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MARKET RESEARCH: TENANCY FITOUT MATERIAL PROCUREMENT ATTITUDES AND PRACTICES

2014



ABOUT THE AUTHORS

The Institute for Sustainable Futures (ISF) was established by the University of Technology, Sydney in 1996 to work with industry, government and the community to develop sustainable futures through research and consultancy. Our mission is to create change toward sustainable futures that protect and enhance the environment, human well-being and social equity. We seek to adopt an inter-disciplinary approach to our work and engage our partner organisations in a collaborative process that emphasises strategic decision-making.

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EXECUTIVE SUMMARY

The Better Buildings partnership (BBP) has previously investigated the tenancy processes that generate waste – successive cycles of fitout, de-fit, make good and re-fit.

This research project has been commissioned to explore why waste occurs in commercial building fitouts and what can be done about it, with a particular focus on the materials that dominate the fitout waste stream. The characteristics of each material and aspects of its usage are explored to determine how to improve reuse and recycling rates.

The Institute for Sustainable Futures (ISF) conducted in-depth interviews with 15 industry participants for this study, ranging from architects and property managers through to contractors and manufacturers. We also reviewed literature to provide context, however we found the available literature somewhat limited in terms of its currency, depth and local relevance. It is the interview conversations that provide a rich picture of the myriad issues and day-to-day problems that make it hard to institute a less wasteful, circular economy. The study attempts to place the problems in the context of the whole system to highlight possible solutions.

Factors that influence resource recovery

Four factors are consistently mentioned as significantly influencing the level of resource recovery, common to all materials and stages of the fitout process. These are time, cost, transport distances and contamination.

Time and Cost

Although time and cost are two separate elements they are so closely interlinked that they can be considered together.

Short, deadline-driven time frames for design and construction, combined with tight budgets for consultants and for construction really limit the ability to investigate or consider alternatives. This gears choices towards the quickest and most familiar option.

New materials are so cheap that the additional handling and transport required makes reused or reprocessed materials unable to compete.

Economics rules: if money can be made then someone is already doing it. A clear example is that very little metal makes it to landfill because its value is easily recognised and there is a simple process to sell and recover it.

Transport Distances

There is so little manufacturing in Australia, and we are so geographically dispersed, that the cost and effort to transport materials back to processing plants can't compete with new materials, and even prohibits some material recovery.



Contamination

A very significant limitation is contamination, in terms of both the reality and the risk.

Contaminant materials disrupt the production stream, equipment gets damaged, and there is a high cost to sort and check loads.

Composite materials can't have materials separated economically for recycling or, in some cases, at all.

Other barriers and issues

A range of other issues that influence resource recovery were identified, including:

- Limited consideration of 'end of life' at specification stage
- Limited uptake of product stewardship schemes
- Resistance to use of second hand materials from a quality and aesthetics perspective
- Limited opportunities for waste segregation on sites
- Sending products to landfill is still too cheap and easy
- Green leasing, which could drive waste reduction in fitouts, currently seems to have very limited traction

Context

We examined the standard fitout materials with a view to how they could be salvaged, reused, or recycled - but before we even get to that point, the preferred answer would be to reduce the turnover in fitouts in the first place. And there is hope here...

Leasing Processes

Although the conventional approach for end of leases is that tenants 'make good', there appears to be a trend towards cash settlements where tenants are leaving their tenancies intact and paying a cash contribution to the landlord instead. This creates better opportunities for incoming tenants to use the existing fitout, or minimise changes, rather than installing something totally new. As a consequence, by avoiding the make good-showroom-refit cycle, two or three rounds of materials changes are avoided each time a space is turned over. Landlords are working with incoming tenants to integrate the previous tenant's make good with new work.

This is primarily driven by a leasing market that is tight at present, with new tenants looking for space that is already fitted out. The opportunity is to embed this as a legitimate and standard procedure before the market softens.



Industry attitudes, knowledge and practices

The level of demand for sustainable materials and good waste management experienced by the interview subjects varied with materials and products and depended on which segment of the market they do business with.

The level of demand in the construction industry for salvaged, second hand or recycled content materials, or a waste management program, is very low and patchy. It seems that the best indicator of whether or not there is a demand is where projects seek a formal Green Star rating.

The study found that very little to encourage waste minimisation is included in standard documentation and, even where it is, it is not consistently applied.

Materials

In the interviews we asked participants to identify the main materials in the typical fitout waste stream. The same few materials were consistently nominated as the main contributors:

- Plasterboard, with or without the framing and other partition elements
- Ceiling tiles, with and without the grids
- Carpet
- Packaging
- Furniture, particularly workstations, and the resultant MDF and particleboard

Workstations are a good illustration of the problems in the system. To be reused off site they need to be assessed, dismantled, transported, cleaned, repaired or refurbished, stored, transported back, and reassembled. When a new workstation can be purchased at a similar price; and when the specifier knows they can get the quantity and finishes they want, in a known time frame, and source and order them without leaving their desk or taking any risks about quality, why would they put in the effort?

One way to streamline this for salvaged items is for a business to take responsibility for assessment and refurbishment, documenting each item, adding it to an inventory and displaying it online so that all the information the specifier needs is available and the risk reduced. But the industry has to be prepared to buy the product so that there is sufficient turnover to make a business out of it.

In the absence of reuse and recycling options for the constituent materials, primarily **MDF**, waste to energy is an alternative that bears further investigation given its prevalence in the waste stream.

The materials presented as case studies are primarily those identified as the main waste contributors. Additional examples are included to illustrate the range of difficulties faced by the industry and the opportunities available to it. The case studies do not purport to be comprehensive analyses of the industries concerned, but together demonstrate the



complexity of the waste avoidance question and show that each material and each problem needs to be tackled specifically. There are recurring issues that can be solved by systemic change, and these are addressed by this study.

Glass

Very little glass ends up in landfill due to its weight and the associated cost, and the ease of access to alternative recycling uses. Equally, very little is recycled into its original use because of the contamination risk to the continuous production line. A key reason for not salvaging glazed assemblies is that the sizes are not standardised. To address this designers would have to adapt plans for new work to accommodate the found sizes, or alternatively, be more disciplined about specifying standard sizes.

Plasterboard

Although in principle the gypsum core of plasterboard could be recycled into new plasterboard, the reality of site contamination, the labour intensive collection and sorting, and the difficulties of cost effectively removing the paper face mean that this is rare for material sourced from commercial fitouts. The best waste avoidance solution is demountable systems, but these are not commonly used. The down cycling option of grinding gypsum for agricultural use is limited by transport distance and cost. Plasterboard was universally nominated as a material that is always found in the waste stream.

Ceiling tiles

The low cost of new ceiling tiles means the economics of recycling do not work in Australia, despite the large quantities of waste generated. The transport costs make the limited recycling opportunities unattractive. Aesthetics and poor management drive much of the replacement demand. Being modular, whole ceiling assemblies – grids and tiles – are suitable for reuse but the handling time and cost make it uneconomical. Its primary fate is landfill. The cardboard packaging of new tiles also creates a high volume of waste, although it can be recycled in the paper stream. Integrated fitouts where make good or new build ceilings are not installed prior to tenant designs will avoid a wasteful removal of good ceilings, as will building management control of products used.

Metals

The widely recognised value of metals and the ease of access to cash-paying recycling merchants means that any wastage is recovered at every stage of the process and very little is sent to landfill. Even then, the residual material that does arrive in landfill is mostly recovered. The ease of recycling makes the handling costs of salvage uneconomical.

Although very little metal contributes to landfill quantities, avoidance, retention and reuse of material are higher on the waste hierarchy than recycling. Specification of modular products and design for standard dimensions would reduce site offcuts. Dismantling to recover material for reuse also needs to become more prevalent.



Carpet

Carpet tiles have a reputation as a material with active product stewardship in place, which is the case for a small number of manufacturers who use overseas facilities for recycling. Australian manufactured product is subject to long transport distances and quantities too small to make recycling economical. Rearranging the wear pattern of tiles to increase their lifespan is not common despite this being a claimed major benefit. Aesthetics is the main driver for changing flooring. There is a small market in resale of second hand product. Most material goes to landfill, with some incinerated. More attention at specification stage to end of life options and recycled content is required, as well as good maintenance during product life and a take-up program for carpet tiles that is understood by the building owner.

Resilient vinyl flooring

Recycling of clean vinyl flooring such as offcuts is feasible, but colour mixing limits the new product to a black-pigmented range. Transport distances, and contamination risk from competitors' products that use unacceptable ingredients, limit recycling of demolished flooring tiles. Demolished sheet is not recycled due to cementitious contamination, and the logistics of mixing it into tile production. Although most vinyl flooring goes to landfill, it could be used for waste-to-energy, subject to EPA approval.

Recommendations

This study surveys the breadth of the industry and attempts to identify the small disconnects in the industry systems that combine to create seemingly impassable barriers. The recommendations of this report draw out possible solutions from the rich pictures of industry practice.

BBP wishes to actively contribute to the solutions. The recommendations have been grouped into those that BBP or its members can implement directly, and those that their combined industry power can influence. Some new business or enhanced market opportunities have been identified which, although outside the direct influence of BBP and its members, could be supported by this cohort through commercial support, investment or promotion. Some of the possible solutions are much broader, requiring political will or legislation, community support, or funding, where BBP could play an advocacy role. These have been included for a complete overview of the study findings.

Suggestions for BBP and its membership

Attitude is a key element of getting the practices right. BBP's role in changing attitudes can be twofold:

- providing sufficient information, support and awareness raising for participants to be aware of the issue, and where to go to get information or help.
- engaging the industry, so waste reducing practices become preferred practice.



There is a pressing need to **improve industry understanding** of good practice, and the role each practitioner plays in reducing waste to landfill. Lack of awareness of where and how a practitioner influences the waste outcomes at the end of the functional life of a fitout means they are often making poor decisions or missing good opportunities.

BBP could address this through:

- Awareness campaigns to bring these matters to the attention of practitioners, owners and prospective tenants;
- Making information available for those seeking guidance on the where and how of waste reduction;
- An education program for a deeper understanding of how to improve practice more systematically.

BBP members can contribute directly to the delivery of these activities and can ensure better advice, standards, documentation and enforcement are implemented in their own practice and properties.

Practices to achieve better results include:

- activate the waste hierarchy;
- build requirements into contracts and enforce them;
- specify and use recycled content materials. The market for these products needs to be strengthened.
- provide information about what materials are hazardous and how to dispose of them.
- change property industry expectations of the time required to undertake design and construction work
- End of life considered at start.
- identify and promote reuse options to specifiers.
- Design to standard product dimensions
- incorporate maintenance and product stewardship details into operation and maintenance manuals; the documentation should follow the materials.
- Site separation of waste loads to facilitate recycling of material
- Site management to reduce instances of cross contamination and rubbish in bins.

Lease arrangements lock in obligations for tenants. A review of standard leases, and promotion of alternative arrangements such as integrated fitouts will open opportunities for less wasteful practices at end of lease.

BBP and its members can contribute by:

- commissioning new standard leases, design standards, and materials specifications and making them widely available,
- raising awareness within the industry of alternative practices,
- promoting existing good examples of documents and tenancy arrangements,
- implementing best practice in new leases.



BBP influence

Tenants responsible for their fitout decisions can enforce requirements through leases, consultant agreements and construction contracts. BBP can offer advice and assistance.

Range of tenant responsibilities includes:

- Seek floor space with existing fitouts, to be reused;
- Reduce tenancy churn;
- Reuse their own existing furniture and fittings in new premises;
- Require Waste Management Plans be included in construction contracts;
- Encourage widespread use of second hand and repurposed materials;
- Require use of materials with recycled content;
- Allow sufficient design and construction contract time for good practices;
- Require products to be fully specified and reject substitutions;
- Contract for product lease and take back options;
- Keep and use easily discoverable records of maintenance requirements, product stewardship contracts and spare material.

There may be an **advocacy role** for BBP to work with the **EPA** on problematic recycling cases, and to act as a bridge to proponents with an interest in implementing innovative solutions.

BBP could **advocate with eco-labelling schemes** to ensure the end of the product's life is adequately accounted for.

Beyond the influence of BBP

New and enhanced business opportunities become available with reduced use of landfill. The role of BBP and its members would be to promote and patronise businesses that address these needs.

- An online inventory of second hand products, by an organisation that repairs and refurbishes products, could grow the market in reuse.
- Access to a good "ecosystem" of operators who collect, assess, sort, stock and refurbish products.
- good ongoing maintenance and cleaning of fitouts, and the repair of damaged fixtures and equipment
- Localised reprocessing plants to reduce transport distances.
- Innovation is required to develop ways to recover materials that currently involve cost-prohibitive manual handling.

Wider impact recommendations

Effective **product stewardship** requires changes to the mechanisms currently in place. BBP can influence the first two aspects through industry education and awareness raising:

- Innovation in how materials are taken from site;

- Designers and specifiers to understand take-back and leasing, take responsibility for incorporating into the procurement process, and provide the documentation that records the commitment.
- Manufacturers to match their offers with real capacity to efficiently use returned material.
- Include the return transport cost in the initial capital outlay for the material,
- A take back commitment should be attached to the product not the purchaser
- Reprocessing plants located near to the main urban centres.

The way a product is designed and manufactured, the information made available about it, and consideration for its full life cycle are the **responsibility of manufacturers**:

- The use of composite materials should be avoided.
- everything to be recyclable.
- Clear labelling of material content
- Offer and promote customised material sizes,
- include a maintenance program in the sale cost.
- 'vertical integration' for materials handling
- Provide Environmental Product Disclosure (EPD) statements for all products.
- Provide Material Recovery Notes (MRN) to advise practitioners on what to do with a material at the end of its life.
- Plan for the end of the product life.
- Reduce packaging.

A number of materials do not have end-of-life options and warrant further **research** to remove the problem. This could involve alternative materials to serve the function, alternative manufacturing of the material to make it recyclable, or discovery of new uses for the old material.

Of all the solutions that were identified during the course of this study, the overriding one is to increase **landfill** fees. If the cost to dump materials increases, the cost of retention, alternative uses and recycling become more attractive and competitive. Ban mixed loads to landfill.

Waste to energy facilities to recover embodied energy from residual wastes that are not able to be recycled and would otherwise be disposed of to landfill



1 INTRODUCTION

The Better Buildings Partnership has commissioned this research project, to explore why waste occurs in commercial building fitouts and what can be done about it. In the conventional leasing cycle, significant waste is generated as office tenancies are vacated and new tenants move in.

This research explores the general context for office fitouts and the influence of industry attitudes, knowledge levels, norms and processes. However the major focus is on identifying the high-volume materials in the fitout waste stream and exploring the factors that influence the likelihood of their retention, reuse or recycling.

The research methodology comprised a literature review and interviews with a diverse range of industry stakeholders who influence fitout waste. This group included designers/specifiers, fitout contractors, project managers, property managers, suppliers, manufacturers and recycling contractors. The manufacturers were chosen to correspond to the high-volume materials found in the fitout waste stream. As we found limited current Australian literature on the topic, the main focus of this project was primary research with stakeholders via the interviews.

Report Structure

Section 1 introduces the project, Section 2 describes the research methodology, Sections 3 - 6 present the findings and Section 7 provides conclusions and recommendations.

In terms of the findings:

Section 3 sets the context. It quantifies the waste problem, describes factors in the leasing process that affect waste quantities, and details the materials found to make up the majority of the fitout waste stream.

Section 4 addresses industry attitudes and knowledge, presenting findings about demand for waste reduction measures and what practitioners perceive the problems, barriers and solutions to be.

Section 5 focuses on processes. It explores how the specification and procurement processes influence outcomes and documents the key process-based enablers and barriers to waste reduction.

Section 6 contains case studies for the main materials in the fitout waste stream: glass, plasterboard, ceiling tiles, metal, plastics, and carpets. It describes the flows and fates of each material to illustrate the issues faced within the industry.

2 METHODOLOGY

Literature Review

A brief literature review was conducted to identify and review relevant literature on the topic. Our focus was on Australian literature for local relevance, although international literature was also included to highlight possible innovations and lessons that could be applied locally. The findings of the literature review informed the development of interview questions, in particular to enable us to fill the gaps not addressed by the literature.

Given the limited available literature on the topic, stakeholder interviews are important to ensuring this research is current and representative of the key challenges facing industry practitioners.

Interviews

Interview subjects were chosen in consultation with BBP to represent the range of industry practitioners who participate in the manufacturing, selection, handling and recycling of materials in commercial tenancy fitouts. A list of interview subjects is provided in Table 1 below. They were telephoned to request their participation or recommendation of a suitable person from their organisation. In advance of the interview, subjects were emailed a description of the study, a summary of the questions, and the ethics parameters. A sample of the email is provided in Appendix A.

Interviews were conducted by telephone or face to face.

The interviews were semi-structured and presented conversationally to explore a similar range of topics with each participant, but took account of the different perspectives involved. The conversations for each group of participants addressed:

- Architects, interior designers and project managers, as materials specifiers - awareness, attitudes, perceived barriers, system failures and major waste materials
- Owners, tenants, managers - awareness, attitudes, perceived barriers, impacts of balance sheet treatments or depreciation
- Contractors - awareness, attitudes, perceived barriers, system failures, major waste materials, site processes
- Material suppliers and manufacturers - material reuse and recycling capabilities and limitations, prevalence of and barriers to product stewardship schemes

The full list of questions is provided in Appendix A.



Interview subject's position	Role Company Type
Associate, Interior Design	Interior Design
Architect	Architect
Director	Project Manager
Management role	Property services Property manager
Management role	Property services Property manager
Director	Contractor- commercial building refurbishment
Project role	Fitout contractor
Management role Architect	Fitout contractor Furniture manufacturer Joiner
Management role	Commercial ceiling system manufacturer 1
Management role	Commercial ceiling system manufacturer 2
Director	Waste recycler
Management role	Plasterboard manufacturer
Management role	Glass manufacturer
Director	Carpet tile manufacturer
Management role	Vinyl (PVC) flooring manufacturer

Table 1: Interview subjects

3 CONTEXT

3.1 FITOUT AND LEASING PROCESSES

The conventional commercial tenancy undergoes a constant cycle of fitout, deficit, make good, upgrade and new fitout. Although each intermediate step is temporary, its removal generates significant quantities of construction and demolition waste. The wastefulness of this cycle is generally recognised within the industry but accepted by some as the cost of doing fitout work, whilst others actively avoid waste creation. Currently the supply of tenancies is outstripping demand, creating leasing conditions that are driving more efficient approaches.

The greatest amount of waste is generated when a tenant leaves a space and it is prepared for or by the following tenant. There is also churn within the lifespan of a tenancy, as a tenant makes alterations to accommodate changes to workforce numbers or workplace arrangements.

Our interview subjects described several alternative approaches that reduced the time and cost for landlords and tenants as well as reducing waste generation. These could guide the industry in widespread changes to reduce waste. However, education is required to ensure all stakeholders understand that these options exist and what needs to be done, and are able to accept a different standard or order of events.

Retaining existing fitout

One property manager advised the default position is that prospective tenants view a space while the existing tenancy is in place, and many then elect to retain the old fitout. Having some fitout in place may make the space more attractive to lease, both demonstrating how the space can accommodate the tenant, and offering a head start on the fitout. Alternatively, unless the existing fitout is obsolete, only one floor of many is cleared to demonstrate how the space may look but the balance is retained. In the currently tight leasing market, to make a space more attractive some leasing agents are fitting out empty buildings ready for new tenants. Some clients who would have previously invested in fitouts are looking for existing fitouts that match their needs reasonably closely in order to reduce the capital cost of taking new space, and they take incentives as lower rent or cash in pocket instead of contributions to fitout costs. “In the current market no one has any money.”

An alternative view was expressed by one of the architects who has experienced trying to fit a prospective tenant into an existing tenancy that did not suit their needs. In this case the tenancy did not proceed.

Make good deeds

One project manager described an arrangement designed to remove the “showroom” step, which is accepted by a large proportion of her client base but probably not reflective of the wider market. A conventional make good schedule is prepared, costed and a deed

agreed. If the landlord can lease the space as is within an agreed timeframe, the outgoing tenant can walk away. Only the cost of work that is needed for the new tenant is deducted, so the outgoing tenant may avoid the full make good amount. The new tenant gets the fitout for very little cost, if any. They may elect to make limited changes only, typically such as a new reception lobby. All three parties benefit in time, cost and effort. A more detailed discussion of this, and a sample deed, can be found in *Greening Make Good Australia* (RICS Oceania, 2009)

Cash settlements

There appears to be a trend towards cash settlements over 'make good' by tenants. Instead of organising the make good themselves, tenants are walking away from their tenancies, leaving everything in place, and paying a cash contribution to the landlord for refurbishment. The landlord having responsibility for and control over the works leads to opportunities for more innovative arrangements.

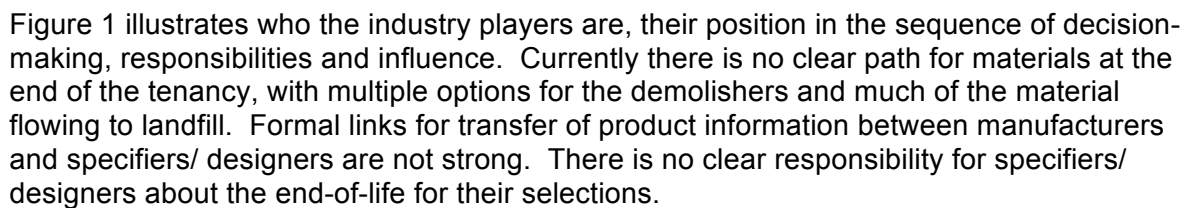
Market variability

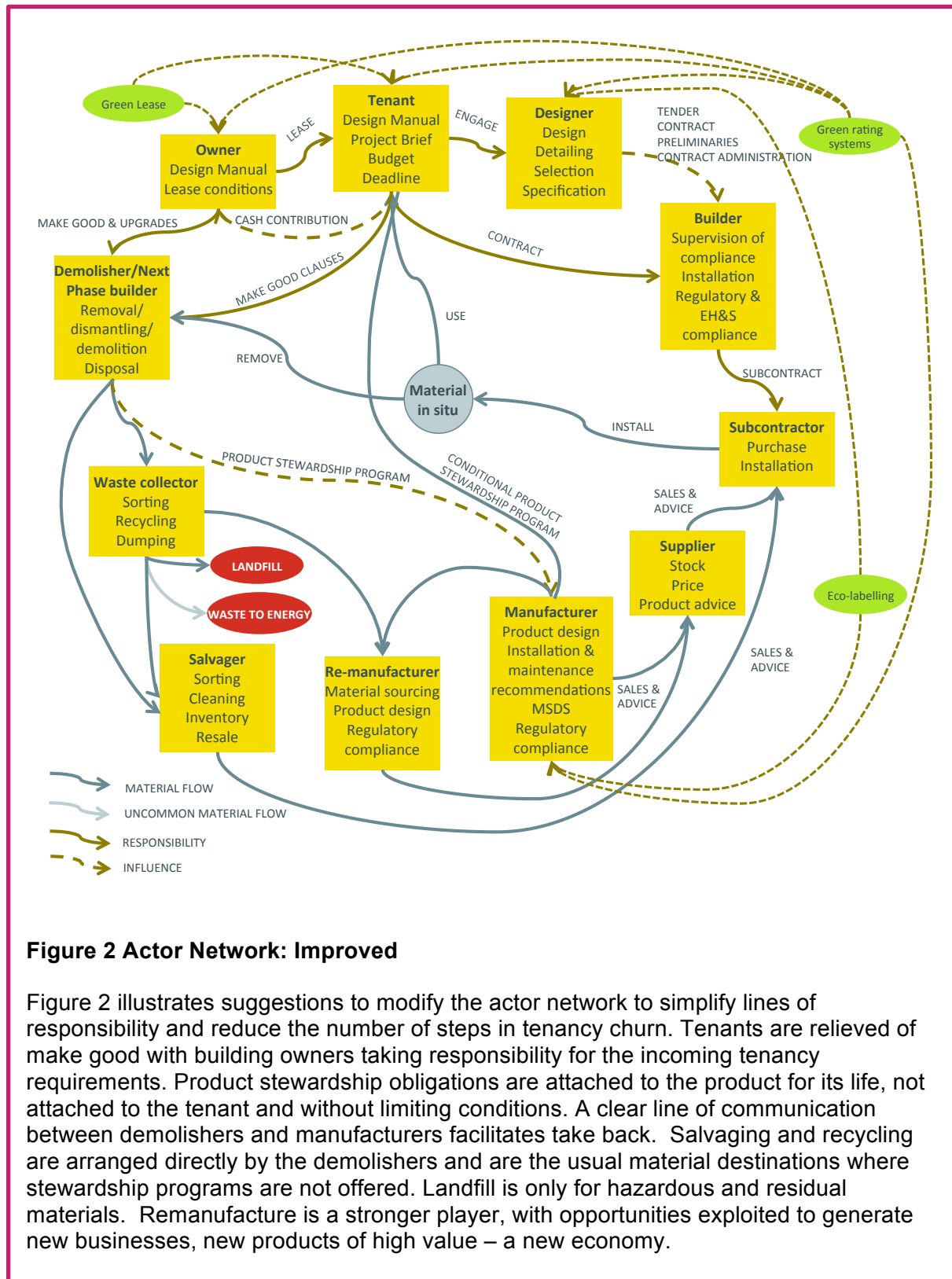
Another property manager advised a variable strategy depending on how well the old fitout presents. They too are finding that cashing out by exiting tenants is more prevalent. Some new tenants do retain the old fitout for reuse, particularly short-term tenants such as teams working on temporary projects who need a base separate from or additional to their head office. In these cases the detail of the fitout is not a priority compared to getting the project up and running.

By contrast, the main work of one of the contractors interviewed is in building upgrades, where base buildings works such as foyers, lifts, wet areas, ceiling and lighting are refurbished. Building owners wishing to market empty spaces recognise styles have changed over the last 15 years (lease period) and need to keep their buildings up to date. Even so, the contractor also noted spaces where some fitout is retained for the temporary market.

The view of another contractor is that the opportunities for reuse are better in B, C and D grade buildings, and in metropolitan and regional centres, compared to higher grade CBD buildings.

The experience of one architect is that how much, if any, of an existing fitout is retained is very dependent on clients, the attitude of the designer, and the available budget. Clients with bigger budgets are more likely to want their own look, down to replacing carpet. Those on a tighter budget are more interested in flexibility rather than quality and are less particular about items such as carpet.





3.2 PROBLEM MATERIALS

There was a general consensus on problem materials, with interviewees consistently nominating the same few materials as the main contributors to the waste stream. These were **plasterboard; ceiling tiles; partitions including plasterboard, studs, glass and aluminium; ceilings including tiles and grids; carpet and underlay; and packaging.**

The flows and fates of glass, metals, plasterboard, plastics, ceiling tiles, and carpet are explored in more detail in Section 6. The section below documents issues with other materials that were nominated during the interviews.

Furniture and joinery

Furniture, particularly workstations, was a concern for many. A project manager described how refurbishment companies are limited in what they will take, looking for near new product, or a certain look that they consider re-sellable. She gave the example of a recent project with good quality, good looking, functioning furniture that she couldn't even give away because the cost of dismantling falls to the contractor; the project will have to pay for the dismantling to have it removed from site. One of the contractors contacts dealers who cherry-pick what is reusable then the rest goes to landfill. A property manager also listed workstations as a major waste contributor when tenants pay the cash contribution in lieu of make good, and there is a limited market for the desks. Another contractor added that there is a lot of reuse in the second hand market but there is a massive volume coming through and that due to transportation the cost of second hand can be greater than new.

MDF

Included in the description of furniture is joinery. Both joinery and workstations are constructed primarily of engineered wood products – mostly medium density fibreboard (MDF), but also particleboard and plywood. The recycler sends tonnes of engineered timber material to landfill daily because EPA does not allow toxic glues to be reused and the material cannot be salvaged without each load being tested, the cost of which is prohibitive.

With the quantities of workstations that are not being reused, and the difficulties faced by the recycler in avoiding sending MDF to landfill, MDF is a significant material by volume to landfill, with limited current alternatives. Higher order uses need to be explored. A patent has been lodged in the UK for returning it to wood fibre for use in a number of applications, but it does not appear to have proceeded. In the absence of other alternatives, waste to energy is an option that bears further investigation.

Timber

Solid section timber of any size tends to be kept and reused by builders. The recycler advises that any clean timber they get is shredded for garden mulch. The quantities they handle are huge so niche recycling makes no discernable impact, otherwise the company



would do it. Also manual handling is required to sort, clean and stack, which is expensive and has OH&S risks, for example with nails, so it is not commercially worthwhile. The company can't risk giving the public access to commercial facilities to pick timber for themselves as is done with some council facilities, so that is not an option either.

Fibre cement sheet

Although fibre cement sheet was mentioned only in a few interviews, those who did mention it raised serious concerns about the lack of alternatives to landfill and the quantities involved. One ceiling manufacturer is able to recycle freshly manufactured material but once it is autoclaved there is no possibility for reuse and it is sent to landfill, other than a tiny quantity of off-cuts used as packers for roof tiles. The recycler confirmed that the only option is to send it to landfill, although there is a liming value for agricultural use if EPA would allow it to be ground up. The company indicated that this does occur in regional locations, but the transportation of product from urban areas for reuse in agricultural regions is not commercially viable.

Packaging

One contractor suggested packaging as the problem that could be resolved to achieve the single biggest impact on reducing landfill. The materials nominated are protective plastics, foams and cardboard. One of the architects supported this view. The contractor acknowledged the need to protect products from damage and breakage but lamented the result, giving examples such as individual boxes for each light fitting, and boxes of tiles with a thin sheet of protective foam between every second tile. One of the ceiling manufacturers commented that the option is to recycle the cardboard boxes from new ceiling tiles. They cited the example of a company in the USA that had investigated alternative packaging arrangements such as in bulk or palletised but had returned to the boxed arrangement, which suggests that it is needed for product integrity. A huge amount of waste is generated that is light but voluminous, but the cost to remove it is still per bin, so it becomes a major site penalty. By contrast, the contractor gave the examples of pallets and cable drums that have a high value in money back when they are returned.

Other materials

The flooring manufacturer suggested laminate floors as a problem; that is particleboard with synthetic wood-look coatings.

One of the property managers listed floor and wall finishes especially tiling, colour back glass and fabric.

A contractor was concerned about light fittings, especially fluorescent tubes and the difficulties of disposing of the hazardous content.



3.3 NEW MATERIALS

In the interviews we asked about any new materials that people were specifying or seeing used, with a view to predicting future problems the industry may find in the waste stream and acting before it becomes entrenched.

A project manager named composite timber, the synthetic timber made from sawdust packed resins.

One of the architects named oriented-strand board (OSB), an engineered wood product.

Another architect is very concerned with the proliferation of composite materials. Examples given were foam-backed products, foam adhesives and gaskets, and the use of strong glues that prevent clean separation of dissimilar materials. Another example is fire-rated sheet lining products that achieve the rating through the addition of fibreglass. He suggests some manufacturers have a very narrow definition of what is environmentally sound and do not mention problematic ingredients, or the lack of recyclability.

This architect also nominated MgO board, a magnesium oxide sheet lining and cladding material that is marketed as eco-friendly, made of waste material, and is water resistant and lightweight.

A contractor has noticed increased use of solid plastic surface materials like acrylic and polyester resins. The trend within their company is to reduce the use of MDF, with plywood being the main alternative.

3.4 FITOUT CHURN RATE

Understanding how frequently fitouts are replaced, or 'churned' helps to determine the size of the waste problem this generates. In this section, the size of floor areas affected are calculated against a total floor area for offices in the Sydney CBD of just over 4.9 million m², as at the first quarter of 2013 (Jones Lang LeSalle, 2013).

The age of a fitout at the time of its removal varies between 2 and 20 years according to our interview subjects. The average seems to be in the range of 5-15 years, and reflects lease periods; for example 3+3+3 or 5+5, meaning 5, 6, 9 and 10 years are common. Near new fitouts may be left vacant if a business collapses.

One of the property managers quoted the *Office Churn Research Report* from Facilities Management Australia (FMA). According to this report, the average churn rate in Australia, that is reconfiguration due to people turnover, is 8-15% (392,000 - 735,000m²/annum).

One of the ceiling manufacturers, whose business supplies the CBD refurbishment market and relies on tenants moving and churn, sees seven years as the norm for the life of his product (700,000m²/annum).



Beyond these estimates our interview subjects could not quantify the age, proportion or frequency of churn. It does not appear to be measured or particularly noted, and nobody had sufficient overview of the market to make a more comprehensive assessment.

In the *Scoping Study to Investigate Measures for Improving the Environmental Sustainability of Building Materials* (Centre for Design, 2006) commercial fitout turnover is estimated at 10 - 20% of gross floor area per year (490,000 - 980,000m²/annum).

This correlates with a 5-10 year age estimate. The report *Waste and sustainable commercial buildings*, (Terry, Moore, Casey, & Andrew, 2008) notes that “[f]rom Investa’s experience, according to Craig Roussac, the fit-out churn range in Australia is between approximately 7.5% and 11.5% per annum, which means that the average life of a typical office fit-out is just over ten years.” (367,500 - 563,500m²/annum)

3.5 QUANTIFICATION

Interviews

This study was unable to quantify the size of the waste problem through the interviews. Subjects either did not collect the information or held it as commercially valuable. The recycler commented that they are unable to readily differentiate the sources of construction and demolition (C&D) waste loads between construction, demolition, refurbishment or fitout.

Green Star credits waste management plans where the implementation is verified through retention of dockets and reporting of quantities, but these procedures are only undertaken where a formal Green Star rating is in place.

One contractor advised that as a company they aim for at least 70% recycling of the waste from their projects, but only some jobs request dockets. On their campus projects, bins are often shared between sites or trades so it would be hard to allocate any of the waste to a single project.

To quantify the waste, individual building companies could be requested to supply their records for projects where these were kept, then extrapolate the figures pro-rata with the size of the industry. Alternatively, records of the source of a load could be kept at recycling centres and landfill sites and reported back to a data collector, in the same manner that hazardous waste is tracked in some jurisdictions.

The carpet manufacturer made an educated estimate of the size of the carpet waste problem through the size of the market. The commercial carpet market in Australia is 30 million square metres annually, of which 30% is tiles. Refurbishment accounts for 80% of this, leading to the conclusion that there are around 8 million square metres of tiles and 16 million square metres of broadloom removed from commercial premises every year in Australia.



A ceiling system manufacturer estimated that approximately 160,000m² of ceiling tiles and grid are refurbished in Sydney each year due to churn and make good maintenance.

Literature

Little information was available in the literature. Figures were over a decade old, from international sources and/or addressed construction and demolition waste too generally. Where quantities were discussed it was often in terms of the proportion of each material to landfill, recycling or reuse, and not absolute amounts.

The difficulty of quantifying fitout waste is illustrated by the *Report into the Construction and Demolition Waste Stream Audit 2000-2005* for the Sydney Metropolitan Area (Department of Environment and Climate Change NSW, 2007). The C&D waste data it contains is the most recent available on the EPA website. The data does not differentiate fitout from base building or civil construction and therefore the figures cannot be applied directly to this study. The major materials the report identified are heavy ones such as soil and concrete, not surprising given the methodology determined quantities by weight (tonnes) rather than volume.

Material type	Quantity tonnes	Expected range tonnes
Concrete	103,000	70,000 – 130,000
Fines (<4.75mm)	97,000	75,000 – 115,000
Timber	90,000	60,000 – 120,000
Clay products	40,000	30,000 – 50,000
Natural aggregate	25,000	20,000 – 30,000
Ferrous metals	23,000	15,000 – 30,000
Plasterboard	17,000	10,000 – 25,000
Paper and cardboard	14,000	5,000 – 25,000
Plastic	13,000	5,000 – 20,000
Garden and vegetation	8,000	5,000 – 15,000
Textiles	6,000	1,000 – 15,000
Non-ferrous metals	3,000	1,000 – 5,000
Glass	2,000	1,000 – 5,000
Asphalt	1,500	1,000 – 2,000
Miscellaneous	8,000	5,000 – 10,000
TOTAL	450,000	

Note: Expected range is at a 90% confidence. For example, we are 90% confident that the true quantity of concrete in mixed C&D waste is within the range of 70,000 to 130,000 tonnes.

Table 2 Estimated quantity of Material Types in Mixed C&D Waste disposed to Landfill in the Sydney Metropolitan Area, 2004-2005 (Department of Environment and Climate Change NSW, 2007)



Of the materials that are commonly found in fitouts, ferrous metals, plasterboard, paper/cardboard, plastic, textiles, non-ferrous metals and glass are counted in the report under minor materials, which together with other materials are listed as “other” and make up 11.4% of the C&D waste disposed to landfill 2004-2005. Only timber is listed under major materials. Timber makes up 7.1% of the waste stream, and comprises both solid sections and engineered board. The report estimates the quantity in tonnes of material types, reproduced above.

The most applicable reference was *Waste minimisation in office refurbishment projects: an Australian perspective* (Hardie, Khan, & Miller, 2006) which focused on refurbished office buildings, not specifically fitouts, and provided tables showing the proportion of each material going to each destination.

“Landfill was the principal destination reported for most fittings removed from refurbishments except for suspended ceilings, partition walls, workstations and glazed partitions. Workstations were commonly reused both on and off site (35% each category). Very little recycling was reported for fittings.”

“The majority of all finishes removed during refurbishments end up in landfill and no recycling on site was reported.” pages 4-5

The same authors produced *The efficacy of waste management plans in Australian commercial refurbishment projects* (Hardie & Khan, 2012) in which they state:

“One of the experts interviewed for this study estimated that a 1000 square metre office refurbishment is likely to generate an average of 130 cubic metres of waste.” pp 2-3.



4 ATTITUDES AND KNOWLEDGE

4.1 LEVEL OF DEMAND

The level of demand for sustainable materials and good waste management experienced by the interview subjects varied with materials and products and depended on which segment of the market they do business with.

Specifier perspective

For the consultants, demand from owner, landlords and tenants varied with the quality of the building, the budget for fitout work and the client's market position.

One architect finds that clients like to think they demand green materials but will ask to match Green Star requirements without enforcing them through a formal rating. The architect thinks it is more a 'feel good' position without real understanding. Clients don't have a fixed position on whether or not second hand materials would be acceptable, but would need to see the material on a case-by-case basis. In the architect's experience most corporate clients want things to be new, indicating a care for their staff. The way an office is presented affects attraction and retention of staff. Not for profits would be the type of clients that may consider reused items.

A project manager finds that, despite good intentions, cost is always prioritised over environmental impact in material selection. Energy efficiency is typically addressed in fitouts because it affects the bottom line. The smaller tenancies and smaller landlords have less flexibility and less interest in materials questions.

Another architect's experience is that clients do expect or accept green materials. The company has a strong sustainability agenda that drives consultant consciousness about their selections, which translates to the built outcomes. The architect hasn't noticed any difference in market segments; the acceptability of reused materials depends on a well-conceived approach to incorporating them and the way the design is presented to the client. Clients are open to it when educated about the design benefit and from a cost point of view.

Property manager perspective

For property managers the demand from building owners and tenants is shaped by the state of the leasing market.

One property manager has found that project teams looking for temporary space are the most likely to reuse an existing fitout; as is frequently occurring in Perth at the moment within the mining sector. On the other hand, most corporate tenants have custom requirements for their offices, such as ratio of desks to meeting rooms and appearance of the reception space, which they perceive makes it harder to adopt an existing fitout.



Another property manager operates primarily at the upper end of market. For many building owners a good Green Star rating is a feature of their base building. These owners may push for the Green Star rating from tenants' fitouts to maintain the prestige of building. The mechanism for this can be a design manual or fitout guide, if not a direct requirement for a rating, referenced in the lease conditions. In some instances tenants negotiate an alternative approach to Green Star compliance from that dictated in the building Design Manual.

Contractor perspective

Builders and suppliers are clear that cost drives selections and procedures ahead of other criteria.

One contractor is concerned by specifications that prohibit the use of second hand materials, requiring that they must all be new. This has been the case with government projects. Also in specifications, 'equal and or equivalent clauses' don't work because they facilitate substitution of poorer standard products that don't meet performance or environmental criteria, because owners, building managers, and facility managers don't have the same level of understanding or education as designers to make this assessment.

Another contractor doesn't believe that the use of high-recycled content materials would be problem for their client base, but they don't think there are many of these products on the market. Because services need to be state of the art, older model equipment, for example light fittings, would no longer meet standards and could not be reused. The contractor believes all the contractors they work with have Waste Management Plans (WMP), but the quality is variable and the extent to which they are used would depend on the project. If there is a contractual obligation to minimise waste it would be done, otherwise they do whatever is most profitable.

A third contractor is seeing lots of interest from architects in the environmental impact of materials, especially off gassing; and believes they are driven by client requirements. The company is seeing improvements to specifications. It promotes sustainability within its own organisation and it is a point of discussion in staff meetings. When it offers alternative cheaper, more quickly obtained products it also includes sustainability criteria.

Supplier perspective

The flooring manufacturer is seeing no client-side demand for recycled content; it has no influence. The market is in a high design and construct (D&C) phase at the moment and clients only care about price. Performance and appearance may also be taken into consideration, but environmental impact is not. If a project is seeking a Green Star rating it will affect selections. The same view is held by one of the ceiling manufacturers. Even when the choice is cost neutral contractors don't see value in recycled content or environmental criteria. In this company's view, architects only select by environmental impact if driven by client directed obligations. The company is producing new products to



respond to the increasing number of 'green' designs that eliminate ceilings, to alleviate the resulting acoustic problems.

Nor is the other ceiling manufacturer seeing a market demand for recycled content. In their view, the new product is too cheap for a salvage market to compete. The business case for recycling may make sense if manufacturing and selling are in a close geographic area. Some architects do seek recycled content but they don't place sufficient value on it to affect specifications, although if the options are cost neutral some specifiers may deliberately select environmentally preferred products.

The carpet manufacturer finds that demand for green material has grown, he believes at the request of the end user. It is driven by the building owner or facility manager because Green Star influences the rental value of space. Flooring forms part of the leasing arrangement so any reuse of materials may be driven further down the contracting and installation chain and not seen by manufacturers.

The glass manufacturer is seeing increase in the market in use of glass and the performance of glass in building envelope because of drivers towards increasing daylight, but reduced use in fitouts due to open plan designs. As producers of the primary material they have less connection with specifiers to comment on market demand for material content.

Because the plasterboard manufacturer does not recover the cost of recycling they do not heavily promote their capacity. The demand for take back of their product is not matched by a site commitment to purchase material with recycled content – again cost drives the decision.

4.2 DRIVERS OF DEMAND

As reported in the preceding section, the level of demand in the construction industry for salvaged, second hand or recycled content materials, or a waste management program, is very low and patchy. It seems that the best indicator of whether or not there is a demand is where projects seek a formal Green Star rating.

This extends to the use of eco-labelling of products, the main two in the market being Good Environmental Choice Australia (GECA) and EcoSpecifier's Green Tag. The carpet manufacturer also mentioned the Environmental Certification Scheme available through the Carpet Institute of Australia.

Specifier perspective

One architect fully specifies finishes and furniture, leaving little capacity for contractors to make selections. The company definitely uses eco-labelling because it makes selecting for Green Star compliance much easier.

Another architect does undertake Green Star ratings for projects but has a company agenda to pursue lower environmental impact regardless. They do look for products that



are eco-labelled but are aware that there are other suitable products and would specify them. They have internal review processes that pick up other opportunities.

A project manager has noticed some changes in the market influenced by Green Star, but little in terms of materials, other than an increasing preference for carpet tiles over broadloom.

Property manager perspective

One property manager doesn't see that Green Star ratings are relevant for his sector of the market, but in his view are more for new buildings and for new fitouts. He has had no exposure to eco-labelling of products.

Another property manager sees requirements in building design manuals to specify materials & finishes to meet Green Star requirements. He has seen a shift over the last couple of years to owners pushing for Green Star ratings to maintain the prestige of the building and position their building higher in market; they don't want the quality of their building to be pulled down by tenants. Building owners include waste management requirements in their contracts but don't enforce them.

Contractor perspective

One contractor is seeing some demand from consultants but believes that Green Star rated projects are mainly driven by clients, who want it primarily for commercial benefits and to a lesser extent for staff health.

Another contractor thinks owners are not willing to undertake formal Green Star ratings due to timeframe, cost & effort to do so, and that the tenant market does not value Green Star above location; 'greenness' is a much lower priority for them.

In the view of the third contractor, Green Star has impacted the top end of market but its influence hasn't flowed through to the lower end.

Supplier perspective

For the material manufacturers and suppliers there are divergent views on the value of having their products eco-labelled. Generally, there is concern with the cost of certification and how applicable or thorough it is, but it is sought in order to protect market share because their competitors have it. There wasn't a common view of how well ratings or certification drives demand.

According to one ceiling manufacturer, clients are not demanding greener products except where directly relevant to Green Star. However under Green Star, ceilings are not counted except as a marginal contribution under assemblies in the new Interiors tool. They contribute indirectly under indoor environment quality but this is about performance, not material characteristics, handling or waste reduction. The company intends to lobby the Green Building Council Australia (GBCA) to credit ceiling materials in Green Star. The



company wants strong environmental credentials and third party verification of documentation as “part of its DNA” but they do question whether eco-labelling is good value. They don’t believe they have won a single project as a consequence of the product A-rating under Global Green Tag but it counts towards their corporate position to reflect on the company as a responsible manufacturer.

The other ceiling manufacturer agrees that Green Star has no influence because ceilings are exempt. They would love it to be covered but there is no support from the industry body or GBCA. By pushing their suppliers to get it on their behalf, the company has GECA certification for some of their range, and Green Tag on others. In their view, eco-labelling and ratings systems are a driver in USA and Europe but demand has not filtered through to Australia.

The flooring manufacturer has Green Tag certification but this only covers manufacturing and raw materials, not end of life. They feel they have to have it to compete.

The plasterboard manufacturer finds that Green Star seems to work well in office space but not in apartments. They had GECA certification of a product with high recycled content but the rules changed to certify VOC off gassing rather than material content. This means they are economically out of the market and having to get their standard product certified to compete, which is very costly. Everyone has the certification so the advantage is diluted but they will continue with it to ensure they don’t lose market share.

The carpet manufacturer believes that Green Star has had an impact on the market. Although it is expensive, the company has Green Tag certification because they are often asked for certification and don’t want to miss out on projects. Although labelling is not essential, it is easy to confuse specifiers with detail about product so it is easier to present them with an eco-label certificate. The company would prefer a more thorough system that protected against greenwash; in their view current systems identify areas of concern but not areas of excellence in a product.

The glass manufacturer has moved away from eco-labelling because they believe barriers to entry have become too relaxed. Eco-labelling programs treat them equally to the imported products with high-embodied energy from extra transport. In the company’s view, smart people can still get their Green Star credits using the manufacturer’s documentation. The company “already has a green product and didn’t need to change any of their processes to achieve the highest rating”; they have EMS, ISO 14001 certification, a sustainability covenant with the EPA Victoria and Victorian Government, high recycled content, and product stewardship.

4.3 INDUSTRY AWARENESS, GAPS IN THE KNOWLEDGE BASE

The interview subjects’ level of awareness about reducing waste varied, in part dependent of the role of their organisation in the industry, and in part dependent on the attitude of



their organisation and the emphasis it placed on sustainability matters. Even so, these reasons do not account for all differences, highlighting the need for better education and capacity building within the industry.

Specifiers

At the consultant end of the process, the issue is their understanding of the impact their selections and design detailing can have on the end of the product's life. They were also questioned on their knowledge about sources of salvaged and recycled product, and sources of relevant information.

One architectural company was reported to have good internal processes and expectations, with an ecosystem of product suppliers and refurbishment trades to assist with salvage and reuse, Green Star being a reference standard, and in-house reviews that identify opportunities for improvement. They are conscious of material efficiency by designing for standard dimensions, and having a good relationship with builders. Being smart about designing in reused items included educating the client. All the same, the extent of execution depends somewhat on the commitment of the individual designer and the client organisation's culture.

Another architect reported lack of awareness of information and product sources and they tended to a conventional approach of only specifying new in this absence. If the items are in good condition and there is a salvage inventory readily accessible and online they would be happy to consider them, although they were concerned that salvaged items would be perceived as junk and reflect a lack of quality. Green Star is a driver of selecting products with recycled content, and this architect relies on eco-labelling. Product leasing and end-of-life take back is seen as a management issue for the client, not a procurement or selection issue for the designer.

The project manager has a high level of knowledge about the possibilities but is limited by the lack of industry opportunities to have deficit items salvaged. She is also finding that the smaller end of the market, relating to building owners and to leased areas, is limited in its awareness and ability to move beyond business as usual.

Property Managers

Property managers can influence the leasing process and lease conditions, and facilitate good site practices.

One property manager exerted little influence, leaving it to landlords and tenants to set the agenda, for example, by ensuring tenancies meet Green Star criteria where a landlord has a building rating in place. They also leave it to contractors to manage site waste management. There was a lack of understanding of the applicability of Green Star, expecting it to only be relevant to new buildings. They are conscious of commercial risks and limitations (such as the risks associated with taking cash contributions in place of tenant make good then reusing the existing fitout) and managing these is the primary driver. They had not come across product stewardship and would be prepared to try it,



with the caveat of concern about risk to project timing. Improvement in documentation about possible reuse and recycling of materials was considered to be a useful way of reducing waste in the sector.

Another property manager exhibited a greater level of awareness of opportunities for reducing waste in the market but is not active in pushing it.

Contractors

As well as having responsibility for on site waste management processes, builders are faced with the practicalities created by installation detailing and product selection.

One contractor reported understanding their responsibilities relating to waste management, but can't see that second hand materials or take back arrangements are applicable to the base building refurbishment work that is their primary area of work. They are not seeing many products with high recycled content, or opportunities for second hand materials, since most of the products they handle are services not finishes. Construction for future dismantling or disassembly is not appropriate to their work because they "build things that don't want to be pulled down...there for a long time". The contractor was not very familiar with product stewardship concepts.

Another contractor reports a strong organisational culture supportive of sustainability, although site realities are influenced by client demand and site practicalities such as available space or the state of existing materials. They find the main drivers are still commercial, and cost drives the efficient use of materials. They were not aware of product stewardship concepts.

The third contractor also reports a strong organisational culture, with a product stewardship program for its own manufacturing. Even though the company has good systems and documentation, the process is still driven by money and resources, and impacted by management approaches that may have other priorities.

The recycler is very aware of the waste volumes and system limitations on reusing and recycling the resource.

Suppliers

Product manufacturers and suppliers are generally aware of the concepts of recycling, recycled content and closed loop, and the commercial impacts on their business, both negative (a cost they bear for the reputational benefits) and positive (reduced cost of input materials). They were well aware of the practicalities of waste collection and sorting and the consequences for their businesses.

4.4 STANDARD DOCUMENTATION

The study questioned interview subjects about whether any standard documentation produced by their organisation contained requirements for using recyclable materials,



recycled content, or waste management and reduction. The intention was to test the organisation's commitment to and control of these issues, and the potential of upgrading standard documents to improve outcomes.

The study found that very little is included in standard documents and, even where it is, it is not consistently applied.

Specifiers

One architect has flexible standard specifications that would meet 6-star Green Star but they select which clauses to use depending on the project and the level of Green Star being targeted. Retaining all clauses is seen as a cost premium on the project of 10%. The builder's premium for a Green Star project includes a waste management plan and tracking. In this company's projects, prototypes are incorporated in the works, not constructed separately and disposed of afterwards. With workstation prototypes, where a range is displayed on site for client trialling, the selected one would be kept for use in the project and others taken back by the supplier.

The project manager has standard documentation that is tailored for each project and has applicable content. She also prepares building user guides that include as much as possible without imposing unreasonable conditions for the circumstances, such as onerous requirements for smaller tenants.

Property Managers

One property manager has experience of building design standards produced by owners to control fitout materials and activities in order to maintain the Green Star rating for the building.

Another property manager reviews tenant's documentation to check it meets building standards rather than typically supplying building specific standards at the start. The only green lease he is aware of are for government tenants, which have mandatory green leases.

Contractors

One of the contractors has a site management plan that includes an onus for recycling of products. Use of this is dependent on the project; for Green Star projects they commit subcontractors to provide waste documentation and to comply. Otherwise the contractor works to the contract documents prepared by external parties.

Another contractor has a waste management procedure that they like their contractors to follow. This has requirements to record, targets to reduce landfill, and recycling of product, which varies between projects.

A third contractor has a fully integrated management system to Environmental Workplace Health and Safety quality. It contains all the relevant requirements but is not necessarily



applied consistently by middle management who control project budgets and therefore processes. The contractor sees specifications that rely on referencing Green Star procedures without requiring a formal rating, in which case they are not followed. His recommendation is that specifications need to set out in full what the waste management procedures should be, and not reference Green Star.

Suppliers

Material suppliers were asked about the information that is included in their product literature.

A ceiling manufacturer includes green details 'front and centre', believing that people do care. The other ceiling manufacturer includes eco-labelling information in their literature.

The plasterboard manufacturer includes information about Green Star credentials and recycled content.

The flooring manufacturer's literature contains information about recycled content where this is high, but it is not mentioned on standard materials where the content is low.

The product literature of the carpet manufacturer relies on the eco-labelling for the product credentials rather than providing the detail. Installation recommendations include very detailed instructions about method of installation, and materials to be used, i.e. low VOC glues. This also addresses appropriate glues for the particular backing system that will facilitate future rearrangement or reuse of tiles.



5 PROCESSES

This section explores the influence of the specification and procurement process on generating and reducing waste from commercial fitouts.

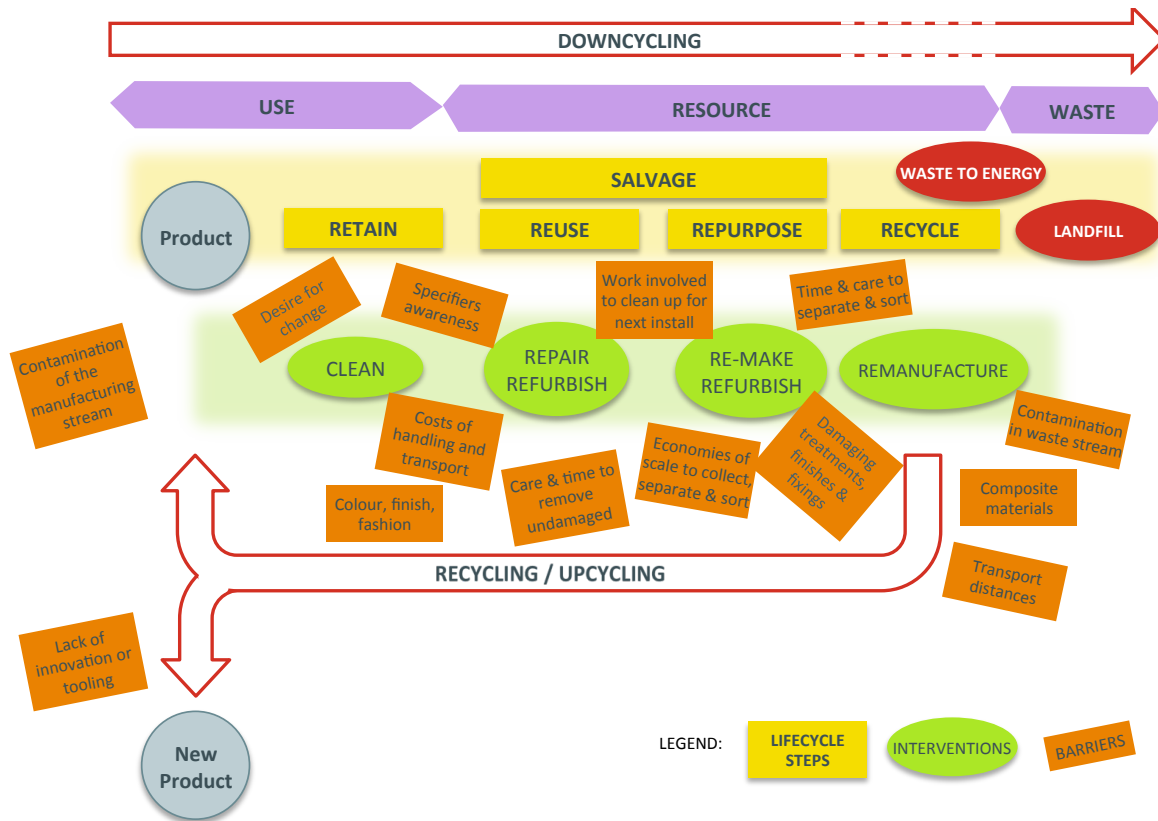


Figure 3 End of product life: potential and barriers The diagram illustrates the terms used in this report and where they fit in the spectrum of options. It indicates the process as linear because the conventional scenario is that, even when products are reused and recycled, materials degrade as they progress through the options towards a final destination in landfill. It is only when they are diverted to be remade into new products that the process becomes cyclical. The claimed barriers are scattered into positions that approximate where they have most impact, although they may be relevant throughout the product life.

5.1 TERMINOLOGY

Retain – products are kept in current condition and intact. They may be cleaned for the next phase of their life.

Salvage is recovering material that may otherwise have become waste.

Reuse – the product is substantially kept intact. It may require repair or refinishing, but its purpose remains the same.

Repurpose – a new use is found for an existing product, possibly with substantial modification and innovation.



Recycling is where a product is dismantled back to its constituent materials, which are then remanufactured to make a new batch of the material. Common examples are metal components.

Downcycling follows a similar path, but the materials are degraded or lost in the process. Examples include architectural glass becoming bottles, and plasterboard gypsum becoming agricultural soil conditioner.

Upcycling is where recycling of a material gives it a higher value life. An example is old structural timbers becoming high-end furniture.

5.2 KEY ENABLERS AND BARRIERS

There are four factors that are consistently mentioned as significantly influencing the level of resource recovery, common to all materials and stages of the fitout process. These are time, cost, transport distances and contamination.

Time and Cost

Although time and cost are two separate elements they are so closely interlinked that they can be considered together. For all participants, tight project timeframes are a significant constraint.

Consultant efficiency and fees

For consultants working to tight fees, time efficiency is a priority. When specifying materials and products, information needs to be online or to hand. Known products or sources of materials are quicker to find and specify. Whilst lack of awareness about options for second hand materials and furniture is a factor, more compelling is the lack of time to visit sites or storerooms to investigate the range or condition of items on offer, to select the individual items, and to arrange any repairs, reconditioning or fabricating that may be required. Many prefer to select from an online catalogue with confidence that they can obtain the required quantity and quality.

One of the architects demonstrated a stronger commitment to retention, reuse and second hand materials when project and client demands allowed. This appears to be facilitated by a network of suppliers and tradespeople built up through regular use, reducing the time and effort required by the architects. Where the cost of work can be reduced by reusing materials, it usually gives flexibility to pay for other things.

Another architect noted that an audit of existing furniture for a current project identified 60-70% to keep. The impost of the time needed for the audit was carried by the staff personally, by undertaking the work on a weekend. Although not mentioned as an issue for this example, the architect commented that the ability to charge appropriate fees for the work involved was dependent on a good relationship with the client.

A suspicion was expressed by others that it is not in an architect's interest to specify second hand products because fees are calculated on a percentage of the project cost, meaning they would gain from using more expensive new products. The architects indicated that this is not the case. On the contrary, a key problem with second hand materials is that they are not sufficiently cost competitive with new materials. A major constraint is the amount of extra effort required to source and assess second hand products, and arrange for any repairs or refurbishment. This requires much more work than ordering from catalogues, without the additional fees to compensate.

A further resource efficient but more time consuming measure discussed by one of the architects is designing to suit sizes and lengths of materials. The fast turnaround required in interiors projects does not allow enough time to consider this as well as they would like.

Contract period and budget

For contractors, time is a contractual matter, with penalties for delays. In addition, there is a cost to maintain a site so the quicker it is completed the more cost effective the build. One of the contractors talked about the increasingly short time frames available to undertake a project, and the additional impositions of having to work out of hours or limits on noise which restricts the time available. "Demand on time, squeeze on time is getting heaps worse.... Not being able to make noise during the day...the silent builders... you can't build without making noise." The view that sites are restricted by time was reinforced by most of the people we interviewed.

Builders' materials substitution was agreed by our interview subjects to be driven by cost. One of the contractors concurred, adding that time is a factor, when specified products have a long lead time or there may be some delay in obtaining them. This point is also made by another contractor in noting that subcontractors with limited contract time offered quickly obtainable products whether or not they fully complied with specification criteria. Since nobody has the time for proper evaluation, should a problem result, the responsibility chain is too broken for anyone to be held to account.

Demolition process and site management

Two of the contractors described a good demolition process as being systematic, where each material is removed in turn and stacked until a full bin or load is ready for removal from site. Small sites must be managed differently - there may be less space to stockpile, but there is less material to be removed. One of them agreed that scale and timing do affect the ease with which waste is managed but noted that a competent contractor organises the site and makes space. There is a cost saving for the demolition contractor in organising for materials to be taken away for recycling – ultimately it makes them money. Time constraints were also the reason given by a contractor for not salvaging from site for reuse. The experience of one of the architects is that it is quicker in a demolition to remove everything, compared to a partial demolition that requires attention to differentiate what needs to be kept and protected. When a waste management system is a contractual requirement, it controls what gets recycled but increases time and costs to comply.

One of the contractors gave site control as the answer to avoiding the damage on site that leads to waste, noting that the problem often occurs when getting close to the end of the contract period. When everyone is rushing to complete, they tend to forget some aspects of their work. Again, time constraint is the contributing factor.

Handling

A further angle on the time and cost implication is that additional handling is avoided.

Time and labour to assess, dismantle and transport off-site adds to the cost of salvaged materials. This makes them uncompetitive with new materials, in that potential purchasers are not seeing the value of them. New products and materials are too cheap by comparison, a point made by one of the ceiling manufacturers in relation to why ceiling tiles are not salvaged. Any extra handling adds expense so is avoided, which can also be the case for recycling. To quote the recycler, “You can buy machinery to sort anything; it is just the cost of it.” Nobody wants the hassle and costs of sorting, cleaning, and handling for the quantities involved and the low resale value at the end. One of the contractors noted that demolishers are very good at separating materials and recovering value, but rework and shifting for furniture are too costly.

Product Stewardship

A contractor sees a possible scheduling complication if product stewardship take back had to be allowed for. This view was expressed by one of the property managers as a program (project timing) risk and he was also cautious of the possible cost implications. Another contractor also believes cost is a disincentive to participate in product stewardship take back schemes because transport costs to remove the material are a direct cost to the owner of the material, whereas demolition transport is embedded in contracts; payments are made from different parts of the client’s organisation.

In the view of one of the contractors “there are no financial motivations for any of this in our current systems.” A few individuals are getting there but the industry is a long way away from it.

Impost for manufacturers

Economics drives the recycling processes and decisions in material manufacture too. The plasterboard manufacturer will collect offcuts and recycle gypsum into new boards, but it costs them in terms of manual handling, checking for contamination and disposal of the paper facing, so it is not offered openly. They have examples of where recycled content board is not specified for projects but there is still an expectation that offcuts will be removed from site for recycling; the commitment is limited by costs.

Transport Distances

Even when processes are available for recycling, if they are centralised they are only convenient to a small geographic area. The cost and effort to ship waste around Australia is too high for the value in the materials, therefore sometimes recycling is available and even publicised, but only implemented for a tiny sector of the market. Alternatively, the



dispersed nature of the source material is the reason given for not implementing a recycling plant, and affects the life cycle costs if analysis is undertaken.

The cost of recycled material, when the extra transport and handling is factored in, is often not competitive with virgin material which has no contamination risk.

The furniture manufacturer has a recycling program but it is most economically viable when furniture is relocated within the same building and without the need for storage. It is not economically viable if product buyback dismantling, transport, storage and reassembly costs result, or are incurred in the process. They noted that embodied carbon from transportation is not being accounted for. If all the true costs including externalities were factored into a material cost, the balance may change towards favouring recycled materials.

Ceiling tiles are one example of this problem. Currently there is no manufacture in Australia so to recycle back into ceiling tiles requires one of the manufacturers to ship container loads to the USA at the material owner's cost for the take back scheme. On the other hand, the other manufacturer's European processes cannot recycle tiles in other than small quantities and they have not found that there is a demand for recycled content in Australia since it doesn't count in the Green Star rating. An alternative use for the material is to make it into rockwool insulation, but without obtaining sufficient tile quantities within reasonable transport distances it is not economically viable, despite ceiling tiles being cited as one of the biggest contributors to the waste stream.

The flooring manufacturer also commented that the freight distance to a recycling facility determines whether or not vinyl tiles can be economically recycled, as did the glass manufacturer with respect to their product. The example given was a recycling facility in Melbourne that is too far for many interstate locations.

The recycler cited the example of shredding timber for garden mulch, because transporting it to paper mills does not compete with the cost of virgin logs.

The story is the same for carpet – although it is a large component of the waste stream, the Australian market is not seen as big enough to support a dedicated recycling plant. To date, all recycling of carpet tile taken back in Australia has been shipped to related companies overseas. The carpet manufacturer interviewed prefers backloading to an overseas plant where they have a better set up. Even so, the company is planning to have a plant operating by 2020 that will refine salvage materials, which will then be exported for remanufacturing, but it will depend on getting the material volumes.

Contamination

A very significant limitation on the recyclability of materials, which was mentioned in the context of nearly all materials, is contamination - both the reality and the risk.



Composite Materials

Composite materials are a major problem, noted by many and of particular concern to one of the architects. Once quite different materials are formed or adhered together there is difficulty determining which segregated waste stream to discard it to, the materials can be difficult or impossible to separate, and if not separated cleanly the residue of other materials can contaminate the remanufacturing of the main material. The architect noted the increasing prevalence of foam backing and gaskets to materials such as aluminium panels and aluminium profiles as acoustic or fire rated treatments or seals; and foam-backed screen fabrics. He also commented on glues so good that materials cannot be separated. In his view, composite materials should be banned. The ceiling manufacturer gave contamination of the painted tile face as the reason for their European suppliers limiting recycling of ceiling tiles to only a miniscule proportion.

Composite materials also come in the form of additives that make recycling impossible. For example, fire-rated and impact-resistant plasterboard contains fibreglass, making the gypsum unusable to remanufacture as plasterboard. The architect is concerned that the impact of additives is not widely understood and materials like fire-rated plasterboard can be misleadingly presented as environmentally sound.

He further noted that prefabrication is becoming more common and frequently involves composite panels. He warns that it must be done with a design for dis-assembly philosophy to ensure doesn't exacerbate composite problem.

Site Management

Another major cause of contamination is through lack of good site behaviour management. There can be difficulties keeping dedicated bins clear of other materials and clear of general rubbish. This adds a significant penalty to the receiving company to sort through and check for contaminants, and presents a risk to their process if items get through. Examples given include the plasterboard manufacturer having to check every plasterboard sheet before recycling because they cannot risk contamination from fibre cement sheet getting into the gypsum stream; small bits of metal, like bolts, getting into any grinding or munching process; and aluminium drink cans getting into anything. Sometimes companies carry these risks and penalties in the interests of maintaining the recycling process. Other processors will not take the risk and so no recycling takes place. One of the architects suggested site management needs formal Green Star certification to drive policing of waste separation.

Material identification

Lack of clear identification of material components limits the options for recycling in some instances. Where there is a good recycling process by a manufacturer, some of them limit it to their own product so they can be sure of the constituent materials. One extreme example of contamination risk to the manufacturing process is glass, as described in the case study later in this report. The flooring manufacturer won't touch certain plastics and plasticisers that are found in some competitors' products, and therefore cannot risk taking material from other brands. The carpet manufacturer gave the example of the four



different backing materials that are found in carpets and carpet tiles. They will take back their own, and that of competitors where the material is known to be compatible.

Residues, Dirt and Spills

Another form of contamination is residues, dirt and spills. Poor maintenance of carpet tiles is a big factor in resistance to their reuse because it increases their worn appearance. Glues, paints and nails on materials make them unable to be reused or recycled, either through process risk, additional handling penalties, or unattractiveness. The flooring manufacturer advised that sheet vinyl cannot be recycled back into sheet product because it is contaminated with cementitious levelling compounds. The paper facing from plasterboard must be dumped to landfill because the residual gypsum makes it unsuitable for paper recycling.

Limitations to remanufacture

Where the flooring manufacturer recycles vinyl flooring all colours are processed together, limiting the remanufactured material to a black colour, because sorting plastics by colour must be manual so it is prohibitively expensive, a point also made by the recycler.

5.3 OTHER BARRIERS AND INFLUENCES

Consideration for end-of-life

During the course of the interviews it became apparent that there is a 'disconnect' between start and end of a product's life. This occurs in terms of responsibility for its next life destination, knowledge about the possibilities and limitations, and forethought in preparing for a future life in the way a product is specified, installed, used, maintained or documented.

The carpet manufacturer commented that at the design and materials selection stage not enough attention is paid to the ongoing needs of the installation, or what can be done with the materials at the end-of life.

Site limitations

Restrictions on site management limit waste segregation and impede good practice. The project manager commented that wheelie bins are the common size of site bin because they are easy to handle and fit in lifts. The consequence is that materials get broken up to fit in the bins. Building or facility management controls lift access and timing, and restricts bin movements, making it hard for the contractors to manage waste sorting and collection. One of the contractors confirmed this point. They also advised that a small sized site can limit its capacity for bins, so waste is taken off site for sorting. Another contractor advised that on a project of a reasonable size, the contractor makes the empty space as work progresses to allow for separation. "The better organised you can be the more effective you will be." He believes that on some of the bigger jobs recycling is an owner priority. He confirms that the ability to recycle is affected by scale and timing and that tight contract

times do limit opportunities for recycling. Very small quantities are not profitable to pick up and are avoided.

An architect suggested that scale is an excuse; it is all about attitude and the contractor's management approach. He thinks the lack of site separation is because some builders don't like being told what to do.

Attitude

The interview subjects varied considerably in their attitude to improving their own practices and identifying what the industry issues might be. Their understanding of the opportunities and problems and the implications for their role depended on their knowledge of the topic. For some, the core of the problem, or the best opportunity to fix it is the responsibility of someone somewhere else in the process. This was particularly pertinent talking to the architects, who tended not to exhibit a sense of responsibility for their product selections at end-of-life, or understand how they can influence the outcome. Typically the property managers were also at arms length, leaving it to the documents prepared by others and actions of the builder on site to control what happens. In the course of the interview, one of the property managers realised he could have an influence through leases and design standards. One of the contractors reinforced the view that the industry is driven by cost, commenting that demolishers are good at separating materials and fittings and recovering value where it is commercial.

The desire for new

A major barrier to retaining a greater proportion of fitouts is the desire for new. Sometimes this desire is driven by clients. It may also be driven by designers wishing to make their own mark rather than working with existing items.

This attitude is reinforced in construction contracts that then control the contractors' flexibility to reuse.

One of the architects commented that it is hard to work with an existing fitout for a new client that has different needs.

Storage of 'spare' material

In cases where the incoming tenant removes sections of existing ceilings or flooring, the materials may be stored for reinstatement at make good, or as spares for maintenance elsewhere in the building or fitout. One of the architects identified the problem that frequently it is forgotten about. As well as having to have a suitable space to store the materials, which comes at a cost, the knowledge of what is stored and where is not retained by the company when there is a change of personnel, or is not notified to the right people at the crucial time. There needs to be a chain of custody of knowledge about stored materials for this to be effective, which could be prompted if the practitioners at the reuse end routinely asked about any stored spare material before ordering new replacement. The requirement also needs to be embedded in the construction contract



and enforced, because one of the architects commented that builders do not always use the material even when it is known to be available.

The other side of this point is that retention of the material for later reuse by others reflects an attitude that defers responsibility, or makes it someone else's problem. Practitioners can feel good that they haven't sent the material to landfill without having changed their own practices.

Quality and Appearance

The quality and appearance of existing materials affect their attractiveness for reuse. The project manager commented that the look, fabric and detailing can affect a products 'saleability' and will not be taken if not right. A contractor and an architect both commented that the state of the existing materials affects whether or not they are reused, with discoloration causing a contrast between batches of old and new. Another architect noted that even where there is an intention to retain existing, sometimes they can't keep as much as want to because they uncover poor quality construction.

One of the architects advised that appearance has a higher priority over recycled content when selecting materials.

End-of-lease practice

The project manager pointed out that tenants are walking away from fitouts more and more, and not even taking their furniture. The option to cash out make good responsibilities allows a tenant to leave all furniture and fittings behind and start afresh in a new location. Previously, tenants would take some, if not all, loose items to the next location, or at least assess it for retention.

Whilst this means the vacating tenant is not reusing its own tenancy items and setting up a scenario for them to be discarded, it presents an opportunity in that the tenancy is intact for an incoming tenant to use.

Recycled content

The interviewees were asked if they would actively select materials with high recycled content, and whether there is any resistance to their use. The intention was to uncover any barriers to market development of such materials.

Generally there appeared to be good acceptance of materials manufactured with recycled content. Specifiers didn't feel that there is any client resistance. The main driver for actively seeking out such material is a formal Green Star rating.

There is still some misunderstanding of what recycled content may be. One of the contractors was agreeable to using such materials but thought that there was not a lot of this type of product available.



Sourcing second hand

Unlike recycled content, there is resistance to the use of second hand materials.

One of the architects didn't know where to go to source materials. They were concerned with the quality of the products and the time to review and assess them. To be attractive it has to be an easy option, more cost effective and still profitable for them to do it.

The project manager thinks there is low demand for second hand products because they are not valued.

One of the contractors thinks they would not be fit for purpose. He did not recognise the possible products and materials or the ways that they could be reused.

The carpet manufacturer advised that there is some buying of old carpet and cleaning for reuse and that demolishers do quote on basis of on-selling take up, but it is the exception not the norm.

One of the property managers believes that most fixed items are difficult to reuse because they are set sizes and damaged.

None of the interviews ventured into a discussion about repurposing. The extent of the reuse opportunity was interpreted as, at best, a direct reuse of furniture and fixtures for the original purpose.

Avoiding off cuts

As well as being potential landfill, offcuts during the installation phase are a waste of good material that has cost the contractor to supply. One of the contractors recognises the cost saving by taking care with the layout of materials to maximise their use and reduce the quantity they need to purchase. Although undertaken as a cost saving measure it has the benefit of reducing waste.

An architect had a similar outlook and mentioned that, as a company, they take care with the way materials are laid out, making an effort to incorporate this in their designs.

The plasterboard manufacturer noted this measure as a waste saving solution, offering customised lengths of material, which also reduces on site labour for a further cost saving. The alternative is that specifiers and designers be more knowledgeable about standard dimensions and design to suit.

Green Leases

A point of curiosity is that very little mention was made of green leases as a driver for change or agent of control. One of the property managers commented that the only green lease he is aware of is for government tenants, who have mandatory green leases. He did not indicate that this had any bearing on outcomes.



Material substitution

The study questioned interview subjects about the extent of and reasons for substitution of specified materials. The relevance of this is to understand if the intentions behind good selections are carried through, or if poor alternatives are substituted. If second hand or high-recycled content materials are not regularly purchased there is no market to support waste-reducing activities.

All of the interviewees, including the contractors, believed that substitution by contractors is prevalent and that the main driver is cost, and many of them also noted lead times as a key factor.

One of the contractors claims to check for and offer greener alternatives, although they admit that this is secondary.

The carpet manufacturer was explicit in blaming design and construct (D&C) contracts for being the worst at this.

One of the architects noted that they fully specify their projects, and that alternatives are rare because they must be submitted for approval.

Depreciation finance

The study tested for any financial implications for or against using secondhand materials, such as balance sheet impacts of incentive structures, depreciation finance, or tax rules. One of the property managers advised that often the owner pays for the fitout as part of incentives to secure the tenant, retains ownership and depreciates it to offset its tax bill. The tenant has possession of the fitout but doesn't own it. In this case, using reduced cost materials means there is reduced depreciation opportunity. It is not a strong driver but in the property manager's experience it has come up from time to time. The way the incentive is given is a function of the tax circumstances of the landlord so they may opt to give it as capital expenditure, rent free period, or rebate, and they are conditional on being taken as offered. Buildings are valued on base rent so the owners preference is to offer incentives as rebate or capital expenditure (such as paying for fitout) so as not to impact value. This is changing and becoming more transparent.

This experience is contrasted with most of the other interview subjects who believe that most decisions are driven by striving for the lowest possible cost. One architect commented that if they could reduce the cost of a material the money saved would be spent elsewhere in the project.

Material segregation

The recycler particularly made the point that segregated waste loads promote recycling and should be encouraged. The company would offer differential pricing to purchase segregated and non-segregated loads, but acknowledges sometimes lack of space on site means there is insufficient room for multiple bins. He suggests a solution is to ban



mixed loads into landfill except for hazardous material such as asbestos, and residue from recycling plants, to force every load through recycling. He believes that although banning mixed loads is preferable, it is important to have facilities such as his to separate materials to a commercially reasonable extent.

One of the architects agreed. In his opinion, if separation doesn't happen on site the chances of it happening anywhere further down the track is reduced. "If it is not simple on site, then when is it going to be simple?" He did then discuss the complication of composite materials – how do site personnel know which bin to use for mixed materials, especially when it can be difficult to separate the elements.

One of the contractors advised that economy is behind the extent of site separation – larger loads are profitable but small quantities may not be, so are not picked up separately.

Another contractor agreed. In his opinion, the effort made to recycle is driven by money and resources and there are no financial incentives to recycle in our systems. Site efforts to sort waste is variable and comes down to management approaches of different contractors.

Waste to energy

A contentious alternative to landfill, that is too big a subject to explore here in any detail, is that of waste to energy. There is a view that instead of burying unwanted materials we should at least recover their embodied energy through methods such as high efficiency incineration, gasification or pyrolysis, to generate energy.

This view is strongly held by the recycler who is seeking EPA approval for such an operation. He is facing opposition, which he finds frustrating in light of materials being sent offshore for incineration in jurisdictions that have little or very poor control, and with associated transport costs. He advocates waste to energy solutions for the 10-12% of residual materials for which he can find no economic value in recycling. He recommends this as a better outcome than landfill because it uses local labour, reduces landfill emissions, has energy recovery, and lower impact energy than central coal-fired power generation.

Quantity contradiction

The study recognises contradictions inherent in the interview narratives:

There is a high volume of waste going to landfill, but not enough to make recycling economic.

It's not economic to transport materials around Australia for recycling, but we can transport interstate for dumping.



It's not economic to transport materials around Australia for recycling, but we can transport overseas for recycling or disposal.

This reflects, in part, differences in regulatory controls and cost structures between different jurisdictions. It also shows a perversity in the way the industry values and costs things. As mentioned in several interviews, new materials are too cheap to justify the effort to recover used material.

5.4 PRODUCT STEWARDSHIP

Limitations of product stewardship schemes

An architect explained that product stewardship is common for carpet tiles and is something they recommend, but didn't have any sense of whether or not it is taken up. The architect sees it as an operating question, not a procurement question.

The property manager had not come across the concept of product stewardship. From his perspective, choice of products would depend on cost, timing, getting the right specification and knowing the scheme is available. He is concerned that product stewardship may be an imposition on the contractor.

Limitations on the penetration of product stewardship schemes could be, in part, an issue of perception as one of the contractors cites durability "owners looking for products that last 20 years of more" as a constraint. He doesn't see product stewardship as relevant for base building refurbishment.

Another contractor is not seeing evidence of product stewardship, and questions whether it is compatible with fitout time frames.

The flooring manufacturer has a take-back scheme in place, but only one project has taken it up. When the building's ownership changes hands, someone has to remember at the end of the product's life that it has a take back arrangement in place. The interview subject believes true product stewardship in practice has not been developed anywhere in the world.

As the carpet manufacturer explained, second hand use of carpet requires a dedicated collection and stewardship program. The owner or tenant needs to drive the requirement. If reused on site, the recipient may think they have lesser product by comparison with others who get new product. In Europe, trolleys are available for carpet tile collection that allow it to be palletised and sent back to manufacturer. This makes contamination less prevalent.

According to the third contractor, specifiers are not around at a product's end of life so don't care. Most clients don't want to pay the cost to transport materials back to the manufacturer, and it isn't typical to see costs for waste transportation embedded in demolition contracts. Most product stewardship schemes are signed up under Green Star with the full understanding that it will never happen, and most material suppliers don't



have the capability to do anything should it be activated. . There is a lack of Australian manufacturing; the building industry is a group of agents who may undertake assembly, so there is reduced ability in the local market to act.

The literature review uncovered “a concept enjoying some success in the UK: Material Recovery Notes (MRN). These notes represent an attempt to extend the earlier recycling industry idea of attaching Packaging Recovery Notes to reclaimed materials. MRNs encourage closed loop management of materials rather than ‘one life accounting’ (Hurley and Hobbs, 2003). As such they emphasise the need for manufacturers to have a salvage and recovery system in place for all items that they introduce to the market. By placing the responsibility for the whole life cycle of a product on the product’s producer, MRNs encourage an eco-system approach to the built fabric of a city as envisaged by the proponents of construction ecology (Kibert 2000).” From CRCCI Relife Final project report (Yang, Wakefield, Setunge, & Venkatesan, 2006)

5.5 DISMANTLING

One architect recently designed demountable partitions for a client with a history of high churn costs. These were more expensive up front but reduced cost and disruption in the longer term. Churn is also facilitated by new technologies like wireless and USB ports that mean there are fewer wiring connection points on desks.

‘Loose fit joinery’ does not fit between two walls but is designed with a free end, which means it is not location specific and can be reused in other locations. The Architect finds loose fit joinery is helpful for the program, to speed site work. Joinery fabrication can start without the need to wait for the opportunity to measure on site. This was the primary driver, loose fit joinery wasn’t chosen for its ease of future reuse.

Consultants have no responsibility for the material at the end of its life and therefore it does not impact selections or construction details at the start.

The Project Manager had not come across the concept of design for easy dismantling a lot.

The Contractor is accustomed to building things to last and believes that structural dismantling is more for overseas (e.g. China) or greenfields sites, and less relevant in a city like Sydney He didn’t consider it applicable or likely.

5.6 LANDFILL

“Landfill is still too easy” in the words of the project manager. Given the extra effort required to recover materials from the waste stream, landfill becomes the default option and an easy recourse. According to the project manager, the smaller end of the market is hardest to change. A number of practitioners mentioned the low cost of dumping being an unhelpful factor tipping the balance away from salvage.



The recycler stated “Material only goes to landfill if there is no commercial reason to recycle it anymore”. It is not economic to process really small pieces so it is this residue that goes to landfill, about 10-12% of the material they handle, which he claims is the highest recovery rate of any recycler in Sydney. The company would like to incinerate this residue as waste to energy rather than landfill, but is prohibited by EPA.

The recycler further states recycling needs to be made commercially attractive, as happens in Germany. He contrasts the European experience with Queensland that has very low tipping fees, and hence little recycling. He believes that there should be regulation to insist that loads go through a recycling plant before landfill to have the best chance of recovering materials.

In the interviews, increasing landfill fees was frequently offered as the key solution to reduce quantities to landfill. This addresses the value imbalance that is at the heart of many of the barriers to recycling and reuse.



6 MATERIALS CASE STUDIES

The interview process drew out interesting detail about technical issues in manufacturing and recycling materials, and barriers to reuse and recycling that at times do not accord with conventional industry wisdom. Where these matters are common to many materials they have been discussed in the previous findings of this report. This section focuses on the ‘problem’ materials consistently nominated as being the main contributors to the waste stream. Each material is presented as a case study to better understand the complexity of the processes involved, to illustrate the systemic issues faced by the industry, and to highlight the variability in opportunities.

The materials presented in this section are **glass, plasterboard, ceiling tiles, metal, plastics, and carpets**. In each case only one or two representatives of companies manufacturing or supplying the product were interviewed, so this does not purport to be a comprehensive analysis of these industries and products but instead reflective of the key issues to be aware of when recommending changes.

For each of the materials, a diagram of life cycle in fitout use has been created. These diagrams describe the main flow paths for the materials and their fates, the alternative (less commonly implemented) opportunities, and the paths that might be expected or have been tried and failed and are not considered feasible. In most cases the route from manufacture to use continues directly to landfill.

The information draws heavily on the experiences of the product manufacturer or supplier interviewed, combined with the perspectives of other industry practitioners.

Each material section concludes with suggestions to improve the process for that product to reduce wastage and avoid landfill.



Figure 4 Legend for following diagrams



6.1 GLASS

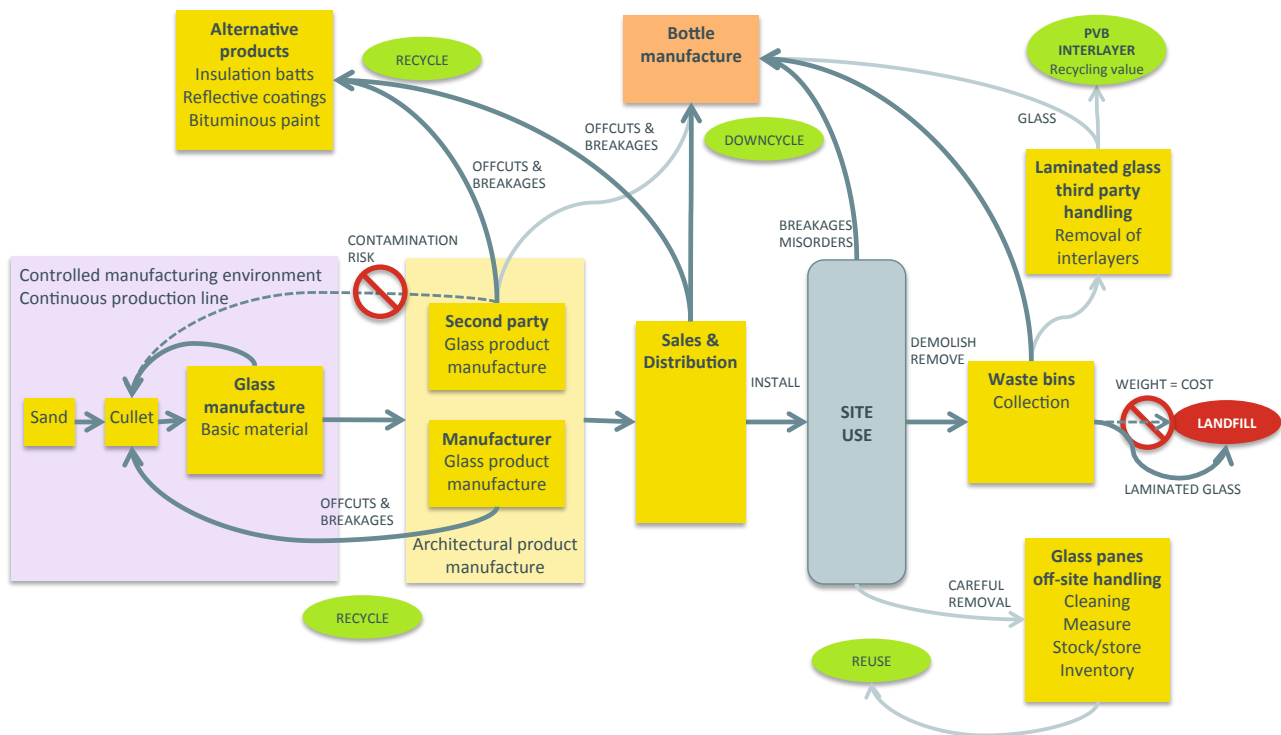


Figure 5 Flows and fates of glass

Very little glass ends up in landfill because of the cost to dump it, due to its weight, and the ease of access to alternative recycling uses. Equally, very little is recycled into its original form because of the contamination risk to the continuous production line.

Production

The glass manufacturer explained that the production of float glass is a complex process that can draw product from the same “campaign” (pool or bath of glass) continuously for 15 years. The environment is closely controlled because contamination causes major disruption and cost. Because of this risk, only their own industrial waste and offcuts from their own secondary manufacturers can be returned to the process. They cannot risk taking back product from other secondary manufacturers in case it contains material with unknown or incompatible ingredients. Material will not be taken back from demolition sites for similar reasons, and in addition, to avoid the extreme risk of any aluminium getting into the production stream.

The manufacturer does recycle cullet, (broken, waste glass), where it can because it takes less energy to process.

Recycling

The manufacturer advised there is no building site wastage, other than breakages and mis-orders, because material is made to measure and doesn't produce offcuts.



Where clean material can be recovered, secondary uses for it are in glasswool insulation batts, reflective paints and bituminous paints. Recycled material generally ends up being recycled into bottles. Glass does not appear to be a major contributor to landfill. The manufacturer explained that due to its weight it is very expensive to dump, therefore most secondary processors find an alternative use for their waste. The recycler claims to be the biggest glass recycler in NSW.

The manufacturer noted that despite a value in the PVB (polyvinyl butyral) interlayer, and the existence of some processes to recover pulverised glass from waste laminates, the opportunity for recycling laminates is very low. The majority of this glass form will end up in landfill. New recovery technologies are emerging but are still developmental and commercially sometime off being mainstream. To reduce landfill, the alternative to laminated glass is toughened glass or re-usable modular systems that offer better and more effective recycling options.

Salvage

A key reason given for not salvaging glazed assemblies (windows and partitions) and glass panes is that the sizes vary since they are not standardised, limiting the possibility that the pane sizes are applicable to another installation. Time and effort is required to assess and measure glazed assemblies. The handling to deglaze, clean and reuse glass is a further time penalty. This extra time and care is not possible under conventional time and budget constrained consultant and construction contracts.

A previously heard excuse that glass cannot be salvaged because of the breakage risk was not supported in the interviews. It was noted that there is no problem with carting new material onto site.

Specification

With the increase in open plan work places there is no decrease in glass usage. One of the architects advises they are still using lots of glass because even though the numbers of private offices are reducing, glass partitioning is used for greater numbers of meeting rooms and separate spaces.

Possible improvements:

To reuse glazed assemblies effectively the designer would need to adapt plans for new work to accommodate the found sizes, rather than dictate the required size.

An online inventory of glass that is listed before demolition may enable more to be sold.

Alternatively, the design industry could be more disciplined about specifying standard sizes so there is more modularity to facilitate reuse.

Toughened glass or re-useable modular systems should be preferred over laminated glass.



6.2 PLASTERBOARD

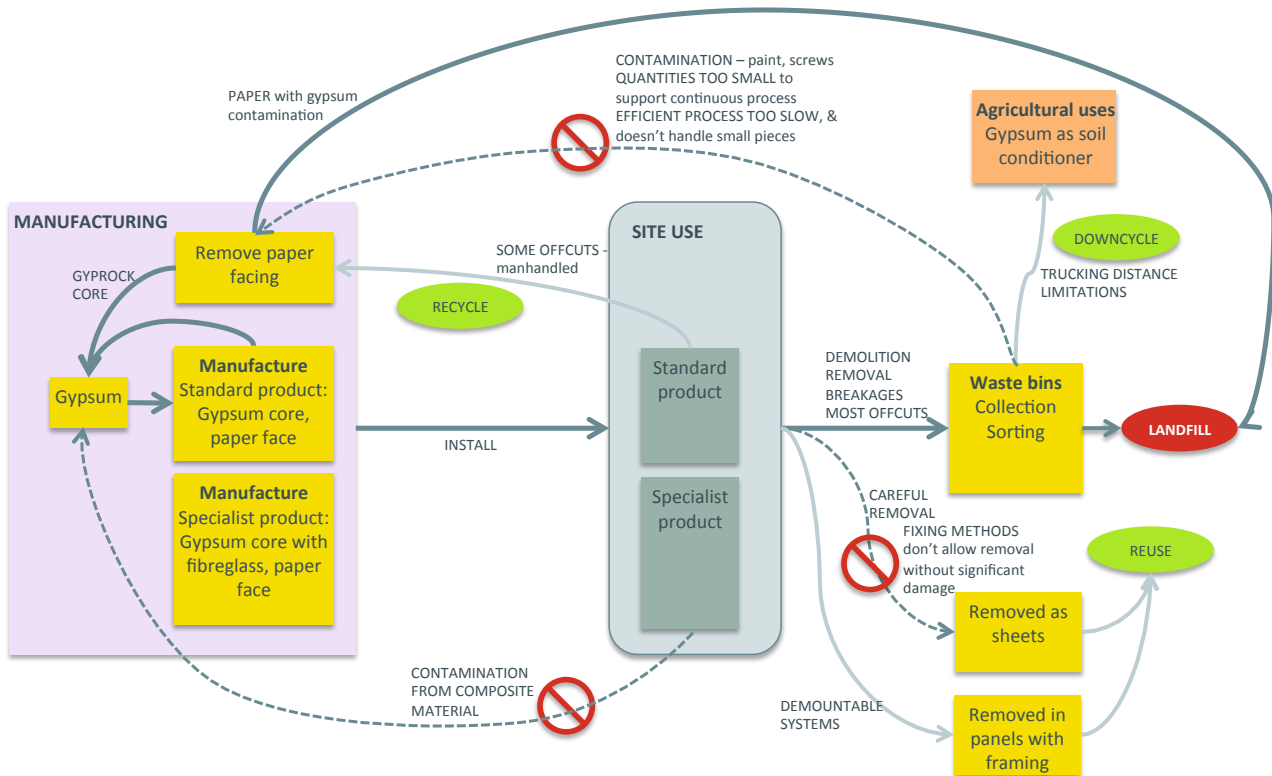


Figure 6 Flows and fates of plasterboard

Although in principle the gypsum core of plasterboard could be recycled into new plasterboard, the reality of site contamination, the additives from specialist products, and the difficulties of cost effectively removing the paper face mean that this is rare. The best waste avoidance solution is demountable systems, but these are not commonly used. The down cycling option of grinding gypsum for agricultural use is limited by transport distance and cost.

Plasterboard was universally nominated as a material that is always found in the waste stream.

Recycling

The plasterboard manufacturer does have a process available to collect off-cuts from construction sites, remove the paper facing and recycle the gypsum core into new plasterboard product. The company prefers recycling from housing developments because it is easier to get clean material with the sites well organised and easier to access. It is not widely promoted to commercial sites because there is a high cost to the company due to on-site handling, transport back to the factory and separating and disposal of the paper face. They use a contractor to pick up the material and sort it for contamination. Each sheet must be checked; fibre cement sheet is a particular concern to prevent entering the production stream, as are small metal pieces.



The exception that cannot be recycled is special impact-resistant plasterboard that has a reinforcing layer of fibreglass mesh behind the paper face.

One of the contractors believes that there are good opportunities to recycle plasterboard but they are inconsistently applied. The project manager believes the ability of plasterboard to be recycled is dependent on the applied finish. She has variable experience of the gypsum being reused.

The paper cannot be removed cleanly so the gypsum residue contaminates it for any paper recycling process and the only destination is landfill. The manufacturer trialled an alternative process that was more efficient at removing the paper but it was too slow and could not handle small pieces.

Recycled content

Some products claiming a high-recycled content contain flyash, a by-product of brown coal electricity production. Although flyash is a waste product it is more expensive than gypsum. The resultant plasterboard product has improved acoustic and impact resistant properties so it is sold as a specialist material, not relying on the recycled content to sell as a 'green' product. Even so, the manufacturer advises that Green Tag eco-labelling rewards low-VOC content of plasterboard but does not address recycled content, so standard plasterboards get eco-labelling credentials without any attention to recycled content. The commercial implication is that cheaper standard board is substituted for lower environmental impact material and still gets green credentials for the project.

There is clearly an imbalance in demand for recycling of site waste versus demand for the resultant recycled-content products. The company has examples of projects that required them to remove off-cuts from site for recycling but declined to pay for recycled content material.

Alternative use

If the material cannot be recycled into new plasterboard there is also a market in shredding it for agricultural application as a soil conditioner. This is the destination for larger pieces of plasterboard through the recycler's facility. He advises that it can't be recycled into new plasterboard because of spoilage and contamination. Small pieces are not recovered.

Possible improvements:

Plasterboard is produced in a continuous process. The material is marketed in standard sheet lengths, but for sufficiently large orders it can be supplied in custom lengths. The manufacturer recommends this become more widespread in order to reduce site off-cuts. Although the customised material may be slightly more expensive, the savings would then be found in reduced site labour, reduced waste quantities, reduced handling for recycling, reduced transport and reduced landfill.



Alternatively, designers could design for standard sheet lengths, for example, in setting ceiling heights to 2700mm, so there is less on-site handling and fewer off-cuts. This approach is taken by the designers at one of the architecture companies who try to work with standard dimensions for most efficient use of materials. Others mentioned the resource efficiency perspective in the context of several materials, with a contractor expressing it as “cost drives efficient use of materials”.

The plasterboard fixing methods of screwing, adhesive daubs and scrimming do not allow it to be removed in sheets suitable for reuse, a view shared by one of the property managers. On the other hand, plasterboard is suitable for use in demountable partition systems that could be reused as assemblies.

One of the architects suggested a further improvement could be to use joinery units to separate spaces instead of partitions, avoiding the use of plasterboard altogether.



6.3 CEILING TILES

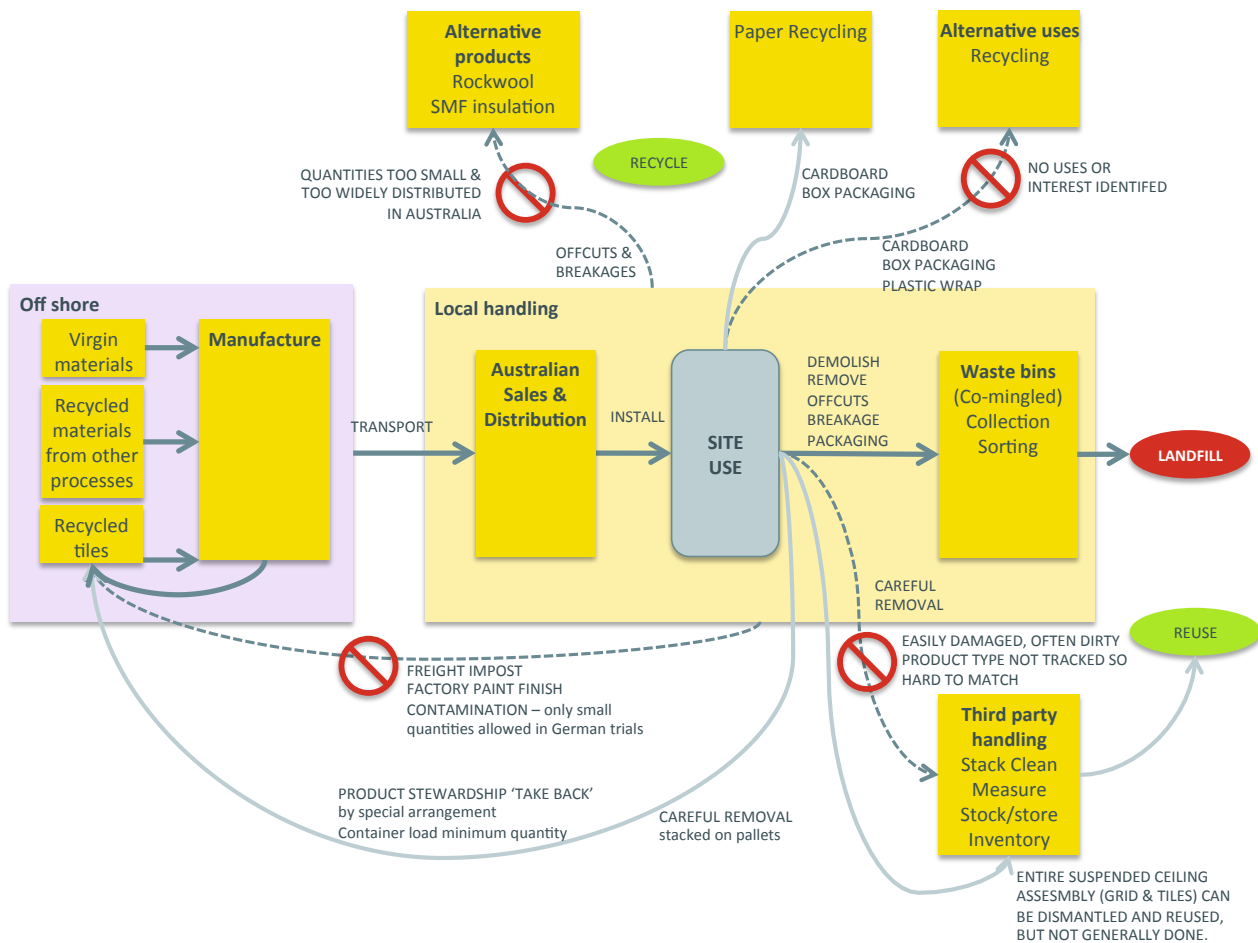


Figure 7 Flows and fates of mineral fibre ceiling tiles

The low cost of new material means the economics of recycling do not work in Australia, despite the large quantities of waste generated. The transport costs make the limited recycling opportunities unattractive. Aesthetics and poor management drive much of the replacement demand. Being modular, whole ceiling assemblies – grids and tiles – are suitable for reuse but the handling time and cost make it uneconomical. Its primary fate is landfill. The cardboard packaging of new tiles also creates a high volume of waste, although it can be recycled in the paper stream.

Ceiling tiles were a frequent nomination as waste stream contributors. They may be made from a number of materials including plasterboard and metal pans. This section addresses mineral fibre tiles; the most commonly used type in suspended commercial ceilings, and often referred to as acoustic tiles.

When first developed, these tiles were made from caneite, an organic by-product of the sugar industry. Because of problems with the material sagging, this is no longer the case.



Production and recycling

Mineral fibre ceiling tiles are not manufactured in Australia. The main two sources are Europe and USA. Typically many of the products in a supplier's range claim high recycled content but this is usually post-industrial product from other processes such as slag wool from steel manufacturing and recycled newsprint or cardboard. One of the manufacturer's products ranges between 30 and 80% recycled content, with post-consumer tiles currently contributing less than 5% of that recycled content.

One of the manufacturers indicated that recycling ceiling tiles into new tile product is not viable due to the large quantities generated. The standard painted face is a contaminant to the process. One of their German suppliers trialled recycling but the process could only bear a tiny proportion of recycled content. The company also indicates that compound materials present a problem.

The other manufacturer does recycle in its USA facility, claiming around 14 million m² recycled in USA in the last 10-15 years. There is no limit to the number of times the product can be recycled in USA, as long as load is not contaminated by other material or rubbish. In Europe they examine the type of fibres first. The plant at St Helens Oregon recycles Australian product (even that of competitors) where the company has an arrangement with larger ongoing refurbishment projects. It is shipped by container volumes of 3000m² under a product stewardship scheme at the clients' cost.

Product stewardship for smaller sites is logistically challenging. A manufacturer is currently investigating a local solution that will have capacity to recycle smaller quantities in Australia.

Salvage

Ceilings tiles are an example of where new product is so cheap that there is no value in salvaged material. There is no functional reason why whole ceilings - tiles and grids - could not be reclaimed for reuse elsewhere since they are constructed of modular components readily able to be dismantled with a little care. The exception to this is where the old tiles are an older generation and out dated in appearance or the manufacturer is no longer in business. Currently the cost to remove tiles and stack on pallets with care is much more time consuming and costly than disposal to landfill.

The mineral fibre content of demolished material means it could be recycled into rockwool insulation, but this is an example of transport distances making it uncommercial to ship the material any distance. Accordingly there are insufficient quantities available to support a commercial operation. Most ceiling tiles end up in landfill.

Lifespan

Although some product can be warranted for up to 30 years, one manufacturer sees the typical lifespan as 5-7 years. The main driver for replacement is tenant churn with whole ceilings replaced during make goods due to damage from partition fixings left behind



when partitions are removed. A high attrition rate also occurs on poorly managed construction sites, which one of the manufacturers suggests can be improved through site scheduling.

Both manufacturers have experience of perfectly good ceilings replaced when a tenant chooses to do their own ceilings regardless of the condition of the existing one. The first ceilings are then reinstated at make good stage, using new or stored materials, causing two rounds of waste. Both companies suggested integrated fitouts as an effective answer to this. An architect confirmed the approach of replacing ceilings, although they now tend to only do this in feature areas rather than throughout. The architect specifies that the removed material should be retained for later reinstatement, or in shell and core that the tiles are used elsewhere in the building.

A contractor explained difficulties with reusing depending on the state of the materials. Small batches of saved tiles may have a pristine appearance next to the discoloured installed tiles that have been exposed to light and handling and exhibit their age. They have experienced client resistance to the patchy appearance, and client demand for new throughout.

Facility management

A further cause of replacement is poor building management. The tile type is not recorded or tracked and mismatched tiles are used for local repairs, or tenants are allowed to use any tile for partial or full replacement. Eventually the ceiling appearance is so poor, or a new tenant wants a smarter fitout with an even appearance to the ceiling, and all the tiles need to be replaced. This could be resolved with better building management that tightly controls the tile types used in any work, as already happens in some buildings where tenants have no flexibility in what they are allowed to use.

In the past, one of the respondents investigated the attrition and cost to manage a ceiling system and found a significant difference between the different types. One-way exposed grids result in more tile damage during building works and maintenance of ceiling services than do two-way exposed grids which are more robust, have 4-sided support and easier handling and installation. The difference in cost/m²/year varied then between 5 cents and \$1.50. Conventional installations tend to use two-way grids with lay-in tiles. A-grade installations still consider these a lesser product due to aesthetics and now tend to a hybrid “modular” system, which is less robust than two-way, but an improvement on the one-way grid.

Substitution

A manufacturer finds a very high proportion of material substitution from that specified. This is usually driven by builders offering a cheaper product, especially under design and construct contracts.



Packaging

The brittle nature of the product means that it is packaged protectively so that it arrives on site undamaged, with particular concern for the edges. One manufacturer uses cardboard boxes that can be recycled in the paper stream, but is conscious that the packaging itself is a major waste contributor. They are aware of unsuccessful bulk packaging trials by a ceiling manufacturer in USA so there doesn't appear to be an alternative. The other manufacturer has tried to minimise packaging, with some being packaged in cardboard sleeves then shrink-wrapped.

Possible improvements:

Asset owners should be more diligent in maintaining their systems and controlling which tiles are used. The mechanism could be a Fitout Design Manual to which the tenants are required to adhere through reference in lease conditions.

Integrated fitouts where make good or new build ceilings are not installed prior to tenant designs will avoid a wasteful removal of good ceilings.

More prevalent use of the more robust (but currently less visually appealing) ceiling types.

Full dismantling and reuse of whole ceilings.

6.4 METAL

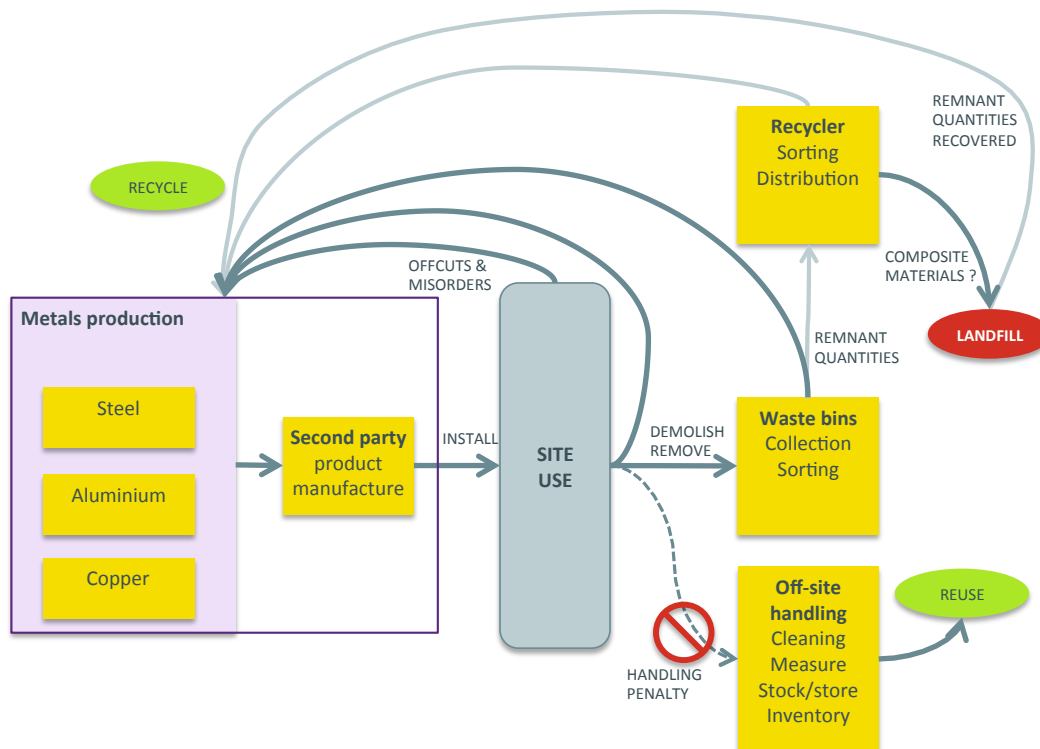


Figure 8 Flows and fates of metals

The widely recognised value of metals and the ease of access to cash-paying recycling merchants means that any wastage is recovered at every stage of the process and very little is sent to landfill. Even then, the residual material that does arrive in landfill is mostly recovered. The ease of recycling makes the handling costs of salvage uneconomical.

Recycling

Metals commonly found in fitouts include steel, aluminium and copper. The value of metal is widely recognised and the recycling destinations are clear, so off-cuts and demolished material are removed from the waste stream at every stage for recycling, and metals rarely make it to landfill. The ease of recycling appears to overtake any possibility of the more labour intensive salvage and reuse of metal components.

Copper is known to have value and scrap merchants pay cash so plumbers and electricians, as the trades handling it, are quick to claim off cuts and redundant product and sell it.

Steel and aluminium from partition systems, stud wall framing and ceiling grids were commonly mentioned as waste contributors but are readily segregated on site and transported direct to metal recyclers.

The recycler of general waste confirms that large quantities of ferrous metal and aluminium go direct from sites to the metal recyclers because of the known value. The recycler sees only small quantities, which they sort and send off for recycling.

The study was unable to interview metal recyclers to discover how composite and contaminated metal products are handled. Possible problem items include aluminium-faced sandwich cladding panels, structural insulated panels (SIPS), aluminium profiles with adhered foam backings and gaskets, powdercoated aluminium, and beads and angles covered with plaster residue.

A tangential aspect of waste metal is its capacity to spoil recycling of other materials. Small metal items such as screws and bolts can sneak through and damage grinding and shredding machinery. The tradesman's errant soft drink can was blamed throughout the interviews for contaminating the waste stream. Glass manufacturing in particular is susceptible to massive and costly disruption if aluminium enters the process. These problems can only be solved through rigorous site management and workforce education.

Possible improvements:

Although very little metal contributes to landfill quantities, avoidance, retention and reuse of material are higher on the waste hierarchy than recycling, so the material is not recovered optimally.

Greater provision and specification of modular products and design for standard dimensions would reduce site offcuts.

Off-site prefabrication allows for better material use efficiency through tighter control.

More prevalent dismantling, recovers material intact for reuse, although the study author has had experience where lack of material labelling can make some materials unsuitable for reuse where performance characteristics are critical, such as with structural members.



6.5 PLASTIC

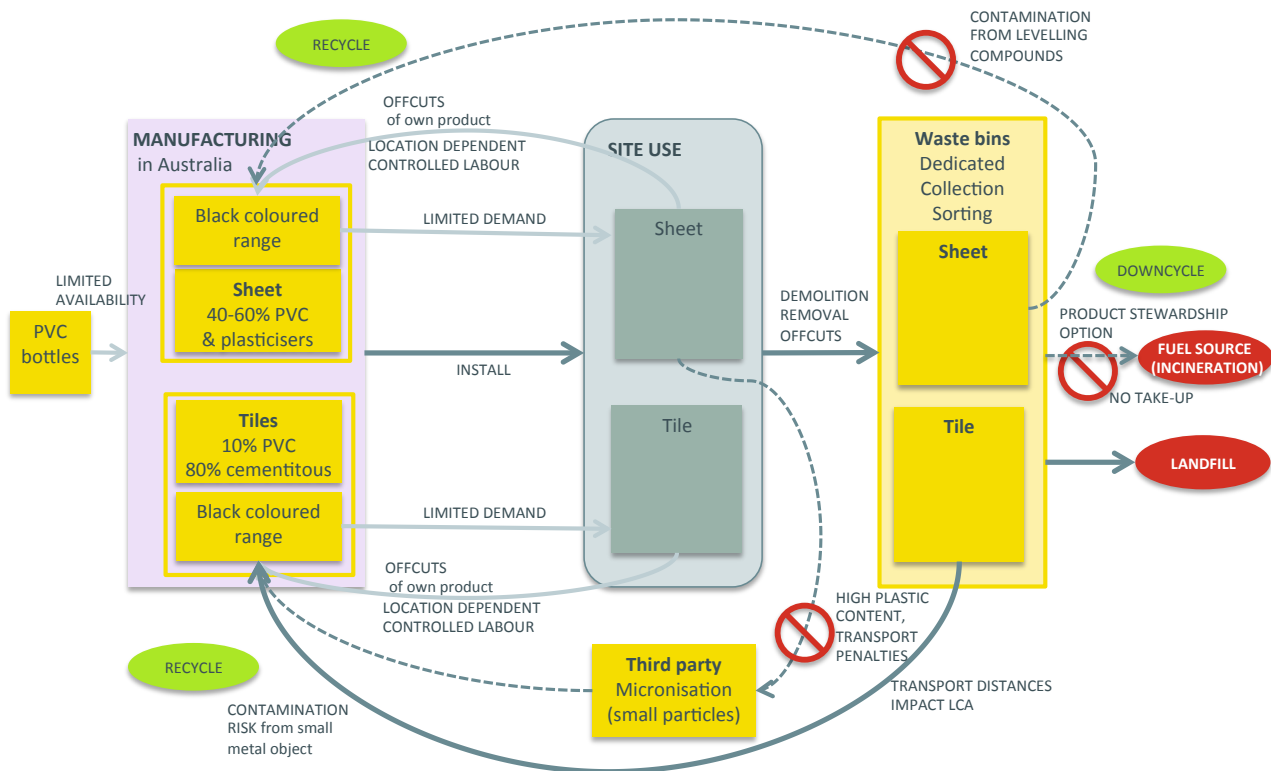


Figure 9 Flows and fates of PVC resilient flooring

Recycling of clean vinyl flooring such as offcuts is feasible, but colour mixing limits the new product to a black-pigmented range. Transport distances, and contamination risk from competitors' products that use unacceptable ingredients, limit recycling of demolished vinyl tiles. Demolished vinyl sheet is not recycled due to cementitious contamination, and the logistics of mixing it into tile production. Although most vinyl flooring goes to landfill, it could be used for waste-to-energy, subject to EPA approval.

Prevalence

Plastics are ubiquitous in the construction industry. Most plastic types are represented and they can be found in products in most trades. Sometimes they are the main or only material, but often they are a small component of a bigger assembly.

Industry focus is on PVC (polyvinyl chloride, commonly referred to as vinyl) due to concerns about by-products from its manufacture and disposal, emissions, and some of the additives that make it useful, like plasticisers. A recent change to Green Star now allows use of PVC produced in accordance with "Best Practice Guidelines", which encourages recycled content.

Green Star (GBCA, 2013) lists the major uses of PVC in the built environment as conduit, pipes and fittings (74%), flooring (19%), cable and wire insulation (7%), followed by PVC windows and doors, which are classified under the heading rigid profiles (0.3%).



Confirming these figures, the recycler mainly sees conduit and pipe in the plastics waste stream.

Flooring

This section primarily addresses vinyl flooring, which, although not widely used in commercial office fitouts, illustrates some of the material flow issues.

The flooring manufacturer described differences in manufacturing and handling of sheet vinyl flooring and vinyl tiles that mean they need to be considered separately.

Recycling constraints

Vinyl tiles are 10% plastic content and 80% cementitious, with the cementitious component supplied through crushed limestone. They can readily be recycled back into new tiles, and little bits of concrete such as residual levelling screed do not affect them. The manufacturer takes back its own product but not that from other manufacturers because some of them, particularly those of Korean origin, contain plastics and plasticisers that are no longer used in Australian production.

Sheet vinyl has a higher plastic content than tiles, 40-60% depending on the product type. Clean off-cuts can be recycled back into new product but demolition product cannot because of cement contamination from concrete or levelling compounds. It could be recycled into tiles but the high plastic content means it must be ground to powder first, 'micronisation', so that it can be mixed with limestone. One manufacturer has trialled micronisation with a company interstate but the shipping and re-processing added too high a cost. Investment and operational scale are needed to make a local facility viable, to reduce transport penalties.

Both sheet and tile products come in a variety of colours, which are not feasible to sort, so all colours are granulated together and reprocessed with black pigment – but there is a limited demand for black coloured flooring.

The Best Practice Guidelines for the Green Star PVC credit require product stewardship with a take-back option. The manufacturer advises that at the moment the only non-landfill destination for contaminated sheet is to incinerate as a secondary fuel source, but that to date only one project has taken up the take back offer.

The manufacturer is not seeing a consumer demand for recycled content in their products. The market is driven by price, followed by performance and appearance.

Recycled content can be supplied by recycled PVC bottles, but the resource is limited and the bulk of the available material is now being used by Vinidex in their pipes. The flooring manufacturer understands that kerbside recycling is bundled and shipped to China for sorting and granulation, and sold back to Australia, and the company is finding less recycled material is now available than previously.

This impression was confirmed by the recycler's experience. They don't see a lot of PVC and what they do get is currently going to landfill. The recycler advises that currently there is nobody in Sydney recycling PVC because it has to be flaked and cleaned. They are considering opening a small flaking and washing plant if they can get sufficient quantities to justify operation, which would allow them to recover 90% of PVC conduits and pipes from the waste stream. They are chasing an EPA licence for a waste-to-energy incineration plant for the balance, and believe there is suitable emissions control technology for it to be safe, similar to European processes.

Other plastic uses and general issues

PVC carpet backing presents a problem for incinerating old carpets because of EPA concerns. Much of the PVC wiring sheathing seen by the recycler gets recycled, although this does not appear to be universal. "The residual copper content of the PVC strippings [of cable insulation] is frequently greater than 5%, which is too high for PVC recyclers to tolerate" (Scheirs, 2003)

"Levels of PVC recycling are not limited by the material itself but by industry practices" according to Green Star's Best Practice Guidelines (GBCA, 2013), although there are significant difficulties with the material to be found in the literature, refer *End-of-life PVC Study* (Scheirs, 2003).

Plastics need to be sorted into the different materials. Sorting by colour must be undertaken manually so it is prohibitively expensive in Australia. It is not economic to refine really small pieces, often dirty, so the recycler ends up with residue.

Plastics get diluted as they are reprocessed due to contamination from dissimilar plastics, and they are downcycled into lower grade uses. Some pipes and conduits are a low grade rigid HDPE (high density polyethylene) and are readily recyclable and made from recycled content. PET (polyethylene terephthalate) commonly found in soft drink bottles, is a high-grade plastic that gets recycled. "Shopping bag films are the lowest quality and can't be used for other things" according to the recycler.

As mentioned in the glass section, PVB interlayers from laminated glass are recovered and recycled.

Difficult materials, including PVC, are reportedly sent offshore and are incinerated under less control than exercised in Australia. The recycler advises coloured films from Australia are burnt in Pakistan.

Possible improvements:

The industry would benefit from a better understanding of the ingredients in the materials specified, and the end-of-life options for products.

Local reprocessing plants would recover some of the material without the transport penalties.

6.6 CARPET

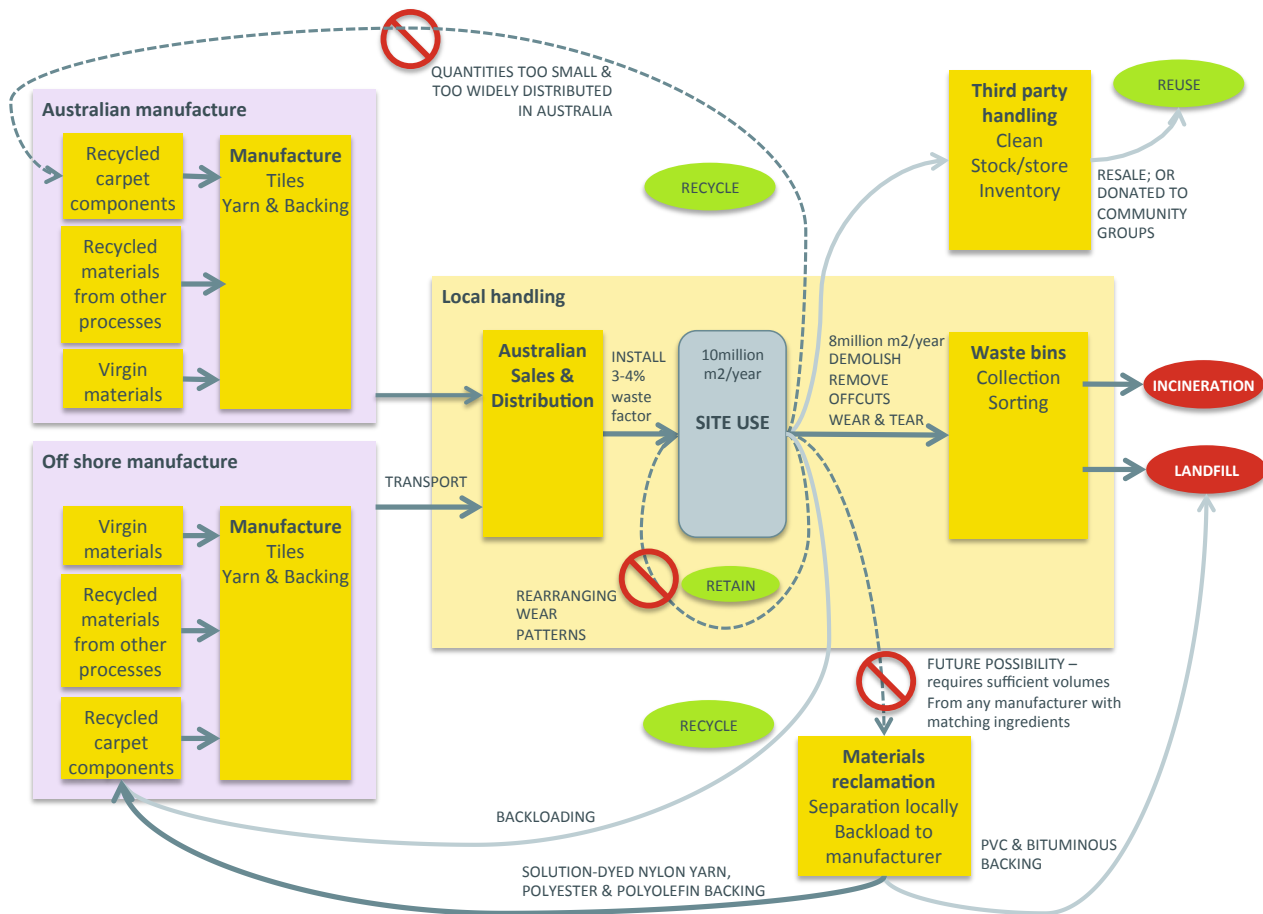


Figure 10 Flows and fates of carpet tiles

Carpet tiles have a reputation as a material with active product stewardship in place, which is the case for a small number of overseas manufacturers. Australian manufactured product is subject to long transport distances and quantities too small to make recycling economical. Rearranging the wear pattern of tiles to increase their lifespan is not common despite this being a claimed major benefit. Aesthetics is the main driver for changing flooring. There is a small market in resale of second hand product. Most material goes to landfill, with some incinerated.

Carpet was regularly nominated during the stakeholder interviews as a significant waste contributor. Little differentiation was made between carpet tiles and broadloom carpet, and few interviewees separately identified carpet backing or underlay.

Carpet tiles

This section mainly focuses on carpet tiles because they have greater potential for reuse and recycling, and are becoming the preferred flooring for commercial applications.



In recent times the number of local manufacturers has significantly reduced. There are now only three manufacturers of carpet tiles in Australia. Much of the product is now imported.

Carpets can have a life expectancy of 15 years but are frequently replaced much earlier for aesthetic reasons, around 5-10 years according to the carpet manufacturer. He echoed a prevalent view in the industry “Carpet is a fashion product”. Rather than wearing out it has been described as “ugly-ing out”. The manufacturer attributes this to lack of maintenance. An architect confirmed that they would replace carpet in refurbished buildings although they now tend to only do this in feature areas rather than throughout. Another architect advises that the amount of carpet replaced or retained is dependent on the client and designer, and tends to be replaced by choice for high budget projects.

Content

Carpets and carpet tiles have two main components. The yarn is the visible wear surface that may be wool, nylon, other synthetic fibres like polyester and polypropylene or a wool/synthetic blend. Solution dyed nylon is more commonly used yarn in high-end commercial applications, with the other synthetics used for reasons of economy where they comply with the building code.

Backings come in a variety of materials. The manufacturer described the four main backing materials for carpet tiles:

- PET (polyethylene terephthalate) used in cushion backing can be made from recycled content such as soft drink bottles;
- Bituminous backing is a graphlar compound that is not good for recycling or Green Star credits, although better than PVC. The manufacturer uses this for its ‘entry level’ products;
- PVC has a stabilising layer of fibreglass and goes to landfill at end-of-life;
- Polyolefin with a stabilising layer is fully recyclable and most efficient in reuse because it does not degrade. This is the manufacturer’s preferred backing.

Recycling

The carpet manufacturer we interviewed is a certified “Cradle to Cradle” company. It finds that the Australian market is not big enough for dedicated recycling. The overseas set up is better so they backload to their overseas plant as a better answer than landfill. Their process can take competitors’ product as well, except for that containing PVC. One of the contractors nominated carpet tiles with the ‘wrong’ backing as a landfill contributor in their experience.

In the carpet manufacturer’s recycling system the yarns are separated from the backing material and returned to the yarn manufacturer for remanufacturing, while the carpet manufacturer recycles the backing. Solution and stock-dyed nylons are used, with polyamide-6 the easiest to recycle but 6-6 also possible. The manufacturer is planning to



implement the same process in Australia when volumes are sufficient. A local plant will salvage and prepare materials for sending back to the manufacturing plant more economically than full tiles. By 2020 they hope to have a manufacturing and recycling plant established in Australia.

Product Stewardship

Without a product stewardship program in place most carpet tiles are sent to landfill or incinerated. The manufacturer gave the example of a project in Melbourne where another carpet company agreed to take back all tile product in the building for cleaning and redistribution. This was an unusual case because most companies are fussy about requiring full, clean tiles of their own product. One of the carpet tile companies has a take back program that can handle competitor's product. They clean and recolour tiles for resale, but this requires full tiles and a lighter base colour.

For reuse to occur, a dedicated collection of take up and companies that are committed to a stewardship program are required. In Europe trolleys are supplied to collect the material and reduce contamination and damage risk. The manufacturer believes that leadership is required from the architects or building owner during planning to specify the outcome for the old material. Since it is not often seen at the specification stage, the manufacturer suggests it is up to owner or tenant to drive the stewardship requirement. An architect has suggested product stewardship to clients for carpet tiles - which has not been taken up - but the architect sees it as an operational matter rather than a procurement or specification responsibility.

Reuse

Reuse of tiles in areas on site is not common, primarily because no one wants perceived second hand carpet. The differential wearing and problems with matching colour batches add to the difficulty. Some market segments do it and the manufacturer gave the example of universities that may take up tiles in a large area like a lecture theatre during upgrades and relay them in a smaller classroom. The success of this depends heavily on the condition of the take up product and good maintenance during the tiles' life.

There are companies that buy and clean old tiles for resale and some contractors quote work on this basis, but this is the exception not the norm. Some take up product is donated to community facilities or on-sold to low budget projects that are not fussy about the appearance, e.g. small factories and not for profits.

One of the touted benefits of carpet tiles is that the wear pattern can be rearranged to extend the life of the installation but the manufacturer has not experienced this happening. A reason given is that there is too great a contrast in appearance between the worn and unworn tiles. The study authors have experienced the wrong glues being used, which prevents the tiles being lifted for rearranging despite that being an intention for the future. Tiles do contribute to waste saving in that damage can be repaired by replacing single

tiles, rather than replacing whole rooms or areas or leaving unsightly patches as in the case of broadloom.

Specification control

Although it can be hard to track orders, the manufacturer confirmed product substitution happens, driven by the builders for cost reasons, especially in design and construct contracts. In his experience the finishing trades are affected most by budget overruns. PPP projects (Public Private Partnership contract arrangements) that have involvement of architects and interior designers in material selection perform the best with regard to minimising product substitution.

Broadloom

The composite materials in broadloom were cited by an architect as an impediment to recycling. The recycler advised that difficulties identifying the ingredients in each bit of carpet complicate the ability to separate and recycle the materials, leading to it being discarded. He is sceptical of the ability to recycle old carpet due to risk of dirt, chemical residues or spoilage through use or being in co-mingled bins, which makes recycling uncommercial.

The recycler confirmed that broadloom carpet and underlay is mostly sent to landfill or incinerated. The PVC backing of some carpets prevents them being burnt due to EPA restrictions.

The project manager nominated old carpet as difficult to find a market for.



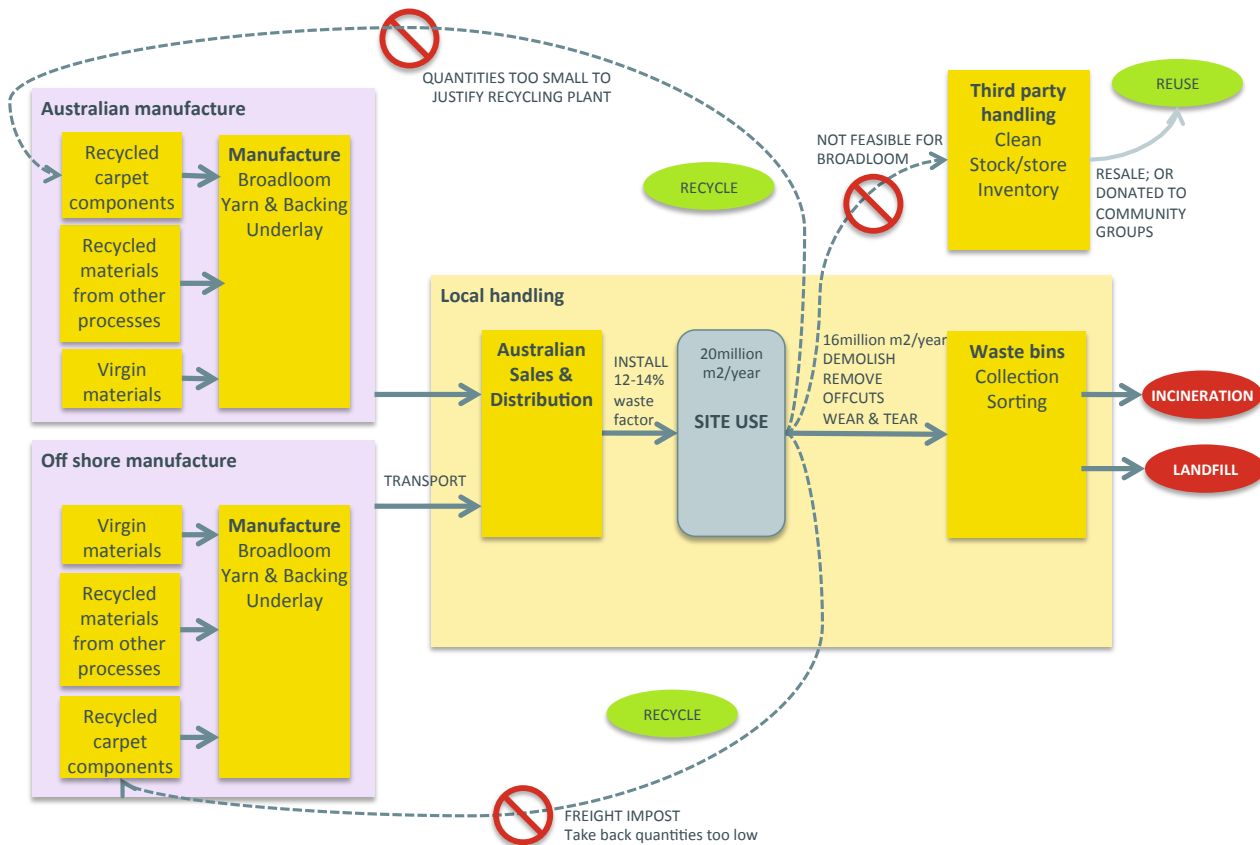


Figure 11 Flows and fates of broadloom carpet

Reuse of second hand carpet is rarely feasible and recycling is not deemed economical, despite the large quantities generated. Carpet is a major contributor to landfill.

Possible improvements:

More emphasis on stewardship in product literature.

Better consideration for end-of-life options at the start of the project.

Attention to ingredients of material.

Good maintenance during product life.

Program to rearrange wear patterns before high contrast between areas occurs.

Dedicated take up program for tiles.

Maintenance and stewardship information is available to the owner and referenced throughout the carpet's life



7 CONCLUSION AND RECOMMENDATIONS

Conventional industry wisdom about what is possible regarding waste reduction is not necessarily reflected in practice.

Cost and time are the most significant factors in all stages of the fitout cycle. These manifest in the design, materials selection and specification stage; the construction contract; during deficit and waste handling; and for the manufacturers trying to close the loop. At its heart is the lack of value the community places on existing resources.

There is high variability between companies and personnel in their knowledge of the opportunities to avoid landfill and the part they can play. For many, this stems from a lack of knowledge about how they influence outcomes and about the opportunities.

There is also variability between materials, in terms of the barriers to retaining, reusing and recycling them. Even though some of the materials that are frequently found in the fitout waste stream create large quantities of waste, there are claims that the quantities are not sufficient for a commercially viable recovery operation. There are many small disconnects in the industry systems that combine to create seemingly impassable barriers. This study surveys the breadth of the industry and attempts to identify the small reasons and excuses with the idea that placing them in the context of the whole system will highlight possible solutions drawn from the rich pictures of industry practice.

BBP wishes to actively contribute to the solutions. The recommendations in the following section have been grouped into those that BBP or its members can implement directly, and those that their combined industry power can influence. Some new business or enhanced market opportunities have been identified which, although outside the direct influence of BBP and its members, could be supported by this cohort through commercial support, investment or promotion. Some of the possible solutions are much broader, requiring political will or legislation, community support, or funding, where BBP could play a role through lobbying. These have been included in the final part for a complete overview of the study findings.

The recommendations are confined to general industry matters. Material-specific solutions have not been repeated from earlier sections.

7.1 RECOMMENDATIONS

Suggestions for BBP and its membership

Attitude

Attitude is a key element of getting the practices right. Even with all the structures and products in place for a reduced waste industry, it will not work if the people involved don't care, won't change or plead ignorance. The practitioner interviews demonstrated that



different outcomes are possible depending on the approach taken by the participants – one architect designs for reduced material use, another doesn't know where to find second hand fittings; one “sells” the design concept of using recycled materials to their clients, another worries that an existing fitout can't be adapted to a new tenant. As expressed by one interview subject “design and innovation are the answer; it is a mindset difference, not just marketing”.

BBP's role in changing attitudes can be twofold:

- In the first instance, it can provide sufficient information, support and awareness raising that participants cannot help but be aware that it is something they should be concerned about, and where to go to get information or help. This is addressed in the recommendation following, “Construction industry education and information”.
- In the second instance, BBP can consider ways to engage the industry, making waste reducing practices something participants want to do, seek out, and promote themselves for.

The community – industry practitioners and those who commission work - needs to be clear about what it is asking for. Where cost comparisons are made between a conventional and an environmentally sound solution, the relative qualities should be clear. Currently cheap, minimal or sub-standard, toxic, poorly performing materials, products and buildings are compared with well-designed, healthy, high performance “green” alternatives and favoured where the marketplace is uninformed. A fair comparison is required based on fully costed life-cycle implications, to encourage good choices.

Although new processes and systems are required in the industry and there are real, practical hurdles to be overcome, a widespread change in attitude will significantly progress outcomes that avoid landfill. Under time and budget constraints, some industry practitioners have no interest in being better informed but are pleased to follow checklists, standard process and be guided by regulation.

Experience with other sustainability initiatives in the last decade has shown that many get taken up and become business as usual within a short time of introduction, as practitioners become aware and see how to do their part - at least in the higher grade end of the property market.

Construction industry education and information

The study identified a pressing need to improve industry understanding of good practice, and the role each practitioner plays in reducing waste to landfill. Lack of awareness of where and how a practitioner influences the waste outcomes at the end of the functional life of a fitout means they are often making poor decisions or missing good opportunities.

BBP could address this through:

- Awareness campaigns to bring these matters to the attention of practitioners, owners and prospective tenants;



- Making information available for those seeking guidance on the where and how of waste reduction. This may require development of easy access tools and checklists;
- An education program for a deeper understanding of how to improve practice more systematically.

BBP members can contribute directly to the delivery of these activities. In addition, now that they are aware of some of the shortfalls in daily practice, the members can ensure better advice, standards, documentation and enforcement are implemented in their own practice and properties.

Matters to be addressed, and the participant group(s) best targeted:

All

- Activate the waste hierarchy. The industry needs more widespread consideration of how to retain and reuse products on site and work with what is there. Use of second hand materials and repurposing should be other options widely used.
- Terminology matters. “Demolition” should be abolished from our language and specifications, and replaced with “dismantling” to encourage the idea that done with care, the resources are recoverable.
- Build requirements into contracts and enforce them;
- If the industry expects materials to be recycled or recyclable it should be prepared to specify and use the resultant materials. The market for these products needs to be strong for the business case to undertake the transport and handling involved.
- Pay attention to the ingredients in products and understand the significance of each. Industry needs information about what materials are hazardous and how to dispose of them. One of the interview subjects was concerned that middle management is making decisions and doesn’t understand the consequences.

Owners and tenants

- The property industry needs to change its expectations of the time required to undertake design and construction work. Contract time is currently inadequate to source and handle the better materials. Tenants need to require that recycling be incorporated in their projects, and understand that it takes extra time.

Consultants

- End of life considered at start. Designers need to understand the end of life consequences when a product is being selected and its installation detailed, and the role they play.
- Processes are needed to identify and promote reuse options to specifiers. It needs to be as easy to source second hand items as it is to order new, and relatively risk free. Opportunities that are currently available are unknown to some of the participants.
- Design to standard product dimensions. Plan the layout to reduce off-cuts.



Consultants and Builders

- Clearly incorporate maintenance and product stewardship details into operation and maintenance manuals for handover to occupant and owner at construction completion. The documentation should follow the materials, and this should become standard practice so that there is a consistent place where everyone knows to find information that improves the durability and reuse of materials, and can facilitate take back at the end of its life.

Builders

- Site separation of waste loads to facilitate recycling of material should be standard site practice reinforced by site management practices.
- Site management needs to improve to reduce instances of cross contamination and rubbish in bins.
- Any product substitutions offered in the course of construction should be accompanied by an explanation of how the sustainability criteria match or better the material being substituted.

Leasing and make good

Lease arrangements lock in obligations for tenants. A review of standard leases, and promotion of alternative arrangements will open opportunities for less wasteful practices at end of lease.

BBP and its members can contribute by:

- commissioning new standard documents and making them widely available,
- raising awareness within the industry of alternative practices,
- promoting existing good examples of documents and tenancy arrangements,
- implementing best practice in new leases.

Particular focus for improved practice:

- Tenancy make good should be removed from the responsibility of the outgoing tenant and any requirements routinely incorporated into works undertaken by or for the incoming tenant. This approach of integrated fitouts increases the chance that existing resources will be retained and removes the repeated reworking that is responsible for much of the waste in this sector. Lease arrangements that facilitate this are currently in use and should be promoted throughout the industry to become standard.
- Property managers can take greater responsibility for outcomes. Since actions are not taken where extra effort is required unless there is some obligation such as a contract or a formal rating, the more requirements can be built into leases and contracts, the more the practices will become embedded in the industry. Options include:
 - Construction contracts to require waste management systems.
 - Design standards for a building to set requirements for tenancy performance.



- Greater diligence by facility or asset management to maintain material specifications and consistency of product use.

BBP influence

Tenant responsibilities

Tenants need to be aware of the consequences of their fitout decisions and the options available to them. If they can include requirements in leases, consultant agreements and construction contracts the options can be enforced, and hence are more likely to be practiced.

Using established networks with bigger tenants, BBP can alert them to the opportunities and consequences, and offer advice and assistance to implement support structures, such as standard design standards and specifications. Smaller tenants can be engaged at time of leasing, and educated about new lease arrangements they are being asked to commit to.

Range of tenant responsibilities includes:

- Seek floor space with existing fitouts, to be reused;
- Reduce tenancy churn;
- Reuse their own existing furniture and fittings in new premises;
- Require Waste Management Plans be included in construction contracts;
- Encourage widespread use of second hand and repurposed materials;
- Require use of materials with recycled content;
- Allow sufficient design and construction contract time for good practices;
- Require products to be fully specified and reject substitutions;
- Contract for product lease and take back options;
- Keep and use easily discoverable records of maintenance requirements, product stewardship contracts and spare material.

The role of EPA

Several examples were reported in the course of the research, where recycling opportunities were restricted by EPA regulations. There may be an advocacy role for BBP to work with the EPA on problematic cases, and to act as a bridge to proponents with an interest in implementing innovative solutions. Materials that warrant further investigation are engineered timber and fibre cement sheet.

Eco-labelling

Another advocacy role for BBP is with eco-labelling schemes to ensure the end of the product's life is accounted for, and that they fairly compare materials based on recycled content and recyclability.



Beyond the influence of BBP

New and enhanced business opportunities

With improvements in the quantity of material bypassing landfill, new opportunities become available. Economies of scale are required to make reuse and recycling of fitout materials the norm – if there is enough demand and activity it becomes worthwhile to set up the businesses to do it. These businesses already exist in places, but they are not known about widely enough, and in a stronger environment for reuse and recycling, it can be expected that there is room for more.

The role of BBP and its members would be to promote and patronise businesses that address these needs.

- An online inventory of second hand products, by an organisation that repairs and refurbishes products, could grow the market in reuse. In the view of one of the architects interviewed, the business case is the speed of delivery, logistics and cost. If second hand materials are quicker to deliver than new products that have shipping lead times, then they could win market share even though they tend to be more expensive because of the handling.
- Access to a good “ecosystem” of operators who collect, assess, sort, stock and refurbish products makes it much quicker, easier, cost-effective and therefore attractive for a specifier to risk choosing to reuse materials. These roles are suitable for small business operators, perhaps working cooperatively.
- Related to the above point, good ongoing maintenance and cleaning of fitouts, and the repair of damaged fixtures and equipment offers a way to lengthen their life. As well as avoiding early replacement, items may be more suitable for reuse at end of tenancy life.
- Localised reprocessing plants would mean material does not need to be transported large distances. Reprocessing may be into new products, or it may be to break down a product into constituent materials ready for remanufacture and for easier transport.
- Innovation is required to develop ways to recover materials that currently involve cost-prohibitive manual handling. As a niche business, or for personal use, such manual involvement may be feasible, but it clashes with the safety controls of industrial scale waste recovery operations. An example in the study is solid section timber delivered to the recycler.

Wider impact recommendations

Product Stewardship

Treating a product as a resource, instead of as waste, at the end of the life of the installation is the first step in recovering its value. Effective product stewardship requires changes to the mechanisms currently in place. BBP can influence the first two aspects through industry education and awareness raising.



Care with removal and handling of the materials reduces damage and contamination for better recycling outcomes. Innovation in how materials are taken from site - handling, packaging and transport options – may find ways to improve recyclable quantities or increase the range of materials for which it is feasible.

Take-back and leasing offers are more likely to be taken up as designers and specifiers become more aware of the potential for product stewardship, take responsibility for incorporating the requirements into the procurement process, and provide the documentation that records the commitment. Manufacturers will need to match their offers with real capacity to efficiently use returned material. Lack of local manufacturing currently prevents much recycling of any consequence. In the early stages, the manufacturers that are leading the way are those that implement local processing plants to recover materials.

A current impediment for the material owner is having to pay the cost of return transport. Alternative contract arrangements, such as including the transport cost in the initial capital outlay for the material, need to be investigated to remove this barrier.

The current contractual arrangement for take back and leasing is that responsibility rests with the purchaser of the material. As the original purchaser may no longer be in possession, or attendance, and will not be in practical control of removal activities even when they are, any take back commitment should be attached to the product. A dismantling contractor can then take responsibility for returning a material, in a schedule to suit site activities.

A major reason given for not recycling is the transport penalty to move materials across the country to a central reprocessing plant. In a future world with most materials being recovered, there may be sufficient quantities for a number of such plants, and therefore the chance to have them local to the main urban centres.

Product manufacturer responsibilities

The way a product is designed and manufactured, the information made available about it, and consideration for its full life cycle are within the control of manufacturers and should be within their responsibility. Aspects that are already addressed by manufacturers advanced in this field include a range of actions that should be taken up more widely.

- The use of composite materials should be avoided. Where they are necessary, the product needs to be designed for separation to allow end-of-life recycling.
- In an ideal future everything will be recyclable. One of the interview subjects proposed there be legislation insisting that everything must be recycled.
- Clear labelling of material content where feasible, similar to plastic recyclability numbers, would facilitate future recycling of some materials.
- Offer and promote customised material sizes, such as is done with plasterboard and glass, to reduce site offcuts.



- One manufacturer with a product needing ongoing maintenance for adequate durability and performance noted a project example that had no problem with the budget for capital expenditure but had no maintenance budget. The solution was to include a maintenance program in the sale cost.
- A furniture manufacturer interviewed recommends 'vertical integration' for materials handling – materials in, product out – for full responsibility to be consolidated and efficiencies to be realised.
- Provide Environmental Product Disclosure (EPD) statements for all products. Lack of transparency about the true content and fate of materials makes it hard for informed decision making by specifiers.
- Provide Material Recovery Notes (MRN) to advise practitioners on what to do with a material at the end of its life.
- Plan for the end of the product life. Design it for repair, dismantling, separation of materials, reuse of components, and recycling of materials within the original process. Implement these processes and make them available to all customers.
- Reduce packaging of products. Investigate bulk packaging, and alternative delivery methods. Any packaging that is required to protect the product integrity should be designed for reuse and taken back by the manufacturer. It should be recyclable at the end of its service life.

Research

A number of materials do not have end-of-life options and warrant further research to remove the problem. This could involve alternative materials to serve the function, alternative manufacturing of the material to make it recyclable, or discovery of new uses for the old material. Materials for which this is a particular problem include MDF, fibre cement sheet, ceiling tiles (synthetic mineral fibre), and some plastics.

In the view of one of the architects interviewed, changes to the system have to be done with innovation and design. Processes need to be in place so the whole system is intrinsically changed. It needs a company seen as innovative to set the trend.

Landfill

Of all the solutions that were identified during the course of this study, the overriding one is to increase landfill fees. If the cost to dump materials increases, the cost of retention, alternative uses and recycling become more attractive and competitive.

- Increase landfill fees nationally. This recommendation comes with a note of caution that differences in landfill fees in different jurisdictions can drive perverse outcomes, so fees and levies should be consistent across jurisdictions. Since Queensland reduced its fees recently, there have been media reports of NSW waste being transported across the border for less total cost than dumping locally.
- Ban mixed loads and require that all waste loads are sorted and materials are recovered for recycling before any residue is allowed to be dumped.



- Ideally landfill will only accept residues too small for recycling, and hazardous materials.

Waste to energy

NSW EPA recently (March 2014) released a policy statement on energy from waste that supports the concept. “The statement sets a framework for the operation of purpose-built facilities to recover energy from residual wastes that are not able to be recycled and would otherwise be disposed of to landfill.”(NSW EPA, 2014) There are many reuse and recycling opportunities for fitout materials that should be exploited before this point, but recovering the embodied energy of a material is a preferable environmental outcome to sending it to landfill.

This is a new business opportunity that could supplement the operations of a materials recovery facility or waste sorting depot, as is desired by the recycler who was interviewed for this study.



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A. APPENDIX

INTERVIEW QUESTIONS

1. Background and experience with commercial fitouts

Confirm the role your organisation takes

Outline your relevant experience.

2. Materials

A. In your view, generally how old are fitouts that are replaced? With what frequency, to what extent, are they churned?

How long are the fitouts you design/install supposed to last?

B. Which materials do you recall as having the biggest waste quantities?

Which materials do you deal with that have the biggest waste quantities?

Why do you think more material is not retained on site or recovered from sites?

For each material mentioned:

Can you quantify the waste volume?

Why is it sent to waste? Why do you think it is not salvaged and reused? Could it be? What would stop you retaining materials on site to reuse them?

If there was a way to recover it for reuse would you use it second hand? If not, why not?

If the material could be recycled into new product, would you specify it/one with high recycled content?

Do you have any data we could use on waste volumes, recovered or otherwise?

Is/could the material be recycled into new product? What would be required to make this happen? Are there any issues with this product having high recycled content?

C. Material trends? Are there any new materials being specified?

Who is driving innovation? Is there an Australian opportunity in this market?

D. Do you use products and materials with recycled content? Which ones and why? If not, why not?

Do ratings systems such as Green Star, or eco-labelling such as GECA or Ecospecifier affect the products and materials you specify?

Do you require compliance with ratings systems such as Green Star, or eco-labelling such as GECA or Ecospecifier for the products and materials on your site/s?

Do ratings systems such as Green Star, or eco-labelling such as GECA or Ecospecifier affect your manufacture/supply?

Do you look for products with take-back, leasing or product stewardship schemes in place? Would you make use of this where it is available? Where products have take-



back, leasing or product stewardship schemes in place, would you make use of this?

Why, why not?

Do you provide take-back, leasing or product stewardship schemes?

If yes :how well is it used? What would increase the use of these schemes for you?

If no: why not, and what would prompt you to start?

Do you use existing or refurbished materials? What materials, and how often?

How often do clients expect or demand green materials? Do you find client/specifier resistance to using recycled content or second hand materials? Are there different preferences in different clients profiles / segments?

How often do you expect or demand green materials? Do you have any concerns with using recycled content or second hand materials?

Would you ever consider sending fit out materials to other sites in your portfolio for reuse? e.g. b or c grade assets

Would you ever consider this as a business opportunity? Under what circumstances?

Do you have any green requirements in your standard specification, construction contract clauses, lease conditions, design standards or other documentation i.e. use of recycled content, salvage of demolition materials, reduction of waste on site, building in prototypes and samples?

What, if any green information is there in your product literature?

Do you ever design for disassembly or dismantling? Are there any issues with this?

Can your materials be design for disassembly or dismantling? Are there any issues with this?

What proportion of products is procured by the contractor?

Do you find that specified materials are often substituted? Which ones? Why?

E. Are there any financial implications for or against using second hand materials? For example, balance sheet impacts of incentive structures, depreciation finance, or tax rules? Is it a factor in decisions?

3. Process

A. How easy is it to separate, collect, sort and reuse materials on site?

Typically, what proportion of waste materials would go to landfill?

Do you have any data we could use on waste volumes, recovered or otherwise?

Does the size of the project impact the ability to separate and divert waste ie. are some projects too small to bother or are some projects so large it's too complicated (with subbies, etc)?

What is a typical process and who are the players? Is everything collected by a waste company and sorted off-site, or do you arrange for some materials and salvage items



to be collected directly? How is the chain of custody documented / evidenced?
Quality and consistent use of waste management plans?
Who is liable for the waste leaving the building?
What would an ideal process look like?

4. Conclusion

A. Are there any changes you would like to see in:

Product information;

Materials handling;

Waste systems?

B. What do you think would have the greatest impact on reducing waste in the industry?

END



EMAIL INVITATION

Dear ---

The Institute for Sustainable Futures is currently undertaking a study for Better Buildings Partnership through City of Sydney to investigate waste quantities and reduction opportunities due to office tenancy fitouts and make goods.

The project has reviewed the literature on main materials contributing to waste and the processes and barriers limiting reuse and recycling. We are now seeking to verify these findings and to look into industry awareness and knowledge of the subject. We believe you will add value to our study so we are requesting your help by agreeing to be interviewed.

The subject of the interview will be your experience with waste on fitout sites – the contributing materials, why materials are removed, and your views on recycled materials.

The aim of the project is to provide information to assist BBP and stakeholders to direct efforts at reforming industry processes, inform industry education and awareness campaigns, and trial practices that will reduce the quantities of waste going to landfill from commercial fitout work. The final report may be made public by BBP or City of Sydney and will be published on the ISF website.

The interview may take 30-40 minutes. It can be face-to-face or by telephone to suit your availability. Before the scheduled interview we will send you a short list of questions that we will use to guide the discussion.

We would prefer to quote you in our report by name and role if you would agree. We will provide the opportunity to confirm any quotes before they are published. Alternatively, the interview can be quoted anonymously or attributed to your organisation but not yourself. You may specify whether you agree to be listed in a table of interviewees or not.

Studies undertaken by the Institute for Sustainable Futures have been approved in principle by the University of Technology, Sydney, Human Research Ethics Committee. If you have any complaints or reservations about any aspect of your participation in this research you may contact ISF Research Directors Emma Partridge [tel: ---] or Chris Riedy [tel. ---], or ISF Institute Manager Carroll Graham [tel: ---]. You may also contact the UTS Ethics Committee through the Research Ethics Officer, [tel: ---]. Any complaint you make will be treated in confidence and investigated fully and you will be informed of the outcome.

We hope you will agree to participate in this research. Please contact me if you wish to discuss any aspect of this invitation.

One of our team members will contact you to organise a suitable time for the interview.

END



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