Report - Mapping the Timber Waste Stream from Building Demolition

2007
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Executive Summary

The objective of the study was to qualify and to some extent quantify the timber waste stream as occurs in housing, stripout and industrial building demolition. A key focus was on assisting the timber industry to better understand where timber demolition waste comes from and goes to, so that actions can be taken to divert more timber away from landfill. General findings and key impediments are dealt with under relevant sub-headings below. Over-arching conclusions and actions follow.

The Demolition Process Onsite

General Findings

There are three main methods used in building demolition:

- “The crunch and dump approach” which makes extensive use of an excavator and sees most timber waste sent to landfill;
- “The miscellaneous salvage approach” which also makes use of an excavator but involves some hand demolition of high-value timber which is recovered for reuse and recycling;
- “The deconstruction approach” which relies mainly on hand demolition and sees most timber recovered for reuse and recycling (Note: an exception is office strip-outs, as hand demolished cabinets and work stations mainly go to landfill)

It is unrealistic to think that timber recovery will dominate demolisher’s decisions - instead, four main economic factors influence their choice from the above approaches:

- The quality and quantity of timber in the building;
- Costs – including site costs (e.g. labour, OH&S, machinery), cartage, and the amount saved or paid at the final waste drop-off point;
- Time - time allowed by clients to demolish the building;
- Entrepreneurship by the demolisher - in integrating with re-use and recycling markets.

There is good recovery of high-value timbers – mostly large section hardwoods and Douglas fir.

A large proportion of timber demolition waste consists of “no-value” and “low-value” timber and most of this goes to landfill. The vast majority will leave the building site as a part of mixed waste. Specific materials include pine framing, particleboard and MDF products. In terms of assemblies, most wall frames, roof truss, cabinets, doors (except solid timber framed doors) and small section timbers are of little resale value.

Key Impediments to the increased recovery of timber onsite

1. The impact of high labour costs and OH&S regulations onsite – to avoid these issues extensive use is made of excavators as in the “crunch and dump approach” to demolition. This typically results in timber waste going to landfill and particularly applies to Victoria and New South Wales.
2. **Lack of time allocated to the demolition process** - developers and building contractors tend to limit the time for demolition which reduces the ability of demolishers to recover timber and manage the logistics of selling it direct from site.

3. **Low tipping costs in some states** - in states such as Queensland, low tipping costs at private landfills and the absence of landfill levies discourage reuse and recycling.

4. **Inefficiencies in timber recovery onsite (especially effecting low-value timber)** – many timber assemblies cannot be easily separated from other construction and take extra time to dismantle. This especially makes low-value timber not cost effective to recover.

5. **Inefficient supply chains between demolishers and recyclers** – despite examples of good efficiency in some quarters, inefficiencies exist in many others, especially where no-value and low-value timber is involved.

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**Timber Reuse and Recycling Markets**

**General Findings**

- **Examples exist of efficient supply chain integration between demolishers and recyclers of high-value timber.** One area of this concerns demolishers who expand their operations into reuse and recycling markets, hence practicing vertical integration. Another involves demolishers integrating closely with specialist timber recyclers, hence practicing supply chain integration. Successful aspects of both approaches include:
  - confidence and reliability in supply chains relationships
  - involvement from recyclers in tendering on the timber retrieval from a project
  - involvement from recyclers in salvaging direct from site
  - improved logistics of physically obtaining timber from site i.e. site pick-up services
  - improved economies of scale for recyclers

- **Few established markets exist for low-value waste timber** – the lack of such markets means that demolishers have little interest in recovery this type of timber from site.

- **A decreasing long term supply of high-value timber** - though the demand for high value timber (as defined previously) is currently strong, its long term supply is likely to weaken as the building demolition stock gradually evolves to newer forms of construction.

- **An increasing long term supply of low-value timber** - though the demand for low-value timber is currently low, its supply will only increase as the building demolition stock gradually evolves to newer forms of construction.

**Key Impediments**

- **Lack of end products and reuse and recycling markets for no-value and low-value timber waste** – this especially includes waste from particleboard and MDF products and all timber integrated with mixed waste. Further development of end products from these waste streams is required.
7. Future lack of supply of high-value timber waste – lack of access to supply and awareness of supply may compromise the ongoing viability and scale of operations of businesses operating in this area.

**Timber Contaminants**

**General Findings**

The proportion of treated timber in building demolition waste currently appears to be very low - timber contaminants in general appear to currently have a low impact on the ability of demolishers to recovery timber for reuse and recycling.

Recyclers are most affected – timber recyclers appear to be more affected by the impact of contaminants than demolishers.

**Key Impediments**

8. Contaminated timber in energy recovery – treated timber and painted timber content present impediments to timber used for energy recovery.

9. Laminates on particleboard and MDF products – these surface treatments act as an impediment to the recycling of the base material.

10. Zero tolerance to asbestos in recycled building materials – this an arising issues in Victoria that has yet to have broad scale impact on timber reuse/recycling markets but is likely to do so in the future.

**Overall Conclusions and Priorities for Action**

The main priority for future action
- Making no-value and low-value timber waste more commercially viable in re-use and recycling markets.

Best points in the demolition process for recovering timber
- At the demolition site – mainly for high-value timber.
- At a resource recovery facility – mainly for no-value and low-value timber.

Opportunities for improvement to site demolition processes
- Adapt the use of excavators and other mechanised equipment to improve the efficiency and safety of the “deconstruction” approach to demolition (addressing impediments 1, 2 & 4).
- Expand the scope of specialist timber salvage teams in order to recover more timber from site and achieve higher levels of productivity (addressing impediments 4 & 5).

Targeted regulation
- Introduce the concept of mandatory “green points” in building development applications, for the re-use and recycling of demolition materials. This could be implemented as an extra dimension to planning tools such as the NSW BASIX scheme. The options used to accrue points could be used to provide an alternative motivation for reuse and recycling (compared to purely market driven
costs) and on this basis could address previously mentioned impediments (addressing impediments 2, 3, 4 & 6).

- Increase the cost of timber disposal at landfills to improve the economic viability of re-use and recycling (addressing impediments 3, 4 & 6). This is likely to involve landfill levies but to ensure a targeted effect on timber, consideration should be given to implementing charges based on cubic weight (eg. http://www.tasfast.com.au/cubic.html). This is because timber is lighter in weight compared to materials such as brick and concrete.

**Market Development**

- Develop innovative end products, especially ones that add the most value to low-value timber (addressing impediments 4 & 6). Key areas of focus should include:
  - Low-value timber recovered from mixed waste.
  - Markets for waste particleboard and MDF products.

- Introduce a web based market place to improve the access and efficiency of timber waste transactions (addressing impediments 5, 6 & 7). The interface would include a standard pro-forma and photographs describing the quantity and quality of timber on a site, plus details about the logistics and time available in which to make the transaction. The web site could also advertise future projects due to be demolished and general information about the waste timber market.

- Undertake industry forums to help initiate and forge supply chain relationships between demolishers, recyclers and those involved in logistics linking the two groups (addressing impediments 5, 6). Emphasis should especially focus on low-value timber waste.

**Monitoring and Evaluation**

- Provide and implement a system for categorising and quantifying timber waste to assist strategic business decision making concerning the development, performance and future direction of timber reuse and recycling markets (addressing impediments 6 & 7). A system for categorisation is provided.

- Provide a system and maintain it via a stewardship group for identifying and acting on industry based impediments to timber reuse and recycling. This should include impacts from contaminants such as asbestos, treated timber, painted timber and timber laminates (addressing impediments 8, 9 & 10).
Glossary of Terms

Reuse – materials used for much the same purpose as their original use
Recycling – materials used to manufacture a new or different end product
Recovery – the act of recovering materials from the demolition site for reuse, recycling, energy production etc.
Salvage – a similar term to recovery
Energy recovery – timber recovered from the demolition site to be used as fuel for energy production

In this report, application of the above terms has aimed to remain consistent with the way industry operators and businesses use them in practice. Even so, it has been found that considerable variance exists in the way these terms are applied around Australia. In many instances, “recycling” is used as a universal term that encapsulate terms such as “re-use”.

1.1 Background and Report Objectives

The Timber Development Association and the Australian Plantation Products and Paper Industry Council (A3P) were successful in obtaining funding from the Australian Government’s Department of Agriculture, Fisheries and Forestry (DAFF) for a project to develop a national extended producer responsibility (EPR) strategy for waste timber. Forsythe Consultants were contracted to undertake a specific part of the overall project, aimed at mapping the timber waste stream from building demolition. This report documents the completed work.

The scope of the project involved qualifying and to some extent quantifying the timber waste stream as occurs in building demolition. A key focus was on assisting the timber industry to better understand where timber waste comes from and goes to, so that actions can be put in place to divert more timber waste away from landfill. In undertaking the project the following points defined the objectives of the work:

- Identify where demolition timber waste comes from including key contributors and key collection points within the economy i.e. points where timber waste could be successfully diverted from going to landfill.
- Identify and qualify where timber demolition waste mainly goes to in terms of recycling, re-use and landfill.
- For the main findings from the above items, map the timber waste stream as occurs in building demolition waste. Mapping of the waste stream should include attention to the main form of timber materials in the waste stream. Attention should also be given to the occurrence of treated timber and composite timber products in the waste stream.
- Identify barriers to the increased recovery, reuse and recycling of demolition waste.
- Recommend a standard system of categorising and quantifying timber waste from demolition.

1.2 Research Method

A two staged approach was taken in addressing the above objectives. The first involved case studies of demolition contractors which aimed to obtain a holistic, detailed and integrated understanding of how the timber waste stream occurs. The second stage involved a confirmatory analysis. This utilised telephone interviews with other demolition contractors to test whether the findings from the case studies were representative of a broader sample of demolishers. From the confirmatory analysis, adjustments were made to improve the overall generalisability of the findings.

In choosing participants, it was apparent that not all building demolition is high in timber content and as a result, the report focused on demolishers working in areas where timber waste content was likely to be significant. For instance the majority of houses use timber framed construction and may utilise timber cladding and fit-out as well – thus making this a clear area of focus. However most commercial buildings have non-timber structures, use metal stud partition walls, use metal door jambs and have ducted skirtings. As a result, a
second area of focus was on internal strip-outs because of the amount of timber based cabinets and work stations involved. A final area of interest (as driven by demolisher’s comments) concerned industrial buildings. Older industrial buildings can contain timber in the form of beams, columns, purlins, rafters and girts. To a lesser extent these buildings can also contain internal timber stud walls.

Details on the Case Studies
The case study methodology was particularly useful in providing an integrated view of the waste stream as a system. The central subject of interest was demolition contractors and how they operate - each making up a separate case study. The sphere of inquiry also included contractors used by the demolishers to treat, re-use, recycle, transfer or dispose of timber waste.

Each case study typically consisted of a detailed interview with the director or general manager of the company (lasting in the order of 1.5 hours). Other staff were often involved in the interview or were interviewed separately. A site visit was conducted for each case study and where appropriate miscellaneous discussions were undertaken with site personnel. Interviews were also undertaken with the recyclers and recovering facilities used by each demolisher. In most instances, this included a tour and physical observations of their operations. Site visits were also made for specific landfill and transfer stations used by demolishers. The sample of 10 case studies included:

- 3 demolishers with specialised operations in housing projects
- 2 demolishers with specialised operations in internal strip outs
- 4 demolishers with generalised operations including industrial, strip-out and housing projects

Within the above mix, 4 of the case studies were conducted in Melbourne, 3 in Sydney and 3 in Brisbane. Efforts were made to ensure an even mix of the above demolition styles were obtained in each state. A copy of the questions asked of demolishers and recyclers is provided in Appendix A and Appendix B.

Details on the Confirmatory Analysis
The confirmatory analysis simply aimed to ask demolishers what type of demolition they did, what processes they used, how much reuse or recycling they undertook and where appropriate, what would help them do more. The resulting details acted as a basis for confirming or modifying the findings from the case studies.

As alluded to previously, the confirmatory analysis was undertaken using telephone interviews which typically lasted in the order of 15-20 minutes. In total, 12 such interviews were conducted including 5 from Melbourne, 4 from News South Wales, 2 from Brisbane and 1 operating Australasia wide. The mix was roughly consistent with the same mix as in the case studies.

1.3 Reporting of Analysis and Findings
Findings from the previously mentioned research method are presented in the remainder of the report in the form of a flowing commentary. The first part looks at demolition processes for different types of building (e.g. housing demolition, internal strip-outs, industrial demolition). The second part focuses on the operations of those who receive demolition
waste including recyclers, salvage yards and landfills. The third part of the report looks at the effects of potential contaminants on the ability to recycle and reuse timber waste. The final stage covers conclusions, recommendations and new ideas for improving on the reuse and recycling of timber - including a classification system for the collection of timber demolition waste data.
2.1 Housing Demolition Onsite

Housing demolition is typically driven by housing renovations, replacement of old houses, and the need to redevelop detached housing for higher density housing. As a generalisation, demolishers indicate that most small to medium sized detached houses typically cost in the order of $8 - $12,000 to demolish. This is a rough indicator as prices will vary according to size, project complexity and local drivers of demolition costs.

Housing demolition is a large generator of timber waste but the actual amount varies according to the type of construction involved. Based on the perceptions of the housing demolishers interviewed and allowing for volume versus weight differences, timber may constitute as much as 75-80% of overall building waste if constructed from suspended timber floors, timber cladding and timber framework throughout. A house constructed with the same timber floor but with timber framed brick veneer walls will only constitute in the order of 25-35% of the overall waste. If the timber floor is replaced by a concrete slab on ground - leaving just the timber framed brick veneer walls and timber roof - then timber content will reduce further to the order of 15 -25% of the overall building demolition waste.

Though there is no objectively quantifiable evidence concerning how these construction types manifest themselves in each of the States studied, comments by the demolishers interviewed indicate that trends exist. These are primarily influenced by the age of housing that is typically being demolished in a given State at a given point in time. Here, it would seem that a significant proportion of houses being demolished in Queensland are from pre-1970s stock which tends to identify with the high timber content scenario described above. In Victoria timber content is likely to be lower because more houses are of full brick or brick veneer construction. Even so, a significant amount of these houses have suspended timber floors and as a result many may constitute mid level timber content (as described above). Though construction in New South Wales is somewhat similar to Victoria, there is potentially a greater component of demolition stock that is newer and may involve brick veneer and slab on ground construction, hence reducing timber content down to the lowest timber content (as described above).

One of the key reasons for mentioning the nature of housing demolition stock is to point out that such issues have an impact on recycling markets. For instance, this study found that all of the Queensland demolishers were undertaking at least some degree of timber recycling. This was particularly the case in housing construction where much of the framework is hardwood and timber cladding maybe Hoop Pine. Both types of timber attract good recycling prices and so despite the very cheap landfill costs that predominate in Queensland (refer subheading 3.1), it is still worth recovering the timber and selling it to specialist timber recyclers (refer subheading 3.3).
In contrast, Victoria and New South Wales appear to encounter wall framing that has low perceived value, thus making it harder to sell. In Victoria, floors are often recycled but little else. In Sydney, stick built roofs are regularly recycled (mainly where made of Douglas Fir) but newer trussed roofs are rarely recovered.

As a result, it is the age and type of construction being demolished (i.e. the demolition stock) which determines the timber materials that will be recovered and their subsequent economic value as reused and recycled products.

**Types of Timber Waste From Housing Demolition**

Key types of timber demolition waste were found to include:

- Timber wall and roof framing (including roof trusses)
- Timber floor framing and floor boards

Significant types but dependant on construction type include:

- Timber cladding/lining boards

Common types of waste in most houses but usually in occurring relatively lower quantity include:

- Timber skirtings, architraves and door jambs
- Particleboard and MDF cabinetry
- Timber doors and possibly timber windows
- Timber decking boards and possibly railings

In considering how the above profile of waste may change in the future, it is again a function of the demolition stock. Here, it is relevant to reiterate the point that truss roofs are gradually becoming more common in housing demolition. This is being increasingly noticed in Sydney and can reasonably be expected to gradually extend to other areas as well. Trends over the last 25 years have seen widespread use of particleboard, plywood and MDF board in products such as platform floor sheathing, skirtings, architraves and door jambs. As a result, these materials are also likely to increase in proportion as time goes by. In contrast, the amount of timber windows is likely to decrease as many newer houses have aluminium windows.

### 2.2 Mapping the Housing Demolition Processes On-site

Among the various methods of demolition used by housing demolishers, all can be described in terms of three approaches, as follows:

- The “Crunch and dump” approach i.e. where timber is demolished with an excavator and without any attention to site separation. Most waste will subsequently go to landfill.
- The “Deconstructions” approach i.e. where materials are site separated usually by hand demolition, and the bulk will usually end up as recovered materials
- The “Miscellaneous salvage” approach i.e. where the “Crunch and dump” approach is augmented by opportunistic salvage of materials – usually the salvage of internal timbers or pitched roofing timbers but rarely both.

Each is discussed under respective headings that follow.
The “Crunch and dump” Approach to Housing Demolition

In this study, companies from Victoria and New South Wales used this approach where they considered it not worthwhile saving timber. In essence, they thought it cost more than it was worth to recover. Figure 1 maps the approach in the form of a process chart. In this process, extensive use is made of a 20-30 tonne excavator with a bucket and/or grapple attachment to knock things over and to scoop or grab materials. A truck – possibly with a demountable tray - will typically shuttle back and fourth from site to take waste away. Masonry and concrete are usually demolished according to a sequence that enables separation and recycling. Unfortunately, timber usually becomes part of the remaining mixed waste and goes to landfill. As a case in point, wall timbers are not worth saving as difficulties occur in removing linings and separating the framework into individual pieces. Another problem is the amount of cuts and trenching in the wall framework which significantly reduces its resale value. As allude to previously, trusses are site specific and rarely transfer to other projects. Specific features of the “Crunch and dump” approach include:

- Hand demolition is almost non-existent.
- Scaffolding and other costs associated with hand demolition are avoided
- The entire operation is very quick - as little as 1-2 days for most small to medium sized houses.
- The process is very simple and lends itself to standardisation, systematisation and minimal project supervision
- The process avoids getting involved in occupational health and safety risks by virtue of minimising the number of people on site and by minimising exposure to potentially dangerous situations that may occur in hand demolition
- After brick, concrete and possibly roof tiles are separated, the remaining waste is crunched by virtue of the excavator crawling over the waste, thus leaving what can be best described as mixed waste that is rich in timber mulch.
- The approach tends to suit situations where timber and other materials are not worth recovering for re-use and recycling i.e. landfill is cheaper.

Photo 1: Excavator with grapple attachment used for crunching timber framework
Photo 2: Truck with demountable tray for taking waste away from site

Photo 3: Timber rich mixed waste mulch from “Crunch and dump” demolition sites
Timber Waste Diversion Points

Site Work Process

Use 20-30 tonne excavator to punch through roof with bucket to ensure timber trusses and wall frames fall inwards later in demolition (also see note 2)

(For brick construction) Use excavator bucket to peel brick skin outwards then use bucket to scoop and load rubble into skip or truck. *Note: bricks are typically taken away for recycling*

Use excavator bucket to push timber framed walls and other construction inwards.

Use excavator to crawl over mixed waste (or use grapple) to crunch the frame, cladding, linings and other remnant materials into a timber rich mulch of mixed waste.

Use excavator (with bucket or grapple) to scoop up mixed waste and place into skip or truck to transport offsite

Cart "no-value" timber rich mixed mulch away to landfill (refer section 3.1)

Cart timber rich mixed mulch to mixed waste recovery operators (refer Sections 3.2). Relatively new technology separates mixed mulch into clean timber mulch for landscaping, fuel or particleboard production

Use excavator bucket and/or ripper attachment to break up concrete slab and/or footings. Use bucket to scoop and load rubble into skip or truck. *Note: concrete is typically taken away for recycling*

Undertake minor surface excavation to complete demolition work and clean remaining rubble from site

Notes:
1. The above process is usually used where timber recovery is more expensive than sending it to landfill
2. Where required, Asbestos removal usually occurs before structural demolition begins but variances may occur subject to the regulatory impacts of requirements in each State (refer Section 4.1)

Legend: sequence of onsite activities   sequences of moving waste offsite

Figure 1: The “Crunch and dump” approach in Housing Demolition
The Deconstructions Approach to Housing Demolition

This approach makes greater use of labour to dismantle the building in an orderly way that aims to maximise materials recovery. It is shown in the form of a flow chart in Figure 2. In general, this approach reflects the method used by a number of demolishers interviewed in Queensland. Only one other instance was found in Melbourne. In Queensland, the apparent orientation towards this may be because of the previously discussed amount of high value timber content in a lot of the demolition stock. Some of these demolishers were also vertically integrated in terms of having their own salvage yards. In other States OH&S risk seemed to preclude use of the deconstruction approach. For instance in Victoria, most house demolisher felt that the OH&S risk was so high that they would not allow workers on the roof to remove tiles or roof sheeting.

Figure 2 maps the deconstruction approach in the form of a process chart. The process typically starts with an internal salvage of floor timbers, bearers and joists. This can be done by the demolisher’s own employees or by a separate contractor (refer Section 3.3). Other items may also be removed but this is more selectively based upon the expected resale value of the items involved. For instance deep skirtings are sought after while smaller size skirtings are not. Solid timber framed doors are often in demand while hollow core doors are not. Kitchen cabinets may have limited re-saleability and may only be retained by demolishers with their own salvage yard or who have access to companies that trade specifically in second hand kitchens. Timber windows may also be salvaged subject to their condition and style.

Removal of tongue and groove boards merits special mention in the internal salvage process. A purpose made tool is used that has arms which lift in the order of 4 boards on a gradual incline off the joists. The highest board is removed without damaging the tongue of the adjacent board then the process is repeated until each board is gradually removed. In this process, nail heads are pulled through the board and this serves the important purpose of preventing the nails heads from splintering the face of the board (as would occur if nails were pulled out the same way they were nailed in).

Following the internal stripout, timber cladding may be removed if the resale value of the timber makes it worthwhile. This is usually done by hand using pinch bars or perhaps the aforementioned floor lifting tool.

Roof tiles or sheeting is then removed followed by the roof framing. The viability of this part of the process is again dependent on the expected resale value of the roofing timber. Hardwood is a good proposition in Queensland but the same is not necessarily true in Melbourne - especially if originally green hardwood timbers have twisted whilst in place. Timbers such as Douglas Fir appear to be in demand in both Melbourne and Sydney. If truss roofs are involved, then it is likely that these will go to landfill as they are generally not realistic to sell and recovery of individual truss pieces is to labour intensive.

Following the roof, stud walls may be dismantled by hand and this may even include hand demolition of brickwork. Alternatively, an excavator can and often is used to do the hard work. For instance, it can be used to improve the productivity of certain aspects of timber recovery by using the bucket or grapple to lift frames up by the top plate and shake the frame such that studs, noggins and the bottom plate fall away. Another option is to use the excavator to flip the timber floor over instead of using the previously described hand salvage methods. This approach seems more common in Queensland than in other States. The bucket (assisted with chain slings if required) is used to do the actual flipping then hand
labour is used to hammer bearers and joists sideways so as to roll them off the floor boards. This method has the desired effect of pulling the nails through the floor boards without damaging them. The only apparent downside to excavator usage is a higher rate of timber damage compared to pure hand demolition - but it does offer greater efficiency onsite.

Parallel to the above, the nails in timber scantling pieces are usually just bent over onsite (for later removal onsite). Timber pieces are stacked into metal crates or strapped slings - the choice between crates or slings is usually determined by who is picking the timber up and where it is going next. For instance if a demolisher has their own salvage yard they may use their own crates to transport the timber back to the yard. However, if the materials are to be picked up by a specialist timber recycler (refer section 3.3), then strapping is used to make it easier for them to retrieve the timber from site. Specific features of this approach include:

• This approach appears to work best where recovered materials have a known resale value such that demolishers can factor this cost saving into their demolition price.
• There is considerable hand demolition involved in this method and so to mitigate occupational health and safety risks, careful attention must be paid to site safety procedures and work method statements.
• The approach is considerably slower than the “Crunch and dump” approach (i.e. in the order of 7-8 days for a 3-4 man team to demolish a mid sized house). The extra time means that clients must be committed to a resource recovery approach otherwise their land holding costs and construction time scheduling may preclude usage of the deconstruction approach.
• Demolishers using this approach believe it is as cheap or cheaper than the “Crunch and dump” approach. This is however dependent on resale of most of the recovered materials (not just select items). Demolishers must also be prepared to act as “materials traders” and not just demolishers.
Timber Waste Diversion Points

Site Work Process

Undertake hand salvage of internal items – usually including timber floor, bearers and joists; possibly deep skirtings, solid timber doors and windows; rarely kitchen cabinets. Stack/strap timber pieces into crates/bundles for transport offsite. Also refer Note 2.

Undertake hand removal of roofing then roof framing timbers. Stack/strap timber pieces into crates/bundles for transport offsite (Note: roofing will often be recycled but generally not roof trusses)

(As relevant) remove timber cladding/lining boards. Then stack/strap timber pieces into crates/bundles for reuse offsite

(As relevant) peel brick skin outwards either manually or using excavator, then use excavator to load rubble into skip or truck. Bricks are typically taken away for recycling.

Deconstruct timber wall frame manually or with the assistance of the excavator (i.e. to lift and shake frames apart). Then stack/strap timber pieces into crates/bundles for transport offsite.

Possible deconstruction of timber floor (but only if not done during internal salvage). Use excavator bucket and chains to flip floor over then hand demolish by rolling bearers and joists off floor boards. Then stack/strap timber pieces into crates/bundles for transport offsite.

Use excavator to scoop concrete rubble into skip or truck. Concrete is typically taken away for recycling

Undertake minor surface excavation to complete demolition work and clean remaining rubble from site

Notes:
1. The above process is usually used where timber recovery is worth more than landfill costs
2. Where required, Asbestos removal usually occurs before structural demolition begins but variances may occur subject to the regulatory impacts of requirements in each State
3. Scaffolding may constitute an individual activity and is subject to OH&S requirements in each State

Legend: sequence of onsite – moving timber offsite

Figure 2: “Deconstruction” approach in Housing Demolition

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Photo 4: Pitched roof being deconstructed for recycling

Photo 5: Timber stacked in metal crates after removal from site
The Miscellaneous Salvage Approach to Housing Demolition

“Miscellaneous salvage” is a combination of the “Crunch and dump” approach plus opportunistic addition of parts of the “deconstruction” approach – primarily internal timber salvage and roof timber salvage. Unfortunately, it appears that in practice that often only one rather than both types of salvage are done on most projects. For instance in Melbourne, demolishers tend to include internal salvage but not roof timber salvage. They typically send the materials – especially flooring - to specialist timber recyclers or these companies may come in salvage the materials themselves (refer section 3.3). In Sydney, almost the opposite appears to apply where roofing timbers are the main item sought by demolishers especially where made of Douglas Fir and where easily dismantled. Internal salvage was less apparent unless doors, architraves and skirtings were of obvious value in which case they were hand removed prior to the excavator coming on-site. The practices in each state seem to reflect the different types of timber used in housing, the value of that timber and ease of removal. In any event, the overall approach is shown in the form of a flow chart in Figure 3.

With regard to this approach, it is apparent that in the overall scheme of things, much timber waste is still sent to landfill. This is placed into perspective by one of the New South Wales demolishers who commented that on a typical timber framed brick veneer cottage approximately six or seven loads of masonry and concrete products are crushed for recycling. Less than one bogey load of timber product is recycled, with seven or eight bogey loads of mixed waste containing timber generally disposed of at landfill. On this basis, the “miscellaneous salvage” approach needs to adopt a less piece meal approach to salvage. In essence, multiple types of salvage must be intensively undertaken on each and every project but for this to happen, it must be made a worthwhile proposition otherwise it will not happen.
Optionally undertake hand salvage of internal items – usually including timber floor, bearers and joists; possibly deep skirtings, solid timber doors and windows; rarely kitchen cabinets. Stack/strap timber pieces into crates/bundles for transport offsite. Also refer Note 2.

Optionally and subject to OH&S risks undertake hand removal of roofing then roof framing timbers. Stack/strap timber pieces into crates/bundles for transport offsite (Note: roofing will usually be recycled but generally not roof trusses).

Optionally remove timber cladding boards, then stack/strap timber pieces into crates/bundles for transport offsite. (As relevant) peel brick skin outwards either manually or using excavator, then use excavator to load rubble into skip or truck. Note: bricks are typically recycled.

Use excavator bucket to push timber framed walls and other parts of the construction inwards. Note: Metal pipe-work and wires may pulled out for scrap metal recycling.

Use excavator to crawl over mixed waste (or use grapple) to pulverise the frame, cladding, linings and other remnant materials into a timber rich mulch of mixed waste.

Use excavator bucket and/or ripper attachment to break up concrete slab and/or footings. Then uses bucket to scoop and load rubble into skip or truck. Concrete is typically taken away for recycling.

Undertake minor surface excavation to complete demolition work.

Notes:
1. The above process is usually used where some timber can easily be recovered and is worth more than landfill costs
2. Where required, Asbestos removal usually occurs before structural demolition begins but variances may occur subject to the regulatory impacts of requirements in each State
3. Scaffolding may constitute an individual activity subject to OH&S requirements in each State

Legend: sequence of onsite activities ————> sequences of moving waste offsite

Figure 3: “Miscellaneous salvage” approach in Housing Demolition
2.3 Internal Strip-out Demolition Onsite

Common stripouts include offices and shops and to a lesser extent public and industrial buildings. Demolishers indicate that office and shop stripouts occurs with relative frequency due to tenancy changes which they estimate occur in the order of every 5-7 years.

Types of Timber Waste From Stripout Demolition

Key types of timber demolition waste include:

- Work stations, cabinets, counters and loose furniture - predominantly made from particleboard and MDF board
- Timber doors - predominantly made from hardboard or MDF board doors skins and either hollow core or solid core timber centres

Common in many types of stripout but lower in amount than key contributors include:

- Feature wall panels (e.g. timber veneered panels) as may be used in office foyers, board rooms and entry areas
- Timber stud walls (more commonly used in shops than in offices)

To place the above list into perspective, one large, specialist strip-out demolisher estimated that all the timber waste in a typical office stripout – such as a given floor in a high rise building - constitutes approximately 18% of total waste from the demolition. Even so, the above list clearly contains a considerable amount of particleboard and MDF board. These sheet materials are often covered in plastic based laminates or plastic based coatings which create a significant problem for re-use and recycling. All the demolishers interviewed identified a lack of economically viable re-use or recycling options for particleboard and MDF products – hence landfill was the most common option. An occasional option used by some, was to sell work stations and cabinets to second hand dealers but this required considerable extra time and organisation onsite. A viewing period for potential buyers could also be required. In addition, considerable logistics were involved in partially dismantling units to fit in lifts. Transportation and perhaps temporary storage could add to the previous issues. As a result, recovery of cabinets tended to be limited to those who could organise buyers that could responsively pick-up directly from site, or who had their own salvage yard storage.

Because of the complexity described above, most demolishers were unable to take potential savings from recovery into account when tendering on the work. For instance the lack of certainty and simplicity regarding resale or neutral disposal costs tended to preclude the systematic use of recovery options.

Generic stripout processes

The overall stripout process is shown in Figure 4 (based on generic office stripout processes). Here, cabinets and workstations are usually broken down into flat pieces using sledge hammers and chain saws. Pieces are stacked into small skips or crates that are narrow enough and light enough to be rolled across floor areas and into lifts for loading into trucks below.
Photo 6: Particleboard work stations prior to demolition

Photo 7: MDF storage cabinets about to be removed
The confined nature of strip-out work makes it inherently reliant on labour intensive deconstruction. To a large extent, site separation of timber products takes place automatically by virtue of the onsite necessity to remove cabinets and workstations before being able to move on to other parts of the demolition work. As a result, site separation is not the reason for most particleboard and MDF board waste going to landfill, but instead, the previously mentioned lack of economically viable re-use or recycling options.

In most instances, little effort is made to flatten the sheets out in the trucks due to the time this takes and in some instances injuries have occurred when having a worker inside the truck.

In general, it would seem that this approach has the same intent as the “Crunch and dump” approach (as described previously for housing demolition) but the actual process - which involves hand demolition and site separation - is more consistent with the “deconstruction” approach. Importantly, this means that if viable reuse/recycling markets can be developed, then strip-out demolishers should be able to easily adapt to using them.

One of the important subtleties of the process is that time availability to conduct the demolition process is limited. It must often take place in the early hours of the morning rather than during normal working hours. For instance noisy work adjoining offices must take place before normal office hours begin. Time in underground loading zones – as occur in busy high rise office towers – may also be difficult during office hours.

The ramification of such a limited time frame means that trucking waste off-site may need to go to landfills that are open early in the day. In Sydney, the long travelling distance from the CBD to landfills tends to mean transfer stations become a more viable option. For instance, transfer stations tend to have higher tipping costs but the shorter travelling time saves on travel costs and becomes crucial where working hours onsite are limited. In any event, waste going to transfer stations ultimately ends up at landfill (i.e. refer sections 3.1).

Photo 8: Hand moveable skips with timber waste - as used in internal strip-outs
Using hand demolition (including sledge hammers, saws and other hand tools) to collapse work stations and cabinets into flat pieces.

Load resulting particleboard/MDF pieces as vertical leaves in portable skips. Transport skips via lift down to loading bay for transporting off-site.

Remove doors, skirtings and partition edgings.

Remove glass partitions.

Cut and remove plasterboard from partition walls.

Remove partition framing and studwork (usually steel studs).

Remove ceiling tiles and support grid as required. (Also remove ducts/electrical if required)

Remove carpets (or other floor coverings) plus final clean to complete job.

Notes:
1. Where required, Asbestos removal is undertaken subject to specific project requirements

Legend: sequence of onsite activities moving waste offsite

Figure 4: Office Strip-out approach including Timber Waste Diversion
2.4 Industrial Building Demolition Onsite

Factories currently represent a consistent part of the demolition market. The amount of industrial demolition appears related to the amount of urban regeneration occurring in the cities of each State. For instance large inner city industrial sites may be redeveloped into smaller industrial units, shopping centres or multi-unit residential developments.

A core motivator for reuse and recycling of timber on industrial sites is the large quantities of materials that may be involved. Large quantities provide improved economies of scale for negotiating and effecting material recovery operations. For instance one Brisbane demolisher exports sheet metal cladding and roofing to Pacific island nations and sells the recovered timber through either their own salvage yard or to specialist timber recyclers (refer Section 3.3). In Melbourne, another demolisher commonly separates high and low value timber into separate groups onsite, then sells the high-value timber to specialist recyclers (e.g. sections of 150x50mm and upwards), but smaller sections are amassed for mulching at their own materials recovery yard (refer Section 3.2).

Types of Timber Waste from Industrial Demolition

As for housing, timber content in industrial demolition varies according to the age of the building and type of construction. For masonry or steel structured buildings it is not a large component of the overall waste stream, but where timber is incorporated into the structural scheme of a building, it can form a significant quantity of waste. For instance in steel portal framed buildings – generally prior to the 1950s - timber may occur as Purlins and Girts. In older buildings there is the prospect of heavy timber column and beam structures that variously occur in rural buildings and old storage buildings such as wool stores. Timber rafters and trusses may also be used on a wide variety of buildings. Therefore, depending on the type of construction, key timber demolition waste may include:

- Purlins,
- Girts
- Rafters
- Large section columns
- Large section beams

Lower contributors to the waste stream which may occur in specific parts of industrial buildings include:

- Work stations and cabinets – as discussed previously under Stripout demolition
- Timber stud walls – where used for internal partition walls
- Industrial timber shelving e.g. timber and particleboard shelving for storage and various other uses
Photo 9: Timber purlins on industrial building

Photo 10: Skid steer loader used to assist in moving recovered timber (to be used for mulch)
Generic demolition processes

The focus here is on the industrial structure rather than any internal stripout within. Even so, the ability to describe this as a generic flowchart process is limited due to the variability of construction types and site specific factors. What can be said is that as with housing demolition there are different approaches that approximate the previously discussed “Crunch and dump”, “miscellaneous salvage” and “deconstruction” approaches. While the intent of these approaches is the same as in housing, the specifics are not. For instance industrial structures demand much greater reliance on the use of large excavators to push-over, break-up, crush-up, lift-off and flip-over various parts of the structure. This is because of the practical necessity of dealing with large structures plus safety requirements and the economic reality of needing mechanisation to achieve process productivity.

For many demolishers, the “Crunch and dump” approach is common though encouragingly it was found that some demolishers in Melbourne send their mixed waste to specific recovery facilities capable of separating timber content for recyclable uses. Like housing, many demolishers will upgrade the “Crunch and dump” approach to the miscellaneous salvage approach where high value timber is easy to recover. The deconstruction approach is harder to undertake in a productive way. It appears to be used on appropriate projects in Queensland but rarely elsewhere. In such cases, it is reliant on not only recovering and selling quantities of high value timber, but in addition, sending low value timber for uses such as energy recovery (refer Section 0).

In delving into the ways that timber can be recovered using an excavator driven approach, equipment such as scissor lifts may be used to lift workers to parts of the structure that allow them to cutting bolts and other fixings that then allow the construction to be pulled apart in pieces using an excavator. For instance one approach, involved oxy cutting bolts away to release the timber purlins from steel portal frames. Roof sections were then lifted or pushed onto the ground and then the purlins were recovered from the roof section. Under another scenario, the excavator was used to push metal clad wall panels over, then timber girts were removed from the sheet metal wall section. In other instances, the excavator is simply used to rip the timber work down and in such instances, waste is then separated on the ground. Under any of these scenarios, there tends to be an increased level of damage especially where demolition productivity outweighs the need for care. For instance damage to timber will see it limited to low value uses such as mulch or for energy recovery.

Perhaps the other main observation of industrial building demolition is simply the greater space on many sites to undertake the process. For instance subject to site specifics, machines such as front end loaders and skid steer loaders are able to move demolished materials around the site and there is space for aggregating stacks of different materials – thus improving the economies of scale for dealing with recovered timber.

2.5 Impediments to Demolishers Concerning Re-use and Recycling

Having discussed the different approaches used in demolition, demolisher’s comments about key impediments to their ability to recover timber for reuse and recycling have been drawn together below:

- “No-value” or “low-value” timber which is not worth recovering and is therefore sent to landfill. A number of sub issues fall within the scope of this point and include:
  - The predictability of prices paid for recovered straight-line timber varies from State to State. In most states Douglas Fir is in demand; in Queensland
hardwood is in demand but is less consistently in demand in New South Wales and Victoria.

- Radiata Pine and similar softwoods have little or no resale value in all States.
- For many, recovery of timber from wall frames is not worthwhile due to the short lengths and the notching, trenching and straightening cuts in the timber.
- Most small section timbers are of no resale value.
- Particleboard and MDF products are largely of no resale value and there is no viable reuse or recycling market apparent to demolishers – apart from a small number of companies that buy cabinets for reuse in kitchen and office fitout operations. Most goes to landfill. Another part of the problem is that bonded laminates limit the options for reprocessing these materials.
- Apart from solid timber framed doors, most other doors are limited in resale value - they can be purchased cheaply new.
- Only deep skirtings and architraves are worth saving, other sections sizes are of little resale value.
- Roof trusses are too difficult to pull apart and too site specific to allow flexible reuse – thus making them of little or no resale value.

- Occupational health and safety on housing sites. In states such as Victoria and to some extent New South Wales, occupational health and safety (OH&S) appears to be a significant problem that affects the ability to deconstruct houses and the subsequent ability to recover timber. Here, scaffolding and other associated requirements increase costs relative to the “Crunch and dump” approach. Working on roofs in Victoria and increasingly in NSW, appears to pose risk management anomalies which demolishers are not prepared to leave themselves exposed to. With the exception of internal salvage teams – which can be sent in before serious demolition begins – demolishers in Victoria were generally averse to having contract salvage teams on their sites as this reduced their control over OH&S. This problem was less apparent in Queensland.

- Not enough time allowed onsite by developers and builders to adopt deconstruction approaches. For instance developers and builders often want demolition to take place in the shortest possible time (i.e. the “Crunch and dump approach”) to limit their time dependent costs. This lack of time limits the ability to recover materials because such an approach may need materials to be held onsite for a period to avoid separate storage costs. In this time a customer must be found, the transaction must take place and materials must be picked up.

- In Queensland, private landfill costs are cheap and hence reuse and recycling options are not as competitive as they could be (also refer Section 3.1).

- A key problem in some states is that long distances to timber reuse and recycling drop-off points undermine the viability of reuse and recycling operators. Local aggregation points or pick-up services are needed.

- Some reuse and recycling operations are selective about what type of timber waste they accept. For instance some landfills which also conduct recycling operations charge less for separated timber waste but this is of little use if it excludes acceptance of timber with nails, bolts and brackets attached. Similarly, some specialist timber reuse/recyclers only accept certain timber species which limit their applicability to the type of waste coming off site.

- A general lack of a reliable and accessible market(s) to accept recovered waste timber materials.
2.6 Conclusions about Economic Decisions Driving the Choice between Recovery and Landfill

The previous discussion provides insight into the processes and issues influencing the choice between timber recovery and landfill. Even so, demolishers are driven by underlying drivers that influence their decisions about whether to undertake “Crunch and dump”, “miscellaneous salvage”, “deconstruction” or other options. They typically go through an economic analysis that they apply to each site situation. In concluding and summarising the findings from this part of the report, it is considered worthwhile to bring together a list of the previously discussed issues which influence their economic analysis:

- The age and type of construction (the demolition stock)
- The estimated cost to recover materials versus landfill costs,
- The time availability in which to do the demolition
- Entrepreneurship in utilising salvage and reuse/recycle markets

Each is elaborated upon in further detail below

The Type of Construction (i.e. the Demolition stock)
The more timber in a certain type of construction, the more it will dominate the approach taken to demolishing it. As previously discussed, this will be driven by the quantity and quality of timber from a given type of construction. Even so, once demolishers become accustomed to a given approach to demolition it may be hard to move them away from it. As a result, those using the “Crunch and dump” approach may need to be coaxed into seeing the full extent of timber that could be recovered to from certain types of construction in order to help move them away from their current norm.

Estimated Costs
Cost decisions primarily come down to an equation as to whether the cost of recovery is cheaper than the cost of sending waste to landfill. Factors in this equation include site costs, cartage costs and waste drop-off point costs or income (i.e. from landfill drop-off or recovery drop-off). Each creates pluses and minuses which ultimately determine the relative viability of recovery versus landfill:

- **Site costs** can be derived directly from the previously discussed approaches to demolition. Approaches that yield recoverable materials (such as the “deconstruction” approach) tend to be labour intensive and may require scaffolding. This subsequently costs more on-site than approaches that only yield mixed waste (such as the “Crunch and dump” approach).

- **Cartage costs** for both recovery and landfill are situation specific, but that said, a close drop-off point tends to be cheaper than more distant options. There must also be sufficient quantity of recovered timber to achieve economies of scale in cartage costs.

- **Drop-off point costs (or income)**. This can be expressed in terms of the relative difference between three competing scenarios including
  - tipping costs for no-value timber going to landfill;
  - reduced tipping costs for low-value timber going to energy recovery, mulch and similar recycling processes;
  - positive income for high-value timbers going to specialist timber recyclers.

Of note, reduced tipping fees and positive income are vital in counterbalancing the extra cost associated with recovering materials onsite. To obtain positive income the perceived quality
of the timber is important. It must be relatively damage free, be a species that is demand among end users, have a suitable section size, be in long lengths and ideally have sufficient volume to be a saleable parcel on its own – these factors will determine how viable it is as a high-value end product. To improve the viability of recovery costs, demolishers must have confidence is re-sale values. Like commodity markets their needs to be a known market where materials can be traded quickly and at known and stable prices. Streamlining the costs in getting the materials to resale markets would also assist the viability of the recovery process.

Time
As discussed earlier, demolishers need enough to time to maximise recover of timber materials onsite. The deconstruction approach may not be possible where clients believe a “Crunch and dump” approach offers a faster and therefore more desirable option. For instance recovery requires extra time onsite to have workers dismantle the building plus time to conduct basic preparation, storage and packaging whilst organising the sale of materials. Involving builder and especially clients in decision making would help alleviate this problem. Ways need to be explored to extend the period of time available to demolishers.

Entrepreneurship
If demolishers are to become involved in timber recovery, they also need to become more involved in practising entrepreneurship in terms of finding buyers and markets for their recovered materials. In short, “wheeling and dealing” must become part of their repertoire and in many ways this is a step beyond the basic concept of demolishing buildings.

For instance, a significant number of demolishers interviewed were vertically integrated by virtue of having their own salvage yards or recycling operations. This provides the ability for these operations to more closely view demolition materials as resalable resources which they can add value to.

In other instances, certain demolishers were found to integrate effectively with external re-use and recycling operators. As discussed later in this report, a number of specialist timber reuse/recycler operators assist this by either picking up timber from site or actually recovering the materials themselves (refer Sections 3.3). This helps create an efficient, standardised, transparent, simple and predictable market.
3.1 Landfill and Transfer Stations

As discussed in previous sections of this report, a significant amount of timber waste goes to landfill from housing, office stripout and industrial demolition. This section of the report delves specifically into the way landfills operate and the effect they have on the economics of material recovery.

Quite a few demolishers in New South Wales and Victoria spoke of the impact that government landfill levies had on their usage of landfill. Such levies are based on weight and at the time of writing, the rate applied to the Sydney metropolitan area had just increased from $30.40/tonne to $38.60/tonne (as at the 1/7/07). In Victoria the prescribed levy in Melbourne and other urban areas was $26/tonne. When factored into disposal fees, this typically converts to an overall tipping fee in the range of $68-$98/tonne in Sydney and $60-$75/tonne in Melbourne.

Of note, these levies have mainly helped in discouraging tipping of heavy weight materials - such as masonry and concrete - but seem yet to have the same level of impact on lighter weight materials such as timber. For instance, all of the demolishers spoken to in NSW and Victoria recycled their masonry and concrete waste, but the same could not be said for the bulk of their timber waste. From this, it would seem that the cost savings associated with heavier waste has seen these materials take the lead in the approaches adopted by demolishers to recover materials.

No landfill levies apply in Queensland and so the same issues are less apparent. Of note, waste in Queensland is often measured using volume rather than weight, hence making the introduction of weight based levies harder. Despite this, it is still worth focusing on the economic impact that Queensland landfills have on timber recycling. For instance, landfills that accept demolition waste in Queensland are typically run by either private entities or by local councils. There is stark contrast between the disposal rates of private versus council run landfills. For instance, Councils typically charge in the order of $50-60/m3 for mixed waste while demolishers pay as little as $6/m3 at private landfills. On this basis, it is not surprising that a number of Queensland demolishers observed that the biggest competition to timber recycling/reuse was the low cost of tipping at private landfills.

Cartage is another factor affecting the choice between landfill and other options but is location specific in terms of cost impact. For instance, the main Sydney and Brisbane landfills are a considerable distance from respective CBDs but this is more telling in Sydney due to its larger size and more intense traffic conditions. Sydney is also many times more expensive than Brisbane in terms of tipping fees. Long hauls in Sydney can sometimes see demolishers switch to alternative options. For instance a Sydney based office stripout...
demolisher used transfer stations close to the CBD for disposing of particleboard and MDF waste – especially when needing to undertake the work during non-business hours. Apart from this example, transfer stations were rarely if ever used by the other demolishers interviewed. To some extent, this was because many transfer stations did not accept demolition waste. Tipping rates also tended to be significantly higher than landfills. In most instances, the transfer stations had no reuse or recycling ability and so waste going to these stations was ultimately passed on to landfill (as mixed waste). Despite this, there was some evidence that the situation was better in certain locations. For instance, one transfer station just out of Brisbane accepted mixed waste loads which were spread undercover onto a concrete deck then a degree of hand and machine sorting was used to extract timber. It was put aside until a sufficient mass was obtained to on-sell to various recyclers or for energy recovery. Even so, a significant amount was still sent to landfill.

Photo 11: Sorting recyclable materials from demolition waste at a transfer station in Queensland

Among the Council based landfills in Queensland, it was noted that one had done well in adapting their industrial/household landfill to include reuse and recycling of materials. Firstly, they offered financial incentives where disposal fees for separated waste was half that of mixed waste. Secondly, they had a novel but well developed model for selling recovered timber products to the public (along with other waste). Here, timber is recovered by virtue of it being already separated on arrival at landfill, or by virtue of Council workers picking timber out prior to it being pushed into the landfill face. Low-value timber waste is mulched and sold for energy recovery or for landscaping used by the Council. High-value timber such as straight-line timber, certain doors and cabinets are sold at the Council’s own market place. It has a sign posted entry that leads to a dedicated carpark within the tip. The market involves a large fenced compound and an industrial sized under cover area. There is a cashier checkout for making transactions. Everything from dumped electrical appliances to push bikes to building materials are stacked or shelved and presented in designated areas. The operation provides a positive cash-flow to the Council’s revenue stream and has done for a considerable time.
The extent of the stock creates a strong customer base with in excess of 300 people typically purchasing materials on each of the 2 days per week that the market is open. The success of the entire operation has meant that the Council now intend to increase and extend its operations. It is a model that appears to work well for all waste materials – not just timber – and could therefore attract bipartisan support from a variety of building materials groups. Being locally based, this type of operation has the potential to allow small amounts of timber waste to be carted quickly and cost effectively to a drop-off point, thus avoiding the situation where high cartage costs to distant reuse/recycling facilities make reuse and recycling commercially untenable.
3.2 Recyclers of Low Value Timber

Eventhough much low-value timber goes direct to landfill, a number of instances were found in this study where it was dealt with more productively as either energy recovery or as mulch reclaimed from mixed waste (i.e. used for horticultural purposes, particleboard production or also passed on for energy recovery). Examples of these instances are discussed under corresponding headings below.

An Integrated landfill and Mixed Waste Recycling Operation in Sydney

A number of commercial landfills have become integrated in so far as being able to divert waste from landfill to specialist waste recovery operations, on the same site. These facilities typically have crushing operations for brick and concrete waste and accept these products at substantially discounted rates compared to mixed waste. Among these, some were also found to accept timber waste at discounted rates but required it to be de-nailed which is not necessarily realistic for many demolishers. In contrast, a Sydney based operation has developed the ability to separate timber from mixed waste and produce a variety of end products from the resulting timber mulch.

The company concerned believe that 70% of waste destined for landfill (at their facility) is now recovered for recycling or reuse and estimate that 28% of this is timber. Financial incentive for recovery has largely come about as a result of the previously discussed “landfill levy” (refer Section 3.1). For instance the levy is not applicable to materials that are diverted from landfill – thus allowing the company to save money on any such materials that are recovered within their facility.

Approximately 60% of the company’s total waste intake is mixed construction and demolition waste containing a significant component of timber (Note: this mixed waste is in the same as the “timber rich mixed waste mulch” referred to earlier in the report). All of this will go through their mixed waste separation process as discussed in more detail below. A further 5% is segregated timber waste which does not have to be processed by the main plant and can be dealt with separately. The remaining 35% of material is separated concrete, brick or asphalt.

The company has a well-developed weighbridge station with the operator positioned on an elevated gantry with a clear view of the contents of each load to enter the site. The cost of tipping is calculated by weight for different categories of material after visual inspection. Rates are considerably cheaper for separated loads. The majority of mixed waste is from demolishers and largely comprises structural timber framework mixed with smaller quantities of other products. Cabinets, workstations and office partitioning sometimes appear in the waste stream but the outlying location of the facility appears to limit their volume of this type of material. Doors and other fixout items sometimes occur in mixed loads. If items are in good condition they may be removed from the mixed waste stream for resale through a small resale yard on site however the majority will go through the mixed waste process.

After tipping of the mixed waste, it is sent through the following process:

- Sorting – mainly by excavators equipped with grapples and a minimal amount of hand separation of re-saleable items.
- Compaction and crushing – This involves a large spiked roller used to run over the waste to break it up and reduce its bulk.
- Loading – Waste is loaded by dozer or excavator onto a conveyor to enter the automated separation process.
- Screening – A long barrel type screening machine rotates the waste and allows pieces less than 95mm to go on to the conveyor for the next stage in the process; larger pieces are directed back for further crushing.
- Magnetic removal of metals – a magnetic field is used to extract steel and aluminium.
- Trommel – It removes soil and gypsum products with some wood fibre content - These materials fall below the trommel onto a conveyor which is then sent of to a stockpile and is sold for horticultural uses.
- Two stage air blower separation – The first stage removes and cleans heavy objects such as brick and concrete fragments which fall through to a stockpile for removal. The second stage removes timber, paper and plastic which come out at the end. The resulting timber mulch is stockpiled while the remaining product is typically sent to landfill.

At the current time, a hand picking section is being added to the process in an effort to further reduce impurities. It is expected that in the order of three hand pickers will be used for this purpose.

From the previously discussed process, a combined soil/gypsum product is produced and purchased by landscape companies for top soil and turfing. Brick and concrete products are processed into a variety of aggregate products and sold to multiple users.

Timber products are dealt with under two broad scenarios: products separated prior to arrival at the facility; products reprocessed from timber recovered from the mixed waste process (as described previously). The former stream represents a relatively small quantity and is largely converted to a crushed timber product being sold in limited quantities as a raw material for composite sheet timber production. The later is in the form of timber mulch which until recently was being sold for energy recovery. At the time of writing this report the main customer for this product had recently ceased to purchase it due to difficulties in meeting EPA fuel burning requirements. The product is therefore currently being stockpiled until upgrades to the previous separation process can be brought into effect. New markets are also being explored.

Perhaps the most notable feature of this operation is the economies of scale and variety of end products achieved by having the waste processed at an integrated landfill and recycling facility. The above separation process also serves as a solution for dealing with low-value timber waste going to landfill as a result of mixed waste created by the likes of the “crunch and dump approach” to demolition.
A Generalist Recycler in Victoria Integrating Timber into its Operations

In Melbourne there are a number of large generalist recyclers who predominantly focus on recycling reinforced concrete and masonry into end products such as aggregate, road base and recovered steel. Some have large stock piles of timber waste but have yet to find appropriate technology to begin recycling it. A Melbourne based company has recently ventured into this area. Similar to the Sydney case just discussed, they have developed their own plant capable of accepting mixed waste and separating it into clean timber mulch. Their aim is to create mulch which can be used for energy recovery, particleboard production and horticultural uses. A differentiating feature of this example is that the company vertically integrates these operations with their demolition business. This provides a more holistic service to their clients but in order to achieve economies of scale, the recycling operation also services other demolishers as well.

Of the end products cited above, mulch for particleboard production is a relatively new and high value added product compared to the other options. The company is currently working with a forestry consultant and particleboard manufacturer to bring the idea to fruition. Inquiries indicate that it is realistic for up to 20% of their product to be blended with normal particle board mulch, to make new particleboard.

The company’s plant is novel in its ability to separate timber from other materials. It assumes that timber has been broken down into large splinter size as typically occur from the on-site “crunch and dump” approach to demolition (Refer Section 2.1). At the recovery yard this timber rich mixed mulch is fed from a bin or hopper onto a “Star screen” conveyor belt. The star shaped nodules on the conveyor toss the mixed waste up into the air and by doing so, allow smaller pieces to be gravity filtered or air filtered out of the mix. The remaining waste is then subjected to a series of ferrous and non-ferrous magnets which remove nails, bolts and other metallic pieces. This is followed by a more labour intensive hand picking station which removes further unwanted materials. The remaining timber waste is then fed into a shredder which provides the end mulch product. The system has a potential output in the order of 400 tonnes/day. Even so, the plant needs further development, because mulch size needs to be...
more accurately sized to suit particleboard production. There is also the need for a cleaning stage in the process - to remove dust and dirt from the mulch – in order to make it suitable for particleboard production.

Central to the feasibility of the company’s plans is the value of the particleboard mulch which is worth considerably more to them than other mulch uses. Economies of scale are a necessary ingredient in such operations but even so, long distances to particle board manufacturing locations can cause cartage costs to be a sensitive feature in the cost competitiveness of the recovered material relative to using 100% new materials in particleboard production.

Given the discussion above, this case is similar to the last in terms of benefiting from integrated services, but in this case, the company’s services are vertically integrated with in the company’s overall operations. The case also services to show the potential of moving into new markets which offer higher value adding to originally low-valued materials.

Photo 15: The star shaped nodules on the conveyor belt toss the mixed waste up into the air allowing smaller pieces to be gravity or air filtered out of the mix.
Recovered Timber in Queensland Power Generation

In Queensland, a significant component of timber recovered from Brisbane demolition waste goes direct to power generation. The facility concerned utilises in the order of one third of its fuel input using wood waste. This equates to approximately 100,000 tonnes of wood waste per year. One of the key factors differentiating this example from the previous examples is the directness of the supply chain. For instance timber is taken direct from the demolition site to the end user.

Typically, demolishers deliver the timber waste by truck but the company also provides local bins for householders in the broader Brisbane area as well. Waste is accepted for no cost and though from a demolisher’s perspective this is less than ideal, it is still cheaper for them than landfill tipping costs (assuming other variables neutral). After going over a weighbridge, trucks simply tip the timber into a compound area. Where possible, high-value timber is removed and sold to timber recyclers who specialise in dealing with this type of timber. For the most part, a front end loader is used to feed the timber into the hammer crushing line. This converts the timber into a crushed mulch of 75mm or less in length. Nails and nail plates are primarily managed by the use of magnets. Timber with paint coatings and the likes of CCA treatment are avoided. In addition, the system cannot accept plasterboard and other mixed waste impurities. An important observation from this is that the process is not as flexible as the previous examples discussed. It requires greater work from demolishers onsite to separate the materials. Though this appears to work in Queensland where the “deconstruction approach” is used with some regularity, it may be harder to encourage the same approach in Victoria and New South Wales where lesser forms of recovery are more common e.g. the “crunch and dump approach”. Even so, the facility is eager to analyse the feasibility of taking timber waste from other states and as a result, may offer a feasible option for recyclers in those states.
3.3 Recyclers of High Value Timber

High value timbers are different to the previously discussed low value timbers because recyclers often pay to obtain them from demolishers. Typical timbers in this category include various hardwoods, Douglas Fir and certain uncommonly available softwoods such as Baltic and Hoop Pine.

Demolishers interviewed in the study commonly used a number of prominent timber recyclers for trading these materials. Because of the size of one operation it is dealt with individually below. Others are dealt with in a more generalised way, but specific features of their individual operations are also discussed.

A Large and Integrated Recycler in Queensland

The company concerned is arguably the largest specialist recycler of timber in Australia. They have recently expanded their existing storage yard and separate design centre to include a new, large and modern facility in Brisbane’s far north. They also own and operate a sawmill and additionally contract sawmilling operations out to separate contractors. The size, scope and integration of their operations make them akin to a timber manufacturer who uses demolished timber instead of trees.

In order to retain their economies of scale, consistency of timber supply is crucial to the operations. They have subsequently fostered close working relationships with demolishers to simplifying the procurement of recovered timber. They begin by being party to the demolisher’s tendering process. On large and complicated projects this entails a site inspection to determine the price for recovered materials, transporting arrangements and any onsite logistics. In this mix, the company is prepared to pick-up timber from site or have it delivered to their premises depending on the most appropriate option for the demolisher. On small or simple projects the company may choose to work on the basis of a standard purchase arrangement for recovered materials. In general, this upfront involvement in agreeing on material recovery prices benefit demolishers greatly by allowing them to confidently factor in the price in their project tender. One the additional benefits of this, is that helps lock demolishers into a “deconstruction” approach rather than say a “crunch and dump” approach.

Of note among the above features is the company’s pick-up service which of considerable assistance to the efficiency of supply chain logistics - especially where demolishers find it uneconomical to drop-off the recovered materials themselves. Onsite, work for the demolisher is to some extent also minimised by needing them to only bend nails over and remove large metal brackets - the rest is done back at the company’s recycling yard. If the company is picking up from site, they simply require that the demolisher strap the lengths of timber into slings that can be craned or man handled onto trucks.

The company is primarily interested in structural hardwood and certain softwoods that have a high retained market value (e.g. Hoop Pine). They are also interested in tongue and groove floor boards. A critical feature of this strategy is that many of the houses being demolished in the Brisbane and greater area are hardwood framed houses – many with hardwood floors and Hoop Pine cladding. Apart from houses, the company also procures timber from warehouse demolitions, commercial buildings, timber bridges and other large demolition projects.
The integration of processing undertaken by the company is impressive. They have a large undercover storage area and outdoor holding area where operations take place. Soon after delivery, timber is checked using sensors for nails. De-nailing takes place using both air guns and conventional pinch bar methods. Damaged sections of timber are removed. Timber is stacked on gluts to assist air drying and to keep the timber as straight as possible. There is also a kiln for drying larger section timber that has been cut down into smaller sections. They have modern sawing, moulding and dust extraction equipment to enable re-milling of large sections into floor boards and other forms suited to their line of end consumer products. Surface processing of the timber may include planning or wire brushing – especially where paint coatings need to be removed or to suit desired aesthetics. A degree of colour and species grading also takes place but this is expected to be improved as new grading standards become available. Filling of knot holes with resin or other treatments may also be undertaken on an as needs basis to improve the appearance of the timber.

Not all timber goes through the full scope of the above reprocessing stages. Floor boards that are in good condition are simply cleaned of loose dirt, de-nailed, damaged sections removed, boards ends are machined matched, the board bundles are strapped into neatly packed slings then wrapped in plastic, for sale.

The company have identified that their recycled timbers are very much used for their aesthetic qualities. This market also offers maximum value adding. In this context they point out that recycled timber tends to be more dimensionally stable than younger timber. Their product lines include:

- Various small to large hardwood sections for beam and column applications. These are grouped into colour gradings (red, yellow, brown) and are either dressed or wire brush finished
- Solid timber end matched floor boards in both 25mm and 35mm thicknesses and up to 210mm in width.
- Benchtops – Kennedys make bench tops to order
- Engineered timber flooring which is a relatively new product involving a 4mm thick pre-finished recycled hardwood veneer, laminated to a tongue and grooved plywood base.

The company have an extensive database of industrial clients such as builders, designers and interior fitout contractors. They supply the furniture making industry as well. In order to attract designers and their end user clients, they have a design centre situated in the inner suburbs of Brisbane. Their range of delivery is not limited to Queensland. They regularly deliver to NSW, Victoria and South Australia and occasionally export to countries such as New Zealand and Japan. The company also have obtained quality assurance accreditation under ISO9000 to maintain the reliability of products they offer to customers.

Key features that can be taken from this example include the extent of economies of scale that can be attained from recycling high-value timber but there is a subsequent need for large amount of recovered timber supply to underpin this level of operation. High levels of integration with demolishers are necessary to help meet supply needs and to generally maintain an efficient supply chain from site to the recycling yard.
Photo 17: Stacks of salvaged demolition timber prepared for air or kiln drying in Queensland

Photo 18: Reprocessing salvaged timber
Other Recyclers Working with High Value Timber

Other medium to large timber recyclers operate in both New South Wales and Victoria and focus specifically on recycling high-value timbers. The four companies reported here, were commonly used by demolishers in both Sydney and Melbourne. Common features of these companies are discussed below as are specific features differentiating them from each other.

To start, each of the companies obtain/procure timber primarily through the same means as the previously discussed Queensland example i.e. through a broad network of demolishers. In addition, each of the companies displays their own specific nuances, as follows:

- One company in Melbourne enterprisingly salvages internal timber direct from site by acting as a contractor to the demolisher. The company is mainly interested in removing floor boards and floor framework. Since this work is done internally and is carried out before serious structural demolition begins, demolishers are still able to maintain control of the more dangerous parts of the demolition process. In any event, the price for recovery of the timber is agreed with the demolisher before beginning the project. As discussed previously, this type of arrangement allows the demolisher to advantageously factor this into their tender price.

- Another company obtains floor-boards via an ad hoc network of floor layers who both remove old floors and lay new or recycled ones. As such, the company’s interest in the network is both as a source of supply and means of selling materials.
• Yet another of the companies is linked to a larger group of companies involved in onsite demolition. As a result, this subsequently acts as a large internal source of supply within the company’s operations.
• The remaining company tends to specialise in the recovery of Douglas Fir which is used to supply their Joinery activities (discussed further below).

The four companies have a general emphasis on receiving flooring, scantling and large column and beam sections. The various timber processing techniques are in general terms similar to those used by the previously discussed Queensland example. For instance, recycled floor boards may only undergo basic cleaning, de-nailing, docking and repacking before being sold to end users. Large timber sections may receive similar attention as well as being wire brushed to both clean the surface and in some instances to create a stylised surface appearance. Resin filling of voids, pockets and damaged areas will be done on an as needs basis. Three of the companies also have their own milling facilities. At these facilities the companies may variously undertake:
• Metal detection and de-nailing.
• Re-cutting and dressing of timber into smaller section sizes – especially recutting into wide floor board and decking profiles. In addition, stair case and furniture section sizes may also be milled.
• Air drying (primarily where large sections are cut into small sections and consequently have uneven moisture content).

In terms of sales and marketing, it is notable that a number of the products offered by all companies tend to take advantage of the wide and large sections sizes that are possible when using recovered timber but are no longer attainable using newly milled timber. Products are also marketed as being less prone to shrinkage movement because of the amount of time the materials have already spent insitu. Two of the companies trade in second-hand timber doors but this constitutes a relatively small part of their overall businesses. Those who sell flooring and large post and beam timbers tend to have well presented show rooms that feature panels of different species and different aesthetic presentations of heavy timber sections. In dissecting the way these companies operate, it is worthwhile looking at key differentiating features in terms of the varying extents of value adding that each company undertakes, as follows.
• One company conducts a fairly low degree of processing but turns over large quantities. They tend to focus on simply de-nailing the timber, docking out damaged sections then presenting it for sale. Timber that arrives with paint is often resold with paint intact – thus passing paint removal onto the end customer. They do little re-milling or reprocessing and so high value-adding is limited
• Two other companies conform to much the same level of value adding as discussed previously for the Queensland example i.e. repackaging floor boards and re-milling larger timbers to either make floor boards or to suit other select sizes. In addition:
  o One of these companies undertake a degree of specialty joinery work which adds further value to their base product line. This includes the production of benchtops, solid timber doors and solid timber partitions. They run this part of the business on a made to order basis.
  o The other company has an orientation to flooring products out of Douglas Fir and softwoods such as Baltic Pine and this appears to assist their ability to niche market. In some of their products they also use a slightly different surface finish referred to as “skip dressing”. This is used
because off-cuts that occur when cutting flooring from larger size timber sections (say 50mm thick) tend to leave a difficult to utilise off-cut. “Skip dressing” can be used on the offcut and provides a more textured appearance than dressed timber. It is marketed for use in timber screens, linings and other features panels.

- The fourth company aims for maximum value adding via its specialist joinery works (which specialises in using Douglas Fir as the main material). Here, end products appear orientated towards the inner city housing refurbishment market. For instance, they make detailed windows, doors and cabinets which are sympathetic to the architectural style sin the area. Their emphasis on these products means they are able to maximise value adding without involving separate “middle men” in the supply chain. To compliment this side of the business they also procure and sell bric-a-brac and heritage assemblies such as fire places, fire place surrounds and doors.

What can be taken from these examples tend to support the key findings from the Queensland example. For instance, integration with demolishers is important in improving the efficiency of materials supply and supply chain logistics. New aspects in these examples cover the way that this is achieved by vertical integration within companies, or by getting directly involved it onsite salvage as a contractor to the demolisher. It is also apparent from a number of these examples, that materials with high value can be processed into even higher valued added end products such as detailed joinery products and high end flooring products.

Photo 20: Display of floor boards and rustic column and beam structures

Commercial in confidence, TDAwaste091007.doc
Photo 21: Bench top after filling and finishing coats

Photo 22: A partition awaiting sanding after resin applied to cracks and holes
Photo 23: Racks of hardwood ready for sale

Photo 24: Window and door products made from salvaged Douglas Fir in Melbourne
3.4 Salvage Yards

Salvage yards overlap with the previously discussed timber specialists but can be differentiated on the basis that they receive and sell a broader range of materials, not just timber. They also tend to undertake a lesser degree of timber reprocessing and value adding. For instance, they typically just rack, stack or place timber in designated areas. They also tend to sell things like recovered bathroom and electrical fittings, metal products, kitchen cabinets, windows, doors, structural steel, sheet metal roofing and virtually any materials that can be successfully reclaimed and sold.

This broader diversity tends to mean that they spend less time and effort on timber and in some ways are more like a second-hand hardware store than a timber recycling specialist. Two of the demolishers interviewed operated their own salvage yards which traded direct to the public. A third demolisher regularly used an external salvage yard who was used to salvage roofing timber and other materials direct from site. Each is discussed briefly below.

A Salvage Yard Integrated with Demolition Operations in Brisbane

The salvage yard aims to bolster the company’s broader operations by vertically integrating salvage and sale, with its demolition activities. In order to provide appropriate economies of scale, the salvage yard also obtains materials from other demolishers as well. By salvage yard standards its operations are considered to be medium to large in scale.

Timber coming into the yard is typically de-nailed, damaged sections removed and ends docked to the nearest standard size. As alluded to previously, processing is kept to a minimum so the company is not equipped for re-milling. As a result, there is more emphasis on simply reselling scantling timber and less on value added products such as re-milled floor boards etc.

The yard contains a broad selection of wares presented in isolated stacks. In the case of timber, scantling is stacked in under covered racks as would commonly be found in many timber yards. Doors, plywood and other sheet materials are shelved or racked in undercover locations. Kitchen cabinets are stacked loosely under cover.

Though much of the company’s trade comes from the general public, little attention is given to the presentation of materials or to showroom displays. Instead, it is more consistent with industrial sales and prices are set to match this scenario. The company also sells direct to certain industrial customers. For instance, short lengths of timber are sold as dunnage to a trucking company. They sell more selective timbers to furniture makers and sell to builders on an ad hoc basis.
A Salvage Yard Integrated with Demolition Operations in Sydney

This salvage yard’s operations run as a subsidiary to a Sydney based housing demolisher. Its operations are relatively small compared to the previously discussed Queensland
example. Even so, the same basic objective of vertical integration with site demolition services still applies. All useable timber products are resold through their yard but primarily focus on selling Douglas Fir scantling timber recovered from roofs, timber doors and windows. Sales are primarily made direct to the public – mainly the home renovator outlet. On this basis, the company is able to flexibly upscale or downscale its timber sales according to supply from site, but at this stage seems unlikely to diversify into larger scale operations.

An Independent Salvage Yard in Sydney
This Sydney based salvage yard regularly work for one of the specialist residential demolishers used in the study. The small family owned business is divided into two sections:

- A recycled building materials yard – materials are sourced from other demolishers plus their own salvage operations
- A timber salvage gang – who specialise in stripping roofs (approximately 1 per day) and contract in this area to demolishers operating the residential sector.
By far the majority of materials handled by the business (approximately 80%) is pitched residential roof framing timbers (not trussed roofs) as salvaged by the abovementioned site gang. Some is also obtained directly from other demolition companies. Of note, OH&S requirements are increasingly limiting their ability/access to hand stripping of roof frames due to the lack of attachment points for safety harness systems. They also expect that the style of recycling in which they are involved will gradually come to an end as the percentage of trussed roofs increase and pitched roofs decrease.

Solid timber framed doors make up a small additional part of their business while the likes of skirtings and architraves are only kept if in good condition and not heavily painted. Floorboards are occasionally stripped and returned to the yard for resale but this is not a core part of their business. Non-timber items sold by the business include fireplaces and a selection of internal fixtures and fittings.

No facilities exist at their premises for remilling of timber sections and consequently two key scenarios of sales exist:

- Rough sawn Oregon is de-nailed, cleaned and docked square for sale direct to builders and the public (from their yard).
- Hardwood is de-nailed and on sold to a more specialised timber recycler who focuses on high-value timbers (similar to previously discussed companies in this area).

What can be said about this and the other two examples of salvage yards are that their businesses are pitched at low levels of infrastructure and low levels of value adding. Two of the operations are small in scale and this is considered to be indicative of many salvage yards. Their stock is driven by small quantities of easily recovered materials rather than aiming for large quantities and large economies of scale. As a result, these operations serve a useful purpose in terms of assisting with timber reuse and recycling but are unlikely to offer a strategic business platform for addressing large scale improvement in timber reuse and recycling.

### 3.5 Impediments to Re-users and Recyclers of Recovered Timber

Timber recyclers and salvage yard operators were asked about key impediments to their ability to reprocess and sell recovered materials. Prominent themes included:

- Difficulties in grading timber for resale. This can include structural grading as well as aesthetic grading (e.g. from wear and tear, nail holes, damage, deterioration).
- The inability to deal with the removal of laminates on MDF and particleboard which in turn limits recycling options.
- The lack of viable end products – especially concerning recycled particleboard and MDF board.
- Problems in NSW and Victoria in achieving an EPA approved standard for burning wood in energy recovery.
- The lack of resource security in timber recycling. There is no guarantee of timber supply and this prevents confidence in investment and the scale of operations. Where possible, government departments with large asset bases of redundant timber should be involved in underpinning the resource base.
- In Queensland, landfill costs are too cheap and hence reuse and recycling options are not as competitive as they should be.
Better equipment is needed to automate the reprocessing of timber received from site including timber cleaning equipment, paint removal and nail removal equipment

Stop authorities from forcing treated timber to go to landfill

A general lack of market definition and viable end products e.g. what is the end product, how much does it cost to produce, what is it financially worth and how robust is it likely to be in the market place – especially if regularly competing with other materials not produced from timber. A more demand lead focus is required.

3.6 Conclusions About Re-users and Recyclers of Timber Waste

The previous discussion describes where timber from demolition waste goes to once it leaves the building site. Of specific interest are the different approaches to reuse and recycling - each targeting different levels of value in the recovered timber. For instance high value timber recyclers add significant value by focusing on the timber flooring market or by undertaking detailed joinery of windows, partitions, cabinets and doors. Towards the middle of the scale are predominantly small salvage yards who simply clean, de-nail and dock timber before reoffering it for sale. At the low end of the scale are those who focus on separating timber from mixed waste for commodity type end products such as energy recovery, horticulture and particleboard products. In many respects, this is where the largest scope for increased scale of operations exist and this is because of the large amount of low value timber being generated by demolition (which will probably only increase with time).

At a technical level there is a need to work out the best ways of adding value at each of these levels. To maximise diversion from landfill, attention should go to getting the most out low-value timbers and this means improving production processing, innovating end products that maximise value adding and ensuring impediments are removed regarding certain existing end uses (e.g. low-value timber for energy recovery).

At a general business level, it is worthwhile noting how some demolishers have effectively created vertically integrated supply chains within their respective companies via salvage yard and specialist recycling operations. Under a different model of operation, a number of “high-value” timber recyclers working externally to demolishers, have managed to work out ways of effectively integrating with them to procure materials. Features of this include involvement in tendering on projects, picking up timber from site and salvaging direct from site. They have also done well in:

- Their efforts to create a confident and reliable supply chain between demolishers and timber recyclers
- Their improvement of the logistics of physically obtaining timber from site
- Their emphasis on creating saleable end products from recovered materials
- The growth and economies of scale that these companies have achieved
- The degree of integration and efficiency these companies have achieved

These features need to be adopted on a larger scale than just the current hand full of companies that exhibit these features. It would be ideal if some of these features could be adopted at the “low-value” end of the market as well.

Despite the benefits of the above features, the largest long term threat to high-value timber reuse is likely to be the sustainability of supply from demolition sites. For instance, as the
demolition stock changes so will the type of timber that is recovered. Resource security is therefore an important issue in this part of the recycling industry.

Low-value timber is likely to be more common and so processes and end products need to be increasingly adapted to suit the changing resource base. There is also a need to work out how salvage teams can obtain a greater variety of timber based materials from demolition sites and still make money out of it.

Another finding from this part of the study is that the more re-processing of timber that is involved, the more plant and equipment that is required. This is necessary to put value back into the timber. Though this will not necessarily affect salvage yards that do little reprocessing, it means larger companies with larger economies of scale are required to mitigate the cost of their plant and equipment. This may limit the number of large companies that the industry can support.
4.1 The Impact of CCA and Other Treated Timber

All of the demolishers interviewed considered treated timber to be a very small proportion of the timber waste stream. They said that where CCA treated timber did occur it was easy to spot prior to demolition because of its tinted colour and its limited range of common locations (e.g. outdoor structures, pergolas, carports, verandas and landscaping applications). The only exception was where paint coatings potentially hid the nature of the timber beneath.

From a recycler’s perspective there were two comments from those interviewed about the impact of CCA treated timber on their operations. For instance one recycler had found that a State Government agency had been sending large amounts of treated timber waste to landfill on the basis that it was contaminated waste. In trying to recycle this timber rather than see it go to landfill, the recycler had to obtain certain approvals and licenses to satisfy the agency that the material would be handled safely and responsibly. However in trying to meet such requirements, the normal categorisation system for licensing and approvals did not match or cover the requirements of the agency. Though some of these problems have since been resolved, the recycler expects new issues to arise with each progressive government agency and department they approach. The situation could be avoided if there was greater clarity and coordination between government bodies about licensing and approval requirements.

A separate problem identified in Melbourne concerns the situation of a specialist timber recycler who was unable to sell low-value softwood waste to a large power station for energy recovery. The power station was interested in using the waste because of the environmental credits they would achieve. Unfortunately arrangements were curtailed as LOSP and other timber treatments were considered by the EPA to contaminate the fuel source.

It is unclear how much these situations have impacted on similar situations in NSW, Queensland and Victoria but it is considered that attention should be given to seeing if it is a problem in all states and action taken as required.
4.1 The Impact of Bonded Asbestos

Demolishers did not consider Asbestos a problem to timber recycling but in some cases saw it as a nuisance. Here, it is important to point out that asbestos removal requirements can be complex and can vary subtly between each state. Even so, many demolishers in all states spoke favourably of the role played by Environmental Hygenists in asbestos related issues. For instance, they may be called in by the client/builder to consult on situations where asbestos exists in the building and to advise on what areas require removal. After removal, they typically issue a clearance certificate. From the demolisher's point of view, the certificate has the effect of clearing the recovered timber from asbestos contamination, hence removing potential impediments concerning its transfer to others. If the certificate is not provided or has specific conditions, then recycling options may be limited and disposal at a licensed landfill may be required.

Despite the above perceptions from demolishers, one recycler in Victoria raised concerns of a different nature. For instance they spoke of a relatively new Workcover regulation which requires zero tolerance to asbestos content in recycled building materials sold in the general market place. Though no instances were mentioned of this effecting trade in timber, the company mentioned that they had a large holding of another common building material which they were not prepared to sell because of the inability to absolutely guarantee zero asbestos content. It would seem that in the future, this situation could potentially arise as a problem for timber as well. Again, further inquiry and proactive action may be necessary to prevent it becoming a major barrier to increased recovery.

4.2 The Impact of Paint Coatings

Most demolishers did not think paint coatings had much of an impact on their ability to pass on timber to recyclers. They did however concede that this was probably because most of the timber they passed on was framing timber (hence unpainted). In addition, the problem was further avoided by virtue of many painted timbers such as skirtings, door jambs and MDF
products being of no value and therefore sent to landfill. If cladding boards were recovered, the problem of paint was again avoided by virtue of on-selling the boards with paint intact to recyclers or end users. Some demolishers raised health issues associated with lead based paint, but they still did not see it as a significant impediment to their ability to pass recovered timber onto recyclers.

Inquiries with specialist timber recyclers indicated that they either used wire brushing, re-sawing, remilling or re-planing to remove paint. Some may also use paint stripping to deal with irregularly shaped objects. Most did not see this as a practical problem to their operations at the current time. One recycler - who was in the process of trying to access waste timber from redundant government assets – addressed the issue at a risk management level. They mentioned that in trying to satisfy a government agency’s requirements, they had been queried about how lead paint would be handled in a way that assured safety to workers and the public during the reprocessing and eventual sale of the timber. Negotiations on these issues were ongoing at the time of writing this report, but it would seem that similar situations are likely to occur when dealing in a similar way with other government agencies.

4.3 The Impact of Laminates

A widespread problem raised concerning the recyclability of particleboard and MDF products was the plastic laminates and edgings that cover these products. As mentioned in the discussion about strip-out demolitions (refer Section 2.3) there is no commercially viable option recognised by demolishers for these particleboard and MDF products. Laminate coatings are seen as a significant barrier to any re-use or recycling markets for these products.

4.4 Conclusions about Contaminants as Impediments to Reuse and Recycling

Given the previous discussion, it is concluded that recyclers are potentially more affected than demolishers by the impact of treated timber, asbestos, paint and laminated coatings on timber. The impact varies for different states, different contaminants and in some instances issues have yet to be felt by the timber recovery industry.

A specific areas requiring immediate attention concern the impact of treated timber on contaminating timber used for energy recovery. This needs to be assessed in all states.

Laminates on particleboard and MDF products act as an impediment to the recycling of the base material in all states and efforts are required to address this issue if they are to be recovered in any significant quantities.

Paint coatings do not appear to be an immediate problem to demolishers. Even so, there is isolated evidence that timber recyclers recovering timber from government agencies need to satisfy specific health standards concerning their workers and the public at large. This particularly applies where lead based paint may be involved. This does not appear to present an insurmountable barrier to increased recovery of demolition timber but will probably require quality assurance procedures from timber recyclers regarding work processes, tests and measures to meet government requirements.
There is isolated evidence that a lack of appropriately categorised licenses and approvals can hinder the ability of recyclers to recover treated timber from certain Government organisations. A means of monitoring such problems needs to be set-up and responsive action taken as required.

In Victoria, zero tolerance to asbestos in the sale of recycled building materials represents a potential future problem for those selling recycled timber products – albeit that this problem has at this stage only been felt by other material groups. This issue should be monitored and dealt with on an as need basis.
5.1 Issues in Categorising and Quantifying Timber Demolition Waste

An objective of the project was to recommend a standard system for categorising and quantifying timber waste from demolition. Existing classification systems (relevant to building demolition) divide timber waste up into core material categories such as hardwood, softwood, particleboard and MDF and plywood. Others have adopted a more generic approach that consider timber in terms unprocessed, processed or treated timbers. Though this report supports the categorisation of material groups it goes further in terms of offering a more holistic approach to categorisation. The objectives of this approach include greater attention to accurately quantifying timber waste and the need to use data for strategic business decision making concerning the performance and future of timber reuse and recycling. To do this, a number of assumptions that underpin the categorisation system are detailed below under appropriate headings. This is followed by the actual categorisation system.

How the data will be collected

Based on current methods, it is assumed that data will be gathered at landfills, transfer stations, resource recovery facilities and any other places where timber waste or recovery transactions takes place. These locations typically gather data via weighbridges or by visually estimating waste volumes. Visual estimates are also made for assessing whether loads are of mixed waste, separated waste or contaminated waste. Assuming such methods are the norm (as opposed to detailed dissection of mixed loads), then the methods of categorisation and quantification must fit in with such methods and must also remain as simple as possible.

How the data will be used

The purpose of the data is vested in the original objectives of this study which is interpreted here as including categorisation and quantification of timber waste to monitor performance in terms of:

- reduction in timber going to landfill
- the growth and sustainability of timber reuse and recycling markets.

How the categories will be measured

During execution of this study, it became apparent that timber is often a component of mixed waste and that demolition waste is often measured in different ways – primarily by weight or by volume but rarely both. Here, landfill in NSW and Victoria is often measured by weight but
in Queensland, volume appears more common. To add to this, individual resource recovery businesses may choose different method to those used at landfills to suit their individual needs. As a result, there is no common denominator under which data from various locations can be drawn together. As a result, it seems necessary for the categorisation and quantification system to encompass a conversion system from weight to volume and visa versa. Here, moderate levels of conversion accuracy are probably achievable but high levels are unlikely. As a result, a “ready reckoner” type conversion factor is recommended.

5.2 The Proposed approach for Categorising Timber Waste

The categorisation and quantification system suggested below aims to maintain simple assessment – be it by weight, volume, mixed waste or separated waste. In this endeavour, some simple additional information will be required at the time of waste drop-off and then it is intended that post hoc calculations be used to convert this information into more detailed timber specific data.

Source classification

Waste data will come from and be used by fairly well defined sectors in the construction industry that broadly reflect the nature of demolition stock (type of building). It is recommended that these be categorised to include:

- housing demolition waste
- commercial building demolition waste (i.e. industrial structures, internal strip-outs, other)
- timber bridge and other civil structure waste

It is expected that this categorisation will allow waste measurement within specific building industry sectors. This could be done to isolate declines or increases in waste in a given sector or to strategically evaluate the effects of industry specific initiatives that have been implemented. At an industry level, these categories will also provide an indicator of changes in the up and coming demolition stock which can be used to predict changes in the supply of timber to re-use and recycling markets.

Material classification

As mentioned previously, existing categorisation systems exist for dealing with core material categories. Drawing on this, there is a need to reflect the value of different timber types in the reuse and recycle market place (i.e. “no-value”, “low-value” or “high value”). Pursuant to this, the following categories are recommended:

- Hardwood,
- Douglas Fir
- General softwoods
- Particleboard and MDF
- Plywood.

Proportion of timber in mixed load

Since timber often comes from the demolition site as a constituent of mixed waste, there is a need to estimate its weight or volume as an isolated component. Detailed measurement of this content on a load-by-load basis is considered unrealistic. As a result, reliance should be placed on using indicative profiles of timber content in mixed waste loads. For instance
existing facilities that separate timber from mixed loads (refer Sections 3.2 & 0) would be able to provide indicative data. Other purpose made studies could also assist this endeavour. Based on indicative waste profiles developed from these sources, the timber component in mixed loads would be visually estimated by whoever is assessing it, and classified as:

- Mixed load with no timber (i.e. multiply total load by factor of 0.0 to determine timber content)
- Mixed load with some timber (i.e. multiply total load by factor of 0.25 to determine timber content)
- Mixed load with considerable timber (i.e. multiply total load by factor of 0.5 to determine timber content)
- Mixed load with mainly timber (i.e. multiply total load by factor of 0.75 to determine timber content)
- Timber only load (i.e. multiply total load by factor of 1.0 to determine timber content)

**Proportion of air space in waste loads**

Significant amounts of air space in waste loads will have a significant impact on volume measurements. Categories for dealing with air space should include:

- No air space in waste load i.e. apply factor of 0
- Not much air space in waste i.e. apply factor of 0.25 to remove air space
- A medium amount of air space in waste i.e. apply factor of 0.5 to remove air space
- A large amount of air space i.e. apply factor of 0.75 to remove air space

The effect of this variable on timber volume calculations will depend on how much timber is in the load and it is intended that this contribution will be mediated by the previously discussed factor dealing with timber content in mixed loads.

**Timber density**

Categorisation also needs to take into account the approximate density of the timber waste to facilitate conversion of weight and volume. For instance hardwood is generally heavier than softwood. Since these and other material categories have already been determined previously, it is only necessary to apply an average density for these groups. No standard average is known for this specific application and though this may be the subject of further debate, it is suggested that:

- 0.45 tonnes/m$^3$ be used as an average density for most commonly available softwoods
- 0.80 tonnes/m$^3$ be used as an average density for most commonly available hardwoods, particleboard and MDF products.
Examples of Conversion Equations

Three out of the five categories discussed above revolve around conversion of timber weight or volume from mixed or separated timber waste. Formulaic application of these categories are shown below.

**Equation 1: conversion of weight to volume:**

\[ W \times P_t \times D_t \times (1 - P_a) = V \]

Where:
- \( W \) Total weight of mixed load (tonnes)
- \( P_t \) Proportion of timber in a mixed load (factor)
- \( D_t \) Density of timber or wood product (tonnes/cubic metre)
- \( P_a \) Proportion of air space (factor)
- \( V \) Volume of timber (cubic metres)

**Example:**

\[ 3 \times 0.5 \times 0.8 \times (1-0.25) = 0.9 \text{ cubic metres} \]

**Equation 2: Conversion of volume to weight:**

\[ \frac{V}{P_t / D_t / (1 - P_a)} = W \]

**Example:**

\[ \frac{0.9}{0.5 / 0.8 / (1-0.25)} = 3 \text{ tonnes} \]

Proposed approach for Monitoring the Effectiveness of Reuse and Recycling Markets

In further addressing the need for a system for categorising and quantifying timber waste, consideration should also be given to quantifying reuse and recovery markets to evaluate the effectiveness of measures undertaken to increase diversion from landfill. By doing this, it is possible to track the value of timber diverted from landfill to reuse/recycle markets. The motivation behind this is simply a result of the findings during the study which impressed the importance of focusing on end products. Finding out the value of end user markets would increase the possibility of attracting investment to the timber resource recovery market. It would also indicate where strategic changes are necessary to improve market performance.

Though it would be difficult to determine overall output in each end product area, periodic audits from a sample of large producers would enable quantities to be established. If these quantities were then multiplied by indicative rates for the sale of such end products then at an industry level the:

- value of the reuse and recycling industry could be calculated
- foregone value of materials still be sent to landfill could be calculated
- percentage of value adding to recovery costs could be calculated
6.1 Overall Conclusions

The evidence in this report indicates that a significant amount of timber from the demolition of houses, strip-outs and industrial buildings is being disposed of to landfills in Sydney, Melbourne and Brisbane. High value timber, mostly hardwoods, is salvaged in all cities, particularly in Brisbane. Low value demolition timber has limited recycling but there are some promising markets which need development.

This report has served to map and develop a framework for identifying variables that influence and explain why timber goes to landfill or why it is recovered. It also details impediments to timber reuse and recycling as documented in Sections 2.5, 3.5, and 4.4 of this report. The conclusions below emphasise specific points from the report and to improve clarity are expressed by way of breaking comments down into four groups – one dealing with the principles that explain the demolition process and how it leads to either reuse, recycling and landfill; another two dealing with high priority and other priority areas of action; the fourth dealing with projected future economic impacts on timber reuse and recycling. Under each scenario, points are expressed by way of a lead statement (in bold) followed by explanatory comments.

Principles that explain the demolition process and how it leads to reuse, recycling or landfill

- **The quality of timber in a building determines if it is worth saving during demolition or not.** The quality of timber is a function of the demolition stock which is primarily determined by the type of construction and the age of buildings being demolished. Timber quality is important as it influences whether demolishers think they will get a good price for recovered timber or not. This report expresses quality in terms of “no-value”, “low-value” and “high-value” recovered timbers.

- **“No-value” and “low-value” timber are currently a large part of the demolition waste stream and will only grow as younger buildings enter the demolition stock.** As a generalisation, high value timbers include hardwoods, Douglas Fir and certain softwoods that are no longer commonly available in the market (e.g. Baltic Pine and Hoop Pine). There is demand and established markets for these timbers. For “no-value” and “low-value” timbers there are currently only limited markets despite large volumes of this type of material. Specific materials that fit into these categories include pine framing, particleboard and MDF products. Further to this, the recovery of most timbers from wall frame and roof truss assemblies are considered by most to be not worthwhile recovering. Most small section timbers are of little resale value. Most doors are very limited in resale value (except solid timber framed...
doors). Efforts are required to improve the value of high volume end products that can be produced from these materials to increase the likelihood of them being recovered from site.

- **Demolishers use different approaches to demolishing buildings - their chosen approach predetermines how much timber is recovered or goes to landfill.** The choice for demolishers about whether to recover timber waste or send it to landfill is primarily determined by economic factors. The first factor concerns the previously discussed quality of timber and the price they expect to get for it. Using this as a basis, other factors that are added or subtracted from the expected price and include the cost of recovering the timber versus the cost of taking it to landfill; the time available for demolition to take place; and the entrepreneurship shown by demolishers in accessing and integrating with reuse and recycling markets. This complex mix of factors tends to be dealt with more pragmatically by demolishers on a day-to-day basis by virtue of choosing one of three generic approaches to demolition (detailed in Sections 2.2, 2.3 and 2.4 of this report) including:
  - The “Crunch and Dump” approach i.e. where timber is demolished with an excavator and without any attention to site separation. Most waste subsequently tends to go to landfill.
  - The “Deconstructions” approach i.e. where materials are site separated usually by hand demolition, and the most will usually end up as recovered materials.
  - The “Miscellaneous salvage” approach i.e. where the “crunch and dump” approach is augmented by opportunistic salvage of materials – usually the salvage of internal timbers or pitched roofing timbers but rarely both.

Strip-out demolition offers a slight variation on the above themes in so far as the process involves hand demolition to remove timber based work stations, doors and cabinets from site, but the lack of reuse/recycling markets in these areas result in the materials ultimately being treated in the same way as the “crunch and dump” approach.

Biases in use of the three main options (above) appear to vary from state to state due to differences in the way the above mix of economic factors impact in each state. In simplified terms, New South Wales and Victoria appear to mainly use either the “crunch and dump” or “miscellaneous salvage” approaches which unfortunately leads to a significant amount of waste going to landfill. This seems to be less the case in Queensland.

- **Identifiable impediments restrict the preferred use of the “Deconstruction” approach to demolition.** Though the previously discussed “deconstruction” approach offers an ideal situation for timber recovery, advocation of this approach may be difficult to implement unless improvements can be made to address impediments influencing its use. Key problems are the impact of high labour costs and OH&S regulations in onsite demolition. Both factors appear to impact on Victoria and New South Wales more so than Queensland. Another problem is that many demolishers are committed to using an excavator as part of the demolition process and therefore it is likely to be difficult to coax those who use this approach away from their normal mode of operation. In the mid to long term, a worthwhile ambition could be to develop methods of using an excavator to assist the deconstruction approach as this could improve efficiency and the recovery of materials onsite, as well as
dealing with OH&S concerns.

Further to the above, recovery of timber often requires extra time onsite to have workers dismantle the building then prepare and store the materials onsite until a buyer is found. Unfortunately, many builders and developers require a faster approach and depending on situational circumstances may not make use of the “deconstruction” approach and instead favour a faster method such as the “crunch and dump” approach. Involving builders and especially clients in decision making may help alleviate this problem as would improvements in the speed of making reuse and recycling transactions in the market place.

- **Extremely low landfill costs in Queensland reduce the economic viability of materials recovery from demolition sites in that State.** Private landfills in Queensland are disproportionately cheap to the point of making landfill an almost insignificant cost in demolition works. This reduces the likelihood of demolishers opting for reuse and recycling options (assuming all other variables are equal).

**High Priority Areas of Action**

- **There is a need for innovation in end products, especially ones that will add the most value to the growing amount of low value timber from demolition waste.** It is considered from this study that new end products must be developed to drive higher value markets for currently low-value recovered timbers. With regard to this point, it is concluded that end products dictate the economic viability of timber recovery onsite (by demolishers). This is already apparent for high-value hardwood products, however the same is not necessarily true for low-value timber products. They tend to exist as commodities and often compete closely with other materials on the basis of price. As a result, a considerable amount of resources must be devoted to nurturing market development and ensuring that commodity type timber products from waste recovery can be efficiently passed on in the supply chain to provide higher value end products. At a technical level there is a need for the timber industry to work out the best ways of adding value.

- **Recycling low-value timber from mixed waste for commodity type end products is probably where the largest scope for increased scale of operations exists.** The large amount of low value timber arising from demolition is often as a constituent of mixed waste. This is by virtue of the previously discussed use of the “crunch and dump” approach to demolition. As a result, actions are required to increase the use of technology that can separate timber from mixed waste and to develop high value end products from such technology. There is also a need to ensure any impediments regarding the sale of end products are dealt with (refer conclusions on contaminants for further direction on this issue).

- **Entrepreneurship and integration of operations are important to improving the efficiency and reliability of reuse/recycling supply chains.** If demolishers are to become more involved in timber recovery, they also need to become more involved in practicing entrepreneurship in terms of finding buyers and markets for their recovered materials and in terms of trying to improve the efficiency of this process. One option is vertical integration. For instance a number of companies in this study have
successfully created subsidiary salvage yard and recycling operations which have become sustainable in their own right. Under a different model of operation, “high-value” timber recyclers have managed to work out ways of effectively integrating with demolishers in accessing and procuring materials. Features of this include involvement in tendering on projects, picking up timber from site and salvaging direct from site. They have also served to:

- create confidence and reliability in supply chains between demolishers and timber recyclers
- improve the logistics of physically obtaining timber from site i.e. site pick-up services
- creating valued end products from recovered materials
- demonstrating that appropriate economies of scale are achievable for mid to large recyclers

These features need to be translated to emerging reuse and recycling markets – especially the low-value recovered timber markets.

**Other Priority Areas of Action**

- **Up-scaling the “Miscellaneous salvage” approach to demolition, potentially offers a flexible way of improving reuse and recycling.** Notwithstanding the benefits of the deconstruction approach, there is potential to improve re-use and recycling by up-scaling and intensifying the usage of salvage teams. A number of companies discussed in this report already contract salvage services to demolishers which makes it a flexible and simple service for demolishers to take advantage of. Such gangs are mainly sent in for the express purpose of recovering timber and there is potential for these services to be expanded if there were appropriate end user markets that the recovered materials could be used for. This concept is discussed further, in the recommendations section of this report.

- **Potential contaminants of recovered timber appear more of a problem to recyclers than demolishers.** The impact and nature of such problems vary from state to state and for different end uses. Specific areas requiring attention concern the impact of treated timber and painted timber in contaminating timber used for energy recovery (as evidenced in Victoria and possibly effecting New South Wales as well). There is evidence that a lack of appropriately categorised licenses and approvals (as evidenced in Queensland) can hinder the ability of recyclers to recover treated timber from some Government clients. There is also isolated evidence that timber recyclers recovering timber from government agencies need to satisfy specific health standards concerning their workers and the public at large – especially where lead based paint may be involved. Laminates on particleboard and MDF products act as an impediment to the recycling of the base material. In Victoria, zero tolerance to asbestos in the sale of recycled building materials represents a potential future problem for timber recyclers – albeit that this problem has at this stage only been felt by other material groups. A means of monitoring such problems needs to be set-up and responsive action taken as required.
Projected Future Economic Impacts on Timber Reuse and Recycling

- **Large timber recyclers are to be encouraged in the industry for their ability to handle large amounts of waste and make large investments in plant, equipment and technology.** A strategy for encouraging the growth of such companies is considered worthwhile and should target areas where large recyclers are currently absent from the market. On this basis, access to materials is likely to be important to these companies. There is subsequently a parallel need to maintain and where necessary further develop markets for recovered timber in a way that effectively provides access to a broad number of sellers and transparently extends beyond state boundaries.

- **One of the greatest long term threats to companies involved in recycling high-value timber is an ongoing supply of resources.** Put simply, as the nature of the demolition stock changes so will the type of timber that is recovered. Though the impact of this may vary from state to state, there is evidence in this report that suggests that there will be more softwood and less hardwood. For example, there is likely to be a reduction in the number of traditionally constructed hardwood floors due to the proliferation of concrete slab construction. In addition, softwood roof trusses have also increased in usage compared to pitched hardwood roofs.

Given the above conclusions, the remainder of this report puts forward a number of ideas for improvement to timber reuse and recycling which have come from demolishers, recyclers and the author of the report.

### 6.2 Ideas for Improvement from Demolishers and Recyclers

Demolishers were asked to suggest ideas that they thought would improve their ability to reuse and recycle timber. Much of their discussion centred on outcomes rather than details. In general terms their preferred outcomes included improved access, timeliness and efficiency concerning reuse/recycling markets. Specific ideas were few and in some cases focused on supporting expansion or further development of existing concepts. The main themes mentioned by them are discussed under appropriate headings below:

**Offsite Mechanical Separation of Timber from Mixed Waste**

There was support for offsite recovery centres capable of separating timber from mixed waste into clean mulch. Existing facilities of this nature typically produce clean timber mulch that can be utilised in a number of product lines including energy recovery, horticultural products such as soil lifter, and as a raw product for particleboard production. From a demolisher’s perspective, it was apparent that this approach had certain advantages for those using the “crunch and dump approach” as it minimised changes to their existing approach to demolition. It was also apparent that this approach could lift “no-value” timber to “low” or “mid-value” levels which would be a significant improvement on the current situation.

**Using Recovered Cabinets for Recycled Kitchen Production**

In response to difficulties in reusing and recycling particleboard and MDF products, this idea was put forward to encourage the use of site recovered cabinets in recycled kitchen production. Here, companies such as Second Chance Kitchens
in Queensland were identified as an indicator of how such an approach may work. For instance the company’s web site indicates that they accept kitchens less than 10 years old. If required, they will remove the kitchen from site. They have a show room and design service to assist clients in designing a kitchen that can be made from their recovered stock. Their joinery section makes it possible to re-model existing stock to suit individual needs.

**Chipping of MDF and Particleboard Products**

The concept is again targeted at difficulties concerning the reuse and recycling of particleboard and MDF products. It calls for appropriate technology to be developed for chipping particleboard and MDF products. Some also mentioned that it would be ideal if such technology could be taken onsite especially if able to fit in a lift and used in office stripouts. At this point in time, those suggesting the idea were unaware of how the resulting material would contribute to end products or if laminates could be mulched as part of the process, or not. As such, could probably gain in interest once questions surrounding end usage were answered.

**Export cabinets and other materials to developing countries overseas**

Trade of this nature already takes place in other parts of the demolition industry – notably in the export of steel roofing to developing countries in the Pacific region. In this instance, the idea put forward involves shipping cabinets, workstations, doors and potentially other timber based materials to much the same destinations. The feasibility of setting up such an operation would probably be reliant on involvement from Austrade and other organisations as well. It seems the feasibility of such an idea would also be reliant how successfully the components could be removed undamaged during demolition and the cost effectiveness of shipping them overseas. For instance doors could be stacked as flat objects but cabinets would take up significant amounts of air space and may therefore be too expensive to treat this way.

**Biomass for wood waste**

A number of demolishers and recyclers were interested in the concept of biomass as a means of dealing with wood waste. They saw it as a broad spectrum answer for a variety of “no-value” and “low-value” timber waste types (including particleboard and MDF products). Unfortunately, none of those suggesting the idea had a strong understanding of the technology and so if this idea was to be pursued, a first step would need to consider basic understanding of its application to timber. To this end, the Australian Greenhouse office has a dedicated web page concerning biomass projects and can be found at (http://www.greenhouse.gov.au/renewable/recp/biomass/ten.html). Specific feasibility studies in this area may also be worthwhile.

**Timber Firewood Briquettes**

A feature of one of the recycling operations investigated during the study was their reuse of sawdust to make timber firewood briquettes. The compressed sawdust pellets measure approximately 85mm long x 75 mm in diameter. The density of the pellets is surprisingly high at approximately 950kg/m$^3$, thus making them comparable with the hardwood that is usually used for firewood. The company sells the sawdust pellets in bags suited to home firewood usage. A company known to make this type of equipment is Weima timber recycling equipment at (http://www.weimaamerica.com/english/application/briquetting-applications.htm). There is perhaps potential that similar equipment could be used to make briquettes but in a way that applied to more than just sawdust. For instance, it could perhaps be applied to timber mulch as well.
6.3 Ideas for Improvement From the Author

In considering the findings from this project, a number of speculative ideas (below) have been put forward by the report author as options for improving reuse and recycling. Such ideas require future studies to determine commercial, regulatory and technical feasibility.

Focused Regulation e.g. Mandatory “Green Points” for New Building Developments Involving Demolition

Though measures such as landfill levies use financial deterrents to discourage landfill, the effect is not as necessarily as direct or targeted as ideally required. It was suggested earlier in the report that clients, developers, designers and builders should become (or already are) involved in decisions about reuse and recovery from demolition waste. On this basis an alternative measure to landfill levies is suggested that aims to make the previously mentioned roles become more directly involved where demolition is a forerunner to new building works. Put simply, resource recovery from demolition would become a measurable feature of the Development Approval process on new building work. Ideally this would happen as a part of a more inclusive building sustainability index, such as the BASIX index currently used in New South Wales. As an example, a new development involving demolition would trigger the use of a resource recovery index. A number of points obtained from a menu of options would need to be accrued to meet targeted levels of improvement. Obviously, this would include taking demolished materials to re-users and recyclers but as an alternative, points could also be accrued by using re-used or recycled materials in the new building work – these could come from either salvaged demolition materials or from the broader reuse/recycle market. The intended effect from this would be to underpin both the supply and demand sides of the reuse/recycling market. In any event, it is considered that the interface for such a system would probably best be offered via the internet - as is used for the BASIX interface. As with BASIX, a certificate would be printed off the web site proving how the required number of points will be achieved and this would then need to be submitted to Council as part of the development application and approval process. Specifically this approach would aim to:

- Make key project stakeholders such as developers, designers and construction contractors more involved in making strategic resource recovery decisions.
- Ensure resource recovery becomes a generic part of the demolition contractor’s scope of works in the project.
- Ensure that markets develop to deal with the increased supply of recovered waste and increased demand for subsequent end products.
- Create a regulatory driven impetus to reduce waste going to landfill.
- Encourage building material producers to more seriously consider re-use and recycling options as an integrated part of their operations.

An E-Commerce Market Place for Trading Timber Recovered From Demolition

One of the greatest problems for timber recycling is the small window of time in which to find a buyer for recovered timber. There is also a lack of structure and standardisation in the market to agree of salient issues and effect the sale. As a result, it is considered that an electronic market place, possibly similar to the likes of E-Bay would be useful. Key reasons for choosing such a web based approach include:

- Consumers are already familiar with similar concepts such as E-Bay
• A web based market place offers the immediacy of facilitating a fast sale of recoverable materials
• A web based market place can provide a standardised pro-forma for presenting recoverable materials including:
  o the area or amount of materials involved,
  o the generic type of timber on offer e.g. softwood or hardwood,
  o the species on offer (if known),
  o photos of the building and/or the timber on offer
  o the terms of sale including such issues as to whether or not the materials will be delivered or alternatively need to be picked up,
  o the time that is available to effect the sale

Grading Standard to Assist the Marketing of Recycled Timber
It is difficult to sell recovered timber if there is limited ability to describe its quality in a standardised way. A grading standard would help address this deficiency and should include:
• Basic colour, density, species (if known)
• Face blemishes
• Checks and cracking
• Nail holes
• Structural grading i.e. visual grading
• Trueness of shape

Recovered Timber for Blockboard Production
“No-value” timber currently poses a problem to reuse and recovery markets and as a result, it currently goes to landfill. To this end, it is suggested that short timber lengths and unwanted framing timber be considered for use in blockboard production. Blockboard is typically used as the core of solid core door manufacture. There is potential that much the same material could be used as the base in say veneer laminated floor boards, veneer laminated benchtops and other uses where an unseen underlay is required. A variant on this idea could also be used for flooring products. For instance in the case of flooring, batten size pieces recovered from small lengths – say 350 mm long - could potentially be re-milled and either glued together or joined via a dove tail type tongue and groove. The concept would be developed in a way that had a different aesthetic to both conventional strip flooring and parquetry flooring.

Expanding the Use of Specialist Timber Salvage Teams
In some areas, specialist timber recyclers have their own salvage teams that (mainly in Melbourne and Sydney) and are used regularly by demolishers for internal timber or roof timber salvage. The emphasis in this idea is simply about encouraging a broader scope of salvage with a view to recovering more timber. For instance some salvage teams concentrate on internal floor or roof timbers bur rarely both. Other timbers are often disregarded because they are perceived as being of “no-value” but this could potentially change if new end user products were developed, thus making recovery more worthwhile. As a result, this mid to long term idea concerns trying to stimulate this link in the supply chain to greater involvement by helping with training, internal system development and development of occupational health and safety practices that will meet demolisher’s requirements.
Questions Posed to Demolishers in the Case Studies

1. What is the typical sort of buildings you demolish?
2. a) What is an average size project for you?
   b) How many jobs do you normally do a year?
3. a) On a typical job, what proportion of the overall waste is typically timber waste based on weight?
   b) Would it be any different based on volume?
4. a) Where does timber waste come from on your sites
   b) Of the ones you just mentioned how common is each one?
5. What specific types of timber materials are involved (hardwood, softwood, MDF, Ply, P’board, CCA)
6. a) Do you have a typical approach (or process) to undertaking a demolition?
   b) Do you separate the timber from other waste materials onsite?
   c) What influences your decisions about whether to separate materials or not?
7. How much does asbestos, coatings and special treatments on the timber prevent you from recycling more?
8. a) To save truck space, do you break-down timber components into smaller pieces?
   b) Would you break it down enough to make a neat stack or just enough to move it more easily into trucks?
   c) Can you elaborate on why you do/don’t do this?
9. a) Do you de-nail or remove fixings from the timber to make it easier to stack or get rid of?
   b) Can you elaborate on why you do/don’t do this?
10. a) Does Occupational Health and Safety impact much on the extent to which you do/don’t process materials onsite?
    b) (If yes), What sort of issues are involved?
11. Where does timber waste from your demolitions sites typically go to?
12. Ideally, at what point would it be best to divert timber waste from your sites, to prevent it going to landfill?
13. a) Do you think there is much timber re-use and recycling from demolition waste
    b) As appropriate - What stops you getting more involved in salvage or recycling of materials
14. What could improve the situation?
15. Do you have a feel for how long buildings last before you come in and do your work?
Questions Posed to Recyclers/Salvagers in the Case Studies

1. Do you specialise in timber recycling?
2. How do you buy or accept materials
3. Do you have a minimum or maximum size load you take
4. What type of organisations do you usually get your timber from?
5. a) What sort of timber waste do you get
   b) What specific materials are involved (hardwood, softwood, MDF, Ply, P’board
6. What sort of timber don’t you accept?
7. How do you handle any re-processing of timber before selling it?
8. How much does asbestos, coatings and special treatments on the timber prevent you from recycling?
9. a) Do you ever pick up materials or set-up deals with contractors to get materials out of buildings?
10. b) Can you elaborate on why/how you do/don’t do this?.
11. a) Does Occupational Health and Safety impact much on the extent to which you do/don’t process materials?
    b) (If yes), What sort of issues are involved?
12. What do you end up selling as an end product (after any reprocessing) and what type of customers typically buys it?
13. What could improve your ability to re-use or recycle timber?