturing Company and Timbertec both based in Canada.

Demanding players and industries (Perth)

Only one manufacturer is based in Australia servicing the building and construction industry demanding a refined type of timber waste. As a result there is no large local demand for industrial wood waste for processing in the production of wood plastic composites. International manufactures are considering opening up manufacturing establishments in Western Australia but no specific dates are given.

Discussions were held with the pallet producers CHEP and Loscam for the potential for these companies to either use or manufacture wood plastic composite pallets. Although considerable research has been undertaken on investigating other alternatives than forestry wood in the production of pallets, plastic timber composites have not yet been identified as a worthwhile alternative. This is due to the lack of strength and durability of most composite materials compared to the timber based product.

The Australian automobile industry representing Toyota and Holden were also contacted. Whilst the Association did not want to reveal any information that could be commercially sensitive in the

manufacture of their cars, it is assumed that they do not currently locally produce car parts from wood plastic composite materials like producers in the US are trialing (Daimler Benz / Chrysler).

Competition intensity

The building and construction market is highly competitive and also tends to be price sensitive. A wide range of building and construction materials manufactured locally or imported from Asia are available. It is expected that WPC products would have to compete with alternatives or substitutions on price. If Australian trends follow international trends then WPC materials would be expected to outperform many of these alternatives.

Market perceptions

Growth in WPCs has increased exponentially in recent years due to its environmental and economic advantages. Innovative production techniques and the preferable alternative demand have made WPCs a cost-effective option for many applications. Local end users including Investa, Peet Limited, FGW and the Housing Industry Association have indicated that the market potential is high. Local adaptation is slow due to existing buying and building practices, combined with the fact that WPC products are relatively new to the local marketplace and prices are higher than alternatives.

Regulations and standards

WPC products must be compliant to Australian Building Codes.

Distribution infrastructure

There is no local existing distribution infrastructure for the supply and take on of wood waste in the manufacturing process of wood plastic composites. It is expected however that market outlets would mirror those of currently established alternatives.

Other external drivers and barriers

Larger sustainable industrial applications tend to attract a broader interest because of the promotional and commercial opportunities it creates for both suppliers and end users.

Market Potential Summary Score

Market Potential	Score	Comments
Demanding players and industries	1	Only one manufacturer in Australia. International manufactures consider establishments in WA.
Competition intensity	2	The market is highly competitive and tends to be price sensitive. A wide array of alternatives. Composite products are expected to have a great future based on product performance.
Market perceptions	2	A positive bias towards the use of recycled and recyclable composites but the local market uptake is very slow due to the high prices, lack of available product and the habit of not to be keen to try anything new.
Regulations and standards	3	Standards stimulate the use of a recycled product.
Distribution infrastructure	1	There is no existing distribution infrastructure for the supply of timber fibres to a local industry.
Other external drivers and barriers	3	Rising industrial and commercial interest for sustainable development

Financial potential

Whilst local market perception regards the product as a quality alternative, market adoption has been slow due to less expensive alternatives conservative purchasing practices of the local industry.

Financial potential	Score	Comments
Expected revenues	1	Potential revenues can be medium to high, but current expected revenues are minimal due to lack of local demand of feedstock material.
Expected investments	4	Capital investments are expected to be significant to extra processing and trialing requirements meeting industry specifications.
Estimated financial impact	0.25	= 1/4

Sources

Desk top research

- Commercial suppliers: JER Envirotech, Brite Manufacturing Company, Trex, CorrectDeck, LP Building Products, The Hackwell Group, Modwood.
- The Network Group for Composites in Construction
- Wood Materials and Engineering Laboratory, Washington State University, Pullman, Washington, USA
- *Utilization of Natural Fibers in Plastic Composites: Problems and Opportunities*, University of Wisconsin, 1999.
- Structure magazine, building blocks, March 2007.
- Applied Market Information (AMI) Ltd
- Wood Machining & Tooling Research Program, North Carolina State University, Raleigh, 2001
- CSIRO Manufacturing and Materials Technology
- www.trademags.com.au; building contractor
- University of Wisconsin

Local surveys

- Allan Stillwell, Housing Industry Association, 02 9978 3320
- FGW Corporation Pty Ltd, 9459 7133
- Francis Doupe, Manager, Modwood, 03 9357 8866
- Phil Derbyshire, CHEP, 0419 262 606
- Peter Not, Development Manager, Investa
- Bunnings
- Toyota and Holden

4. Paper recycling – Lessons learned

The societal acceptance and performance of large-scale paper recycling is significantly advanced over timber recycling. Discussions held with Amcor in WA presented the lessons learned in their four decades of experience in paper recycling. In summary their lessons were:

1. Potential markets of the future are not easily predicted due to rapidly changing market conditions, therefore allow for substantial further product trials and market monitoring and development to capture those changing circumstances.
2. Sales prices are still expected to rise on the short term due to developments in Asia, however longer term developments in commodity prices are always uncertain.
3. Target larger wood waste generators first, for they are easy to work with, and join the comprehensive recycle@work programme to get small and medium sized businesses on board.
4. Recycling can grow into a business of its own, larger than the founding businesses

The lessons of paper recycling align with key findings and directions given this study. Recycling in general provided it is implemented on a large enough scale to produce products that adhere to industry requirements can generate viable business opportunities in the current global context. Future developments are promising but remain tentative.

Paper recycling started in the late sixties, resulting in Amcor's present production of 1.2m tonnes of cardboard packaging material, 700k tonnes of newspaper print and 600k tonnes in office and writing material. Currently, Amcor's global recycling business is larger than its paper manufacturing business.

In Australia, the recycling development has traditionally been fully cost driven. Before the use of recycled paper, it cost $600 per tonne to produce the pulp to make paper. This cost reduced significantly with the advent of recycled paper. Today, it would simply be non-viable to produce non-recycled paper in Australia, due to our lack of ability to compete on grounds of either forest or water access with countries such as Brazil, Chili and Indonesia

Significant research was performed internally by Amcor to consider the development of different grades of product for different types of market applications. The cartons used to package beverages are made of 100% recycled material and "one-liner" carton. Carton's used to package computers, laptops and other electrical equipment are equipped with two liners of corrugates and a one liner in between, all made of 100% recycled material. Boxes that are used to package vegetables are fitted with different types of recycled and non-recycled material to give strength, durability and moisture prevention. Discussions with the larger supermarket chains during workstream two infer that this impetus into product development for fruit and vegetable packaging has led to a decline in the use of wooden crates.

Most of the current packaging products and services couldn't be foreseen when Amcor started its recycling programmes. Twenty to thirty years ago most trade was done in bulk and locally. Currently the global trade demands different types and varieties of packages to be transported. The alternatives to carton - plastics, styrene and timber - were easily outperformed on price, flexibility and weight. More other products and services could be added to a cardboard box - filling, printing, labelling, colours, covers - than you could on a timber crate or plastic box.

Paper waste has become a commodity mostly through the developments in Asia. Five years ago paper waste was worth nothing. Now with the commodity boom across the board, paper waste is reaching $120 per tonne. The Asian markets are driving the price as they do for many resources.

In establishing a comprehensive paper recycling program the larger paper waste generators in Perth were easily identified, eager to join Amcor's recycling and easy to work with. The quantities of waste these companies work with make a proper waste management and recycling planning very worthwhile.

Amcor is now working to get the next level of companies involved, namely local SME's. This is a more difficult market, as most of the SME's don't want the inconvenience of multiple bins: it costs more and it needs additional training and instructions to people to work with them properly. Recently Amcor - in partnership with local governments - started the Recyle@work programme aimed at SME's. Amcor provides site evaluations and easy and simple information about what is recyclable, how to do it, what the prices are and whom to contact. Simplicity of the information proved vital in the success of the programme.

Amcor competes for waste on the local market with Visy and local waste companies but demonstrates that being a recycling company is different than being a waste management company. Competition with Visy is mostly on logistics (getting the transport price of the commodity right).

Sources;

- Jamie Young, Manager WA, 08 9434 0514
- Justin Pereira and Ben Johnston, Recycling Consultants

5. Terminology

Terminology used in this report is further explained below.

Industrial wood waste

For the purposes of this study the term industrial wood waste refers to timber material with no other identifiable market value or reuse. This includes material generated from manufacturing, construction and demolition debris.

Untreated industrial wood waste

In gathering information for the quantities of industrial wood waste generated in Perth's Eastern Region, untreated industrial wood waste was described as wood waste that may have undergone a heat or fungicide treatment but had not undergone a permanent treatment.

Treated industrial wood waste

Treated industrial wood waste comprised wood waste that had been treated with a permanent method that would affect the quality of resale of the chipped wood. The treatment identified during the study was limited to copper, chrome, arsenic (CCA) treated wood.

MDF

Medium density fibreboard.

Engineered timber

Engineered timber was defined as previously manufactured timber including particleboard and MDF.

Forestry wood waste

The definition of forestry wood waste is adopted from the National Association of Forest Industries. It refers to low-grade timber material with no other identifiable market or environmental value. This includes material that is left in the forest after the higher-value timber resources have been harvested. It also incorporates the sawdust, shavings, off-cuts and other wastes associated with timber processing (NAFI, What is Wood Waste?).

Biomass

For the purposes of this study, references to biomass are restricted to plant matter in the form of forestry and industrial wood waste.

Mulch

Any pasteurised organic product (excluding polymers which do not degrade such as plastics, rubber and coatings) that is suitable for placing on soil surfaces. According to these standards mulch has at least 70% by mass of its particles with a size greater than 15 mm and before organic materials are used as soil conditioners or mulches, they should be pasteurised to kill any harmful bacteria, plant pathogens and weed seeds (Australian Standards 4454).

Compost

An organic product that has undergone controller aerobic ant thermophilic biological transformation to achieve pasteurisation and a specified level of maturity (Australian Standards 4454).