BOOMERANG ALLIANCE

Mattress Recycling & Disposal

THE COLLECTION, RECYCLING AND DISPOSAL OF USED MATRESSES IN VICTORIA

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EXECUTIVE SUMMARY:

End of life mattress recovery, recycling and refurbishment is a valuable activity that delivers significant environmental and economic benefits. For every tonne of used mattress material recycled there is an estimated 1.5tonnes of Co^2-e savings in greenhouse gas material and some $25M^3$ of landfill space preserved.

Recycling mattresses is surprisingly complex; requiring dismantling and separation processes that requires significant capital investment to undertake safely. While not common, sub-standard handling and processing of end of life mattresses has been known to:

- act as a vector to allow parasites (mites, bed bugs) and contagious disease (via infected blood, sweat, urine, faeces) to be transmitted across the community;
- create OH&S risks (lifting, eye injuries and lacerations), contribute to lung disease (inhalation of fibres and dusts), and increase the risk of fire at storage facilities;
- result in illegal dumping and other unlawful disposal methods; and
- take up significant land fill space and lead to instability within the fill.

Concerned about whether the current practice met the community's expectations, Boomerang Alliance commenced a review of the sector in Victoria in September 2015.

The results of our review highlight significant inadequacies across the sector and an uneven level of service between different operators. However, it should also be noted that the vast majority of operators should be congratulated on their efforts – most where committed to pursuing the highest standards possible but are stymied by a lack of regulations and industry standards to regulate the management of mattress waste and an approach to contracting within the local government sector that often does not encourage the maximum level of resource recovery.

Our investigation highlighted a number of serious concerns, which include:

- The fate of as many as 166,000 mattresses (38% of sales) in the Greater Melbourne Metropolitan area is unknown;
- A very high rate of illegal dumping (over 8% of all collections are recovering illegally dumped mattresses, plus an unknown amount of mattresses that are not yet recovered);
- The rate of mattresses recycled and the overall recycling rate of the materials recovered are exaggerated.
- Dismantling and shredding of mattresses for recycling and/or landfill space reduction generates a very large quantity of small lightweight mobile plastic pieces – ranging in size between $5mm^2$ down to nano-scale dusts and fibres of 75nm in diameter (around the thickness of a human hair). These materials have toxic properties and represent a substantial health risk to workers and major environmental impacts (particularly in the marine environment). Large volumes of uncontrolled micro plastics were evident at all sites and at all outdoor operations we recorded very high levels of these pollutants escaping the sites and entering the stormwater system.
- While we observed a diligent approach to inspection and cleaning of mattresses for resale and refurbishment, unlike the USA, there is no common standard for sanitation or clear requirements to inspect for contagions, nor are there any labelling requirements to ensure that purchasers are aware the product is refurbished or stating how the mattress had been sanitised.
- There is little incentive for recyclers to maximise the amount of material that is recovered (as the materials outside of steel are lightweight and cheap to dispose of and offer little financial value). This has seen comprehensive recycling programs (who operate a far much capital and labour intensive operation) forced to compete at the gate prices of partial recycling and landfill reduction despite without recognition in considering contracts.
- The potential for improper waste levy avoidance is high, where shredding is undertaken inside the gate (past the weighbridge) at landfill facilities and waste transfer stations.

Recommendations:

- *The Victorian State Government should undertake a detailed and formal study to better understand the fate of end of life mattresses in Victoria***.**
- *The disposal of whole mattresses to landfill should be banned in urban centres.*
- *The only way to eliminate the high levels of illegal dumping and micro plastic pollution escaping facilities already evident in mattress disposal is to establish the environmental licensing of collectors and recycling facilities or establish a product stewardship scheme where the cost of disposal has been embedded within the sale price.*
- *While beneficial, the sale of refurbished and re-used mattresses should only be permitted with a formal approval by state government. At the minimum this license should describe the minimum sanitation standards required before resale, labelling requirements and storage regimes to isolate any mattresses which may represent a bio-hazard.*
- *Shredding and dismantling should NOT be undertaken in an outdoor environment where it is exposed to wind and rainwater.*
- *Sumps that will capture fine microplastic dusts and fibres should be fitted to any stormwater outlets and drains to sewer at mattress recycling sites and surrounding roads.*
- *Residual waste should always be placed in a bin (not added loose to a waste pile). Bins to t residual mattress waste should be situated where they are protected from wind and in units with a lid and not left outdoors*
- *Local Council and the EPA should regularly inspect the boundaries of mattress recycling facilities and issue fines where microplastics are evident outside the site boundaries.*
- *Workers should wear dusks mask eye protect ion and gloves whenever handling or dismantling mattresses.*
- *Lifting and moving equipment to reduce back injury are commonly used in new mattress delivery and removals operations. Collection vehicles should be fitted with hydraulic lifters and dollies used for moving mattresses. On site mattresses should be moved via conveyor belts or earth moving equipment.*

What Next?

During February and March Boomerang Alliance will be hosting a number of meetings seeking feedback regarding our observations and the development of a minimum standard for safe operations.

During this time, we will also seek to undertake a similar review of mattress recycling in NSW.

As part of our consultations we will also meet with proponents for a voluntary product stewardship scheme and seek to use the proposed standard as the operational basis for revised state regulations and possible EPA licensing and/or enhanced regulation.

INTRODUCTION:

End of Life mattresses are a significant component of the waste stream – it is estimated that some 1.6-1.8million mattresses are disposed of each year – representing approx. 51,000 tonnes per annum. While this represents just 0.1% of the total waste stream, mattresses are a significant aspect of the specialist areas of waste and recycling that deal with dismantling of products into individual materials for actual recycling such as e-waste (computers and TVs), general electronics, mobile phones refrigerators and air conditioners, white goods, automotive, tyres, batteries, mercury containing lights etc.

The recycling of assembled products creates significant residuals which are often not sold as recyclate and accordingly, the stated recycling rate is often exaggerated. In the case of mattress recovery, it is apparent that while operators claim as much 75% of all mattresses are recovered for reprocessing the overall amount of mattress material recycled may be less than 40%.

Further, the nature of mattresses construction means that around 42% (by weight – 80+% by volume) of each mattress is made up of synthetic latex, textiles and foam, which become brittle during their life and break up into microscopic fibres and nanoplastic dust during disassembly and shredding. When uncontrolled, these materials are a significant health and environmental hazard and also reduce the amount of material actually recycled. Our initial testing indicates that production losses can be as much as 20% of its contents (by weight) during dismantling and shredding This results in significant over-estimations regarding recycling rates and also causes high potential for mattress recycling to be a potentially major point of pollution (particularly when disassembly and shredding occur outdoors).

Mattresses are also a major source of illegally dumped materials – Victorian Councils report that 8.3% of the mattresses they recover were illegally dumped. After factoring in those mattresses not recovered by council (i.e. disposed of by a commercial operation at an abandoned industrial premises, by an op shop or remaining in an unidentified dump) it is likely that more than 1 in 10 mattresses end their life by being illegally dumped.

Combined with potential pollution from escaping fibres or dusts discussed later in this review, it is apparent that, conservatively, 20-25% of all recovered mattresses end their life outside of the control of legitimate waste and recycling facilities – making it one of the highest risk sectors of the waste stream. The table below compares mattress disposal with other recycling requiring disassembly in volume and relative recycling g performance levels:

Waste Stream (To Be Completed)	Generated (Tonnes P.A.)	Recycling Rate %
Automotive	900,000	78%
Tyres	408,000	36%
E-Waste (TVs & Computers)	131,607	40%
E-Waste (Mobile Phones)	1,232	8.6%
Fridges and Air Conditioners	103,600	32%
Lead Acid Batteries (Auto)	80,200	87.2%
Mattresses	51,000	35%
Mercury Containing Lamps	14,200	5%
Plastic Bags	21000	1%
Microbeads (in cosmetics)	1,000	0%

Further, the foam and textiles used in the manufacture of mattresses present a number of hazards to the environment: microplastics and synthetic fibres[1] have a high potential to reach the marine environment and are proven to be absorbing toxic chemicals at concentrations some 1 million times greater than the seawater surrounding it[2]; the materials themselves include a number of toxics including benzidene, brominated flame

[1] Predominantly comprising polyester, rayon, polyurethane and polystyrene - all significant polymers polluting the world's oceans
[2] Algalita Marine Research Foundation

retardants (carcinogenic), carbon disulphide (a neurotoxin), and styrene-butadiene (mutagenic and carcinogenic).

There are strong opportunities to re-use and refurbish mattresses – which is the priority activity within the waste hierarchy and a relatively strong market for second hand mattresses. However, there are ongoing concerns regarding the potential bio-hazards that could be presented without an established standard for biological testing and subsequent sanitation.

Within this context, Boomerang Alliance decided to undertake a review of the sector to determine the performance of mattress recyclers, extent to which environmental and health risks are well managed and truth behind various environmental claims. We selected mattress recycling in Melbourne as the Metropolitan Waste and Resource Recovery Group (MWRRG), through Mobius Environmental, had reviewed key aspects of the sector – establishing something of a base line for our work.

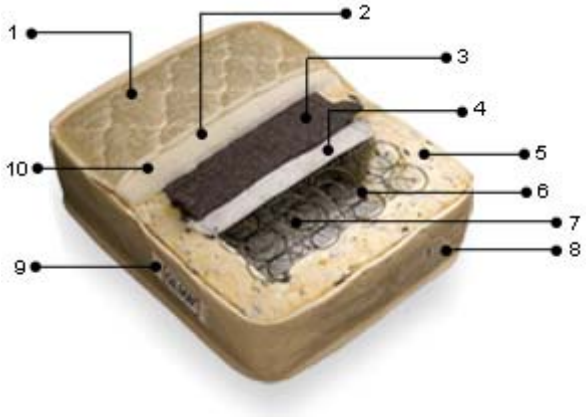
The review seeks to outline the current handling of mattresses, provide a framework for the best practice approaches to handling mattresses and make recommendation regarding the regulatory / product stewardship actions necessary to ensure the appropriate recovery and disposal of mattresses.

Our review:
To undertake this review Boomerang Alliance undertook a comprehensive desktop review of literature regarding mattress recycling; identified a number of key players within the mattress industry to be interviewed; and covertly observed a range of collection, processing and disposal operations in Victoria to inform ourselves regarding the current practice. We also sampled the output of one major local recycler (TIC Mattress Recycling) to assess the accuracy of assumed average weights used by the industry and to establish the actual amount of material recovered post processing. 5 Victorian mattress collection and recycling operations were chosen to be both interviewed and investigated to establish: the degree their recycling claims were legitimate; and whether the operations are undertaken in a responsible and safe manner. Using this information, Boomerang Alliance has sought to: benchmark each operations level of recycling and re-use achieved; check that environmental and safety claims were accurate; identify compliance with relevant state and local government regulatory standards; and check specific aspects of the operations that can cause pollution, safety and/or environmental health concerns.

The operations selected for review are diverse in their scale of operations and approach to recycling. They are: Bed Collect (largely refurbishes mattresses), Jubilee Trial, Kush-Inn (based at Wyndham Landfill), TIC Mattress Recycling (TIC), and WM Group (based at Knox Transfer Station). Each organisation reviewed was approached and asked to assist; where they agreed Boomerang Alliance also offered to do a more detailed review for their own purposes. TIC accepted this offer and their open book approach allowed us to delve down into core issues with much greater confidence. The intention of this review is not to name and shame and subsequently do not intend to publish our review of each operation individually.

In general, we congratulate the industry on their openness to the need for independent scrutiny and assistance in understanding what constitutes legitimate re-use and recycling within the mattress sector. While there were identified risks and failings at all operations and the standards of safety and recycling varied greatly from site to site, 4 out of 5 operations were observed to be diligent product stewards who accepted feedback regarding shortcomings and were committed to corrective actions suggested. 1 operation was viewed as suspicious and we believe is potentially acting in an unlawful manner – this operation has subsequently been reported to the proper authorities for further investigation.

WHATS IN A MATTRESS:



While there is no uniform construction of a mattress in general the various component parts typically include:

1. **Ticking** is the mattress cover made from a largely synthetic quilted (2 layers of cloth stuffed with a synthetic material. Most (particularly in the low to medium priced mattresses) ticking is made from a blend of polyester, polypropylene and viscose rayon polymers and is treated with a flame retardant.
2. **Foam Padding -** A layer of either polyurethane foam or synthetic latex generally made from styrene-butadiene rubber or a derivative of same.
3. **A felt pad** that acts as an insulator. Traditionally felt or wadding was made from natural fabric scraps (cotton, wool etc.) but today is generally a mix of natural and synthetic textile scrap including acrylic and polyethylene.
4. **A layer of non-woven fabric** generally comprising rayon (in older mattresses), polyethylene terephthalate (PET) and/or polypropylene.
5. **Spring support** made from high density polyurethane foam.
6. **Metal springs** for support. The steel in a mattress represents around 40% of the total weight.
7. **Metal wire** used to tie the spring units together
8. **Plastic Air Ventilators** are small pieces of rigid plastic used to allow air circulation through the mattress
9. **Product labels** are typically satin or rayon textiles
10. **Thread** in the quilted ticking is typically a heavy duty cotton.

MATTRESS DISPOSAL

End of Life Mattresses: In Australia it is believed that some 1.6 – 1.8 million mattresses reach their end of life each year – A survey undertaken by Mobius Environmental Consulting for the MWRRG (the Mobius Report) identified that some 427,000 new mattresses were purchased in Metropolitan Melbourne in 2014 (95% of which are for residential use and 5% for institutional use (hospitality, gaols and hospitals etc.). Assuming a 1 for 1 rate of disposal, the Melbourne sales figures are broadly consistent with national recovery data.

At the end of its first productive life, mattresses are either landfilled, recycled, refurbished for a second life or dumped.

The Mobius report identified that some 271,000 mattresses were recovered by commercial mattress recyclers under local government contracts, dropped at transfer stations or landfill sites (where typically the steel is recovered and the mattress size reduced for landfill) or collected by councils themselves. Of these council reports that they recover some 19,600 mattresses that were illegally dumped (8.3% of their total collections).

At face value this indicates that 36% of all mattresses sold (153,000 p.a.) in Greater Melbourne are not a replacement but represent market growth. This seems implausible the vast majority of sales are to persons that already have a bed and while the population of Victoria is growing at a rate of 100,000 people per annum, new domestic arrivals are likely to arrive with a mattress (and other household furniture). Over and above the number of new mattresses sold is a second stock of second hand and refurbished mattresses sold (which in turn replace another 13,000 mattresses that should be recovered. As a result, we believe that a very large proportion of the 153,000 mattresses (whose fate is unknown) are likely to be stockpiled, illegally dumped, transhipped outside of Melbourne or landfilled in mixed and unsorted loads.

Based on our observations Boomerang Alliance believes that the claim that 99% of mattresses are recovered and that the overall recycling rate for end of life mattresses are both exaggerated. With up to 38% of all

mattresses having an unknown fate; the limited proportion of the mattress that is actually recycled; identified losses of material during disassembly and shredding; and allowing for contaminated mattresses recovered but not recycled; and would indicate that, overall, a more realistic estimate is that around 35-40% of the total weight of materials used in mattresses enjoy a second life.

Recommendation: The information regarding the amount of mattresses disposed on in Victoria is very poor and there is reason to suspect that many moor mattresses are improperly managed than previously believed. The Victorian State Government should undertake a detailed and formal study to better understand the fate of end of life mattresses in Victoria.

Mattress End of Life Pathways: Based on the available in formation our best estimat**es** of the various pathways when a mattress ends its first life in Greater Melbourne is thought to be as follows:

Fate of Mattress	# Mattresses (% of total); Tonnes	Material recovered (Tonnes[3])	Comment
Unknown	166,000 (38%) 4,980 TPA	0	(Difference between stocks of sales and recovery = 427,000 new mattresses p.a. + 13,000 refurbished mattresses – 227,000 recovered mattresses). While not all sales of mattresses are a replacement, it is difficult to believe that 38% of sales are not a replacement and don't generate an end of life mattress.
Refurbished or re-used	13,000 (3%) 386 TPA	386 TPA	Assumes 3% re-use (based on Mobius Report for MWRRG)
Fully recycled (recovering 70+%)	110,000 (25%) 3,300 TPA	2,310 TPA	70% - While some recyclers claim to be recycling 85% of all mattresses, tests conducted by BA indicate that significant production losses occur during dismantling and shredding (2-3kgs of steel; 2-3kgs of synthetics; and some timer / cotton)
Partly recycled and landfilled	130,000 (30%) 39,000 TPA	1,560 TPA	At best 40% - Based on 12kgs of steel per mattress recovered (20% production loss through the shredder and or staples and straps not recovered
Illegally Dumped	20,000 (5%) 588 TPA	0	While later re-processed we subtracted illegally dumped mattresses from the above recycling estimates to reflect the mattresses initial fate.
TOTALS:	440,000 13,200 TPA	4,256 TPA	Apparent Recycling Rate = 32.3%

Unknown: The final fate of nearly 40% of all mattresses is unknown - this is cause for significant concern and is indicative of regulatory failure.

Re-Use: Mattresses are an attractive product for re-use. Where clean mattresses in good condition can be recovered there is both a healthy (if niche) commercial market at the lower end of the market and via op shop sales and the provision of furnishings for crisis / emergency accommodation. The Mobius report identified that 3% of recovered mattresses were re-used, though it should be noted that if op shops were included in a future survey this number may be significantly higher.

A Bed Bug

[3] Total tonnes recovered and reprocessed expressed as whole mattress units. 1 mattress = 30.2kgs

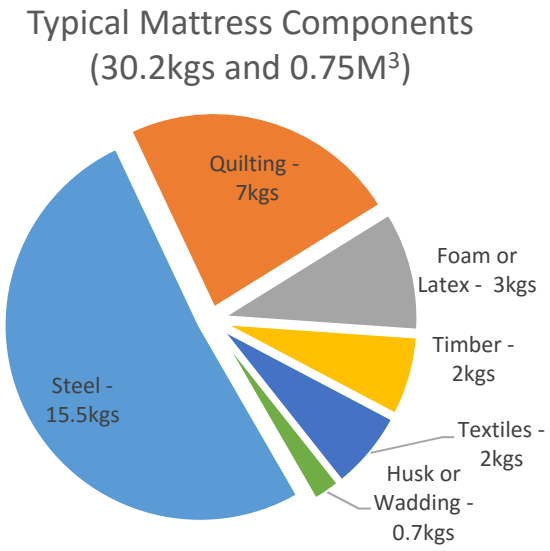
Providing a second life to used mattresses (either through second hand sale or refurbishment and re-use) is the best environmental outcome at the end of initial productive life.

The opportunity to re-use second hand mattresses has been a divisive issue for mattresses manufacturers and recyclers – with industry scuttlebutt claiming infestations (beg bugs and mites) and potential bio-hazards (from blood, urine etc.). BA did not identify any examples of poor standards within re-use, though we did note that overall standards for inspecting, testing and sanitization where inconsistent and somewhat lax.

It is equally important to recognize that bio-hazard risks associated with mattresses are genuine, and it is important that stringent standards be adopted in cleaning and sterilisation processes to ensure they do not spread disease or promote vermin infestation. Unlike the US and much of Europe there are no regulatory standards to ensure used mattresses are tested or properly sanitized in Australia.

A sample of the regime of management recommended in Connecticut USA can be found in the appendices.

Recycling: While the materials used in mattresses differs significantly from product to product, using a case study of Mission Australia's Soft Landing mattress recycling enterprise published in the 2015 National Waste Report we estimate that, on average, an end of life mattress weighs 30.2kgs and is 0.75M^3 in size. The various components and their various material proportions are represented by the pie chart to the right.



This figure appears to reflect a mix of mattresses and bed bases as there is little to no timber in a typical mattress, but for the purposes of consistency we have used these figures[4].

Typically, mattresses that are recovered for recycling are handled via one of two broad methods:

A/ Genuine Recycling – where mattresses are dismantled by hand (or in rare occasions using an automatic process). The layers of textiles and foam stripped off, timber removed (where evident) before the steel springs are recovered after being processed through a shredder. This process can capture up top 85% of some mattresses components, but the overall recycling rate is reduced to around 70% of the mattress weight after production losses during dismantling and shredding. This process is typically undertaken in a custom indoor facility where millions of dollars is spent in pollution controls, site infrastructure and equipment. BA estimates that, in Greater Melbourne, around 42% of all mattresses actually recovered are processed by this method.; &

B/ Landfill Reduction – Much of what has been labelled mattress recycling, is probably better termed landfill reduction - Where a mattress is recovered but rather than be fully re-processed it is torn via the use of earth moving equipment and mechanically shredded to reduce its volume in landfill. Typically, this sort of operation recovers some of the steel but none of the foam or textile materials. This process can recover as much as 50% of the mattress' weight but after production losses during shredding is more realistically reflecting a recycling rate of around 40%. This process is typically found operating on an outdoor hardstand 'pad' at a landfill or waste transfer station. BA estimates that around 50% of all mattresses actually recovered are processed by this method.

Landfill: Mattresses are a difficult aspect of the waste stream; as a bulky item with a relatively low weight to volume ratio (the average mattress weighs 30kg but is some 0.75m^3 in volume) they are expensive to collect

[4] Typically, mattress recyclers use assumed weights, and these appear inaccurate. State Government should review these estimates as they are likely to be leading to some level of landfill avoidance.

and transport. Mattresses also take up considerable storage / landfill space and can float once buried (creating stabilisation issues). Subsequently, most landfills that receive significant mattress volumes tend to shred the mattress for size reduction and opportunistically recover the steel separated during this process.

It is claimed that virtually no mattresses are landfilled without this size reduction in Greater Melbourne, though as outlined below the final fate of as many as 1 in 3 end of life mattresses in Victoria is unknown – creating doubt regarding this claim.

Recommendation: Ban the disposal of whole mattresses from landfill in the urban centres in Victoria

Illegally Dumped and/or stockpiled: With councils reporting that 8.3% of all mattresses they recover coming via illegal dumping activity[5] it is obvious that dumping is a major pathway for the end of a mattresses life. This estimate excludes those mattresses that are not recovered as well as those disposed of via a C&I waste service or private recycler (op shops, abandoned industrial facilities etc.) – indicating that at least 1 in 10 mattresses end their life via an unlawful method of disposal, however, with over a third of End of Life mattresses having an unknown fate it is possible that the amount of illegal dumping could be far higher.

This level of illegal dumping is one of the highest across the entire waste stream. It is likely that this level of dumping will extend to commercial recovery operations adopting a dumping strategy and in at least one instance we identified a Victorian operation that was suspicious. The simple act of requiring mattress collection and recycling facilities to be licensed along with waste tracking typical of much of the recycling undertaken in Australia would significantly reduce the incidence of illegally dumped mattresses in Melbourne.

The current level of illegal dumping represents a substantial cost to local government (in the order of $400,000 p.a. in Greater Melbourne alone) that cannot be recovered and government should consider applying a charge (to the benefit of local government) to fund this recovery activity.

HOW WELL ARE END OF LIFE MATRESSES MANAGED IN MELBOURNE?

Within the complex mattress recovery and dismantling process there are virtually no environmental standards or regulations to ensure health and the environment is protected. As a result, the barriers for new players to enter the mattress recovery market is very low – resulting in the sector becoming a target for inexperienced or 'dodgy' operators to establish operations with little to no infrastructure to contain pollution, optimise recovery or maintain fire and safety standards.

Local Government bears virtually the entire cost of mattress disposal and often has little option to recover their outlays. This pressure pushes councils to award costs to the lowest cost bidder, when it may be in their long term interest to pursue a more robust service provider.

While, generally we found commercial mattress collectors and reprocessors approached their operations with a solid level of diligence and a strong determination to 'do the right thing'. However, overall, the understanding of the threats and hazards of poor management are not well understood.

As a result, we generally found operations to be undercapitalized, servicing contracts that lacked the necessary specificity required (e.g. targeted recovery rates, pollution controls etc.) which is exacerbated by the lack of industry standards expected of government.

BA found that mattress producers and retailers (generally) demonstrate a strong level of responsibility regarding the disposal of their products. Many are starting to offer collection services as part of their new mattress sales offering and there is a strong desire to develop an industry wide producer responsibility scheme commitment to product stewardship principles (without really understanding the requirements of a scheme) despite receiving little government support. Yet without a basic regulatory regime or support of state and federal regulators it is difficult to see this coming into fruition in the near future.

[5] Mobius Report

As no regulations or standards specifically apply to mattress recycling, Boomerang Alliance has approached this review as a part of a study to develop minimum and best practice standards based on the review of a number of operators. These standards are in development and will be published following consultation with key stakeholders in early 2016. As reference points we have used our knowledge of the waste and recycling industry gathered over 12 years, published reports and studies, industry wisdom and feedback to develop our position on mattress recycling.

Large amounts of mattress waste residuals were observed being dumped into this landfill without weighing - how are landfill levies paid on this material? What stops this lightweight material escaping the site?

A commentary of the potential risks and hazards in mattress recycling, observed failings in operations observed and an indicator regarding the best practice approach we saw across the 5 targeted sites are outlined below:

Aspect of Mattress Recycling	**Observation**	**Industry Av. Score**	**Best Practice Score**
Regulatory Compliance: *Holds a Planning Permit that reflects current activity and complies with conditions of Planning Permit.*	Of the 3 operations sited on private property (2 are sited within an existing operation at a transfer station) only 1 (TIC Mattress Recycling) held a planning permit that reflected the sites activities. Basic infrastructure (which would be required with a planning permit) to capture waste within the property and fire safety were lax at 3 out of 5 sites.	3/5	5/5 (TIC & Knox Transfer Station)
OH&S Management *Has and OH&S system and is observed to manage same.*	4 out of 5 operations failed to ensure staff wore masks and goggles when dismantling and shredding. 3 out of 5 operations expected staff to regularly lift and handle mattresses without lifting equipment or without assistance of other workers. 2 sites were observed using inappropriate dismantling techniques creating airborne hazards (nails and staples). Only 1 of 5	2/5	5/5 (TIC)

	sites ensured that materials were stored in the designated storage locations.		
Level of Recycling *Overall level of materials recycled.*	3 out of 5 operations recover less than 50% of materials.	3/5	4/5 (TIC & Bed Collect)
Accuracy of Environmental Claims *Information regarding recycling performance and regulatory history.*	All claims were exaggerated, but were not outright false environmental claims.	3/5	4/5 (TIC)
Accuracy of Operational Description *Accuracy of website claims and statements made to public.*	Information was non-specific and exaggerated the state of operations. There was a lack of clarity across the board regarding specific processes and controls over waste and OH&S systems.	2/5	5/5 (Knox Transfer Station)
Pollution Controls *Capture of waste and pollutants within the site.*	Only TMR had equipment and systems to control waste escaping the site via wind and/or stormwater. 3 sites had very large quantities of microplastic and fibres found offsite.	2/5	5/5 (TIC)
Fire Hazards *Observed fire hazards*	Fire hazards observed at 4 of 5 sites. Major hazards observed at 2 sites.	2/5	4/5 (TIC)
Management Control	3 sites showed evidence of management failure to respond to identified risks. 1 site appears to be acting unlawfully and has been reported to the appropriate authorities. Another 2 sites were observed breaching existing waste regulations (possibly through ignorance).	2/5	5/5 (TIC & Knox Transfer Station)
Average Score		**2.7/5**	

RISKS AND HAZARDS IDENTIFIED IN MATTRESS RECYCLING:

It is easy to regard a mattress as a fairly benign product within the waste and recycling stream, when (like any manufactured product) a mattress contains a number of components and additives which have a significant impact on the environment and human health.

While, mattresses are a benign waste stream when properly managed, when handled without care there are a number of significant environmental risks and health hazards that become apparent. Some of the risks and hazards identified within our review are well known to the sector, where others do not appear to have been recognised previously. The key risks identified by Boomerang Alliance that are associated with mattress recycling include**:**

- Illegal dumping (which in the mattress industry has 2 major sources – the professional scale of operation where mattress collectors illegally stockpile at unpermitted premises; and fly tipping - i.e. the dumping of smaller quantities of waste along roadsides and outside op shops or transfer stations) is very high – at least 1 in 10 mattresses.
- We observed a trend for large quantities of pollution escaping all sites (synthetic fibres and other microplastics) as a result of poor controls to ensure waste materials did not escape the site.

- Inconsistent application (and disclosure) of health standards and sterilisation of re-used and refurbished mattresses.
- Worker safety hazards in the collection (lifting), dismantling and the recycling process were strongly evident.
- There is a strong dependence on loose estimates of material weights – potentially leading misleading claims and (in some instances) potential waste levy avoidance.
- Poor storage regimes creating fire and vermin infestation risks were observed at many sites.
- Claims regarding what proportion of mattresses are recycled by reprocessors are exaggerated in all instances and in turn creates somewhat misleading information communicated to customers and rate payers.
- It is evident that some councils have adopted sub-standard due diligence processes in awarding mattress recycling contracts.

The lack of separation between this pile of tyres and mattresses represents a significant fire risk

Occupational Health & Safety (OH&S): At a primary level it is vital that operators recognize that a mattress recycling operation represents significant OH&S issues that must be better managed overall. Key issues for workers at a mattress recycling facility are:

- Air Quality: The nature of the fibres and dust circulating around any mattress recycling site is a significant risk of causing allergic reactions and lung diseases and will dramatically exacerbate asthma. Only one operation – TIC Mattress Recycling (TMR) was seen to ensure staff wore masks consistently.
  Recommendation: At the minimum workers should wear dust masks whenever handling or dismantling mattresses.
- Lifting: Mattresses are of a weight (30kgs average) and size where repeated lifting creates significant stress on the back and joints. Collection services are largely manual (note operations using automated loading) and over the course of a day collection staff are likely to be required to repeatedly lift heavy items.

Recommendation: Lifting and moving equipment to reduce back injury are commonly used in new mattress delivery and removals operations. Collection vehicles should be fitted with hydraulic lifters and dollies used for moving mattresses. On site mattresses should be moved via conveyor belts or earth moving equipment.

- Flying Objects: In 3 of the 5 operations we observed 'jerry-rigged' modifications of earth movers / forklifts etc. to strip the mattress from timbers. This created substantial hazards such as steel staples being shot across dismantling areas at high speed.
  Recommendation: Recycling operations should ensure dismantling areas are isolated from general work areas, dismantlers should be required to wear goggles at all times.
- Bio-Hazards: Mattresses can contain any number of bio-hazards. Bed Bugs and mites are common and can survive inside a discarded mattress for long periods. Parasites and infectious disease can also contaminate a mattress via the sweat, blood urine of someone sick and live within the mattress for considerable time. While most mattress collectors undertake visible inspections and some form of sterilisation the lack of a consistent standard like those required in the USA creates a serious health risk for the staff (and purchasers) of these mattresses. No operation could clearly describe their process of inspection and sanitization.
  Recommendation: A licensing or registration process for refurbished and re-used mattresses should be adopted. At the minimum this should describe the minimum sanitation standards required before resale, labelling requirements and storage regimes to isolate any infested material.

Pollution: The level of material loss evident in mattress recycling is an important environmental impact. Not only does this see a reduction in the effectiveness of recycling, it also (when improperly managed) results in the creation of significant micro and nano scale plastic pollution escaping the site.

While difficult to quantify in exact terms, our observation and sampling of grounds, fence lines and surrounding waterways showed that the amount of materials observed to be escaping indoor sites was between 1-5% of the total weight (1kg); at outdoor dismantling operations it would be expected that between 10-15% of the weight of a mattress (depending on prevailing weather conditions and the length of time the mattress or its components are left outdoors) and outdoor dismantling and/or shredding operations should reasonably expect losses of 15-25% of the mattress[6].

This potential to pollute is a serious matter, similar to the emerging issue of 'nurdle loss' associated with plastics manufacture and extrusion. Based on estimates that between 1-6-1.8million mattresses end their life each year, Boomerang Alliance would project that mattress recycling is generating around 4,800 tonnes of micro and nano scale plastics enter our environment each year. The lightweight nature of this material means it has a very high potential to enter the estuarine and marine environment.

Shredder – fitting these screens at TIC has suppressed most dust operation and restricts pollution escaping the site.

Once in a waterway or stormwater drain these materials will migrate into our oceans as they are too small to be captured by screens or gross pollutants traps. In the marine environment these nano-scale fibres can (and will) be immediately ingested by as much as 96% of the marine food chain including plankton and coral[7].

[6] NB While this issue is also reflected in the production losses calculated to assess the overall level of mattress recycling in Melbourne, the calculations herein are different from those earlier. In this instance we used the total production losses experienced to reflect the total potential pollutants and then considered the likely proportion of these materials that are likely to escape the operators control i.e. virtually all the microfibres generated at an outdoor mattress shredding operation are likely to escape the operation, where an indoor dismantling operation will still experience production losses but the vast majority of dusts and fibres will be captured.

[7] Plymouth University Marine Research Institute and ARC of Excellence for Coral Reef Studies at James Cook University

As a point of comparison, all state and federal governments have agreed to ban the use of microbeads in personal care products from 2017 - typically these microbeads are larger than the microplastics generated in mattress recycling and are estimated to generate around 1,000 tonnes per annum in pollution.

The scale of microplastic pollution is such that it now represents genuine threats to our fisheries that Professor Tamara Galloway of Exeter University warned in October 2015 that "anyone consuming an average amount of seafood would ingest about 11,000 plastic particles a year"[8].

In any environment, these materials have levels of toxicity which adds to the total pollutant load of our cities and exacerbates growth health issues like Asthma, a range of allergies and chronic conditions such as multiple chemical sensitivity.

In the marine environment, the toxics and poisons contained in these dusts and fibres are compounded by the fact that microplastic act as a sponge sucking up other pollutants found in our seas. Studies by the Algalita Marine Research Foundation have shown microplastics to be as much as 1 million times more toxic than the sea water surrounding it.

It is already an offense for an industrial facility to allow materials within its controls to escape a site as is allowing materials to be washed into the storm water system.

Large amounts of plastic and other waste were observed around the boundaries at 3 out of the 5 mattress recycling operations reviewed. In the first image plastic is escaping via the site due to poor hydrological control, in the second waste has been caught in the wind and is strewn across adjacent roads.

A pollutant inventory of a used mattress includes:

- Some of the toxics and poisons found in ticking include: benzidene based dyes (a carcinogen), brominated flame retardants which typically contain boric acid (affects reproduction and foetal development) and antimony (damages the heart and lungs), quaternary ammonium biocides (a poison found to leach from polypropylene), the monomers ethylene glycol and terephthalic acid used to make polyester are known to be poisonous and carcinogenic, polyester textiles are also commonly treated with a formaldehyde solution to keep the material 'wrinkle free', carbon disulphide (a neurotoxin) is used in the manufacture of viscose rayon.
- High and medium density polyurethane foam typically used in mattresses include chemicals like methylene dianiline, vinilideine chloride, methyl benzene and dimethyl formamide and acetone (while generally regarded as 'safe' for use in the home these chemicals are thought to be carcinogenic and cause damage to the liver, thyroid, lungs, nervous system and eyes in their use during use in manufacture – subsequently they are a significant risk to workers in mattress recycling and impact the environment.

[8] http://www.bbc.com/news/science-environment-34414710

- The synthetic latex typically used in mattresses is styrene-butadiene rubber or a derivative of same. Styrene is regarded as toxic, mutagenic, and possibly carcinogenic, while butadiene is a known carcinogen, suspected teratogen (causes birth defects), and irritates mucus membranes.
- Traditionally felt or wadding was made from natural fabric scraps (cotton, wool etc.) but today is generally a mix of materials including polyester (containing acrylic (a strong irritant to the skin, eyes, and mucous membranes) and polyethylene (relatively low health risk compared to other plastics but a substantial issue within the environment – particularly marine environments).

  This material is non-woven and when ripped and/or shredded releases a significant proportion (up to 50%) of the material which subsequently migrates off site via wind or rain water runoff.

Recommendations:

- *Shredding and dismantling should NOT be undertaken in an outdoor environment*
- *Stormwater outlets and drains to sewer at mattress recycling sites require sumps that will capture micro and nano scale fibres*
- *Waste storage should always be in units with a lid and not left outdoors*
- *EPA's should regularly inspect the boundaries of mattress recycling facilities and issue fines where microplastics are evident outside the site boundaries.*

Illegal dumping

The illegal dumping of mattresses in Australia is largely unknown due to the inability to access all data in a central place and restrictions in identifying illegal dumps in remote or inaccessible areas.

Boomerang Alliance tracked these mattresses from a well-established waste facility to this residential house in Melbourne.

Information from Local Government sources in indicate that about 8% of mattresses received by Councils facilities (usually collected by Councils) are from illegal dumping sources. Whilst anecdotally evidence suggests that these are generally not from commercial sources or collectors, information has been provided to Boomerang Alliance that supports the idea that some 'mattress collectors' may be illegally dumping in identified dumping hotspots or taking advantage of Council hard waste collections to offload mattresses, pushing costs onto Local Government and the Community.

We discovered one significant stockpile in the private residence of a current collector – details of which will be published after reporting them to the authorities. We have also identified 2 operations providing false information regarding the company they represented and/or the destination of the mattresses (which are common indicators when investigating illegal dumping).

Recommendation: The only ways to eliminate the high levels of illegal dumping evident in mattress disposal is through environmental licensing of facilities or a full product stewardship scheme where the cost of disposal has been embedded in the sale price. In the event that there is no product stewardship scheme the use of EPA licenses and waste tracking for mattress disposal facilities will eliminate the wide scale dumping.

Reuse and refurbishment

Reused and refurbished mattresses and beds are available in the market for sale and offered via charity groups to people in need or at a greatly reduced cost.

It has been brought to Boomerang Alliance attention that some of these offered for sale may be of poor quality and present health risks – contamination of blood, urine and faeces and/or vermin infestation). In at

least 1 case we identified collection from a high risk mattress user being offered for resale. There are a number of collectors and processors offering these as product to retailers and charities, without standards and with inconsistent methods of inspection and sanitization.

While there is little question that refurbishment of used mattresses represents a great social and environmental outcome, Boomerang Alliance is concerned that, without stringent standards and enforcement the refurbishment and sale of second hand mattresses represents a substantial health risk.

Recommendations:

A refurbished and/or second hand mattress should not be allowed to be sold without clear disclosure and a label accurately describing same.

Either an independently audited industry standard (similar to those adopted by the tyre industry) or a regulation should be established to ensure there are consistent standards regarding inspection and testing similar to those in place across the USA.

FINANCIAL VIABILITY OF MATTRESS RECYCLING:

The market to collect and process mattresses is highly competitive and typically operates at very low margins. Typically, the value of the scrap materials recovered represent a value of around $2.40 each – comprising 11-13kgs of steel (@ $85 - $120 / tonne) and 1.7kgs of foam (@ $650 / tonne), with the recovered textiles and timber having little to no scrap value.

This significantly outweighs the cost to fully dismantle a mattress – which requires significant disassembly and can cause large amounts of pollution (particularly when dismantled or shredded in an outdoor facility) when handled irresponsibly. Consequently, the financial underpinning of mattress recycling is heavily weighted on the gate fees and/or collection charges.

When disposal / disassembly costs are high and the reward for recovered materials are low it is common to observe sub optimal recycling activities and/or unlawful disposal activities to minimise costs. For mattress recycling the relationship between the gate fee and the material recovered is very low - a gate fee of $20 per mattress (which is the lower point within the market) represents over 90% of the total income received by a mattress recycler, where the recovered material itself is worth just $2.20 each. By comparison, in mature recycling sectors the recovered materials represent around 55% of its revenues via the sale of scrap (45% from gate fees) and even well known ‘depressed’ recycling sectors like tyres earn around 20% of its earnings from the sale of recovered scrap.

As a result, like much of the speciality recycling sector, mattress recyclers are subject to intense financial pressure – largely driven by low quality and undercapitalised operators entering the market and offering prices that are unsustainable (if the mattresses are properly handled and disposed).

Further, there is little to no incentive for recyclers to maximise their recovery, when in the current environment they would actually receive better net earnings by undertaking no more than steel recovery and landfill reduction collection - with these facilities receiving a comparable gate fee to a full recycling complex despite the fact they enjoy significantly reduced costs and lower environmental performance.

Ironically, this leads to the development of inferior pollution and management controls which in turn increases council costs in trapping stormwater systems, litter management and to some extent illegal dumping. Councils should seriously ask themselves whether there is any value in paying an operator recovering less around 35% of a mattress a similar fee to an operation recovering 70% of the materials? Perhaps consideration should be given to a body (Sustainability Victoria or the MWRRG) to apply a Pollution Abatement Charge to any mattress waste sent to landfill to fund local government costs to recover illegally dumped mattresses and ensure microplastic dust and fibres are retained within their reprocessing facility. This would have a ‘double whammy’ effect both incentivising best practice recycling while also substantially offsetting the significant costs experienced by local government to deal with illegal dumping.

Recommendation: ***Consider applying a Pollution Abatement Charge (which is 100% hypothecated back to local government) over and above general waste levies to any mattress material sent to landfill.***

CONCLUSION:

It is evident that mattress recycling in Melbourne (and in turn across Australia) is at best sub-optimal in its performance and that a lack of standards and regulatory support has seen an important environmental industry, become a major source of environmental pollution.

Data on the sectors performance is poor, the levels of pollution escape and illegal dumping is perhaps as high as 20% and the real recycling rates (at less than 40%) are unacceptably low in a well-developed economy.

While it is evident that the sector is affected by rogue operators to some extent, generally the failure evident is directly attributable to the lack of regulations and/or product stewardship – particularly given the willingness of producers, retailers and recyclers to embrace stewardship.

There have been talks and some meetings to discuss the viability of a Product Stewardship Scheme, which Boomerang Alliance views as a priority which will not only address mattresses but also establish a standard applicable to other soft furnishings and hard waste collections.

SPECIFIC RECOMMENDATIONS:

- *The Victorian State Government should undertake a detailed and formal study to better understand the fate of end of life mattresses in Victoria***.**
- *Ban the disposal of whole mattresses from landfill in the urban centres in Victoria*
- *A licensing or registration process for refurbished and re-used mattresses should be adopted. At the minimum this should describe the minimum sanitation standards required before resale, labelling requirements and storage regimes to isolate any infested material.*
- *A refurbished and/or second hand mattress should not be allowed to be sold without clear disclosure and a label accurately describing same.*
- *The only ways to eliminate the high levels of illegal dumping evident in mattress disposal is through environmental licensing of facilities or a full product stewardship scheme where the cost of disposal has been embedded in the sale price. In the event that there is no product stewardship scheme the use of EPA licenses and waste tracking for mattress disposal facilities will eliminate the wide scale dumping.*
- *Shredding and dismantling should NOT be undertaken in an outdoor environment*
- *Stormwater outlets and drains to sewer at mattress recycling sites require sumps that will capture micro and nano scale fibres*
- *Waste storage should always be in units with a lid and not left outdoors*
- *EPA's should regularly inspect the boundaries of mattress recycling facilities and issue fines where microplastics are evident outside the site boundaries.*
- *At the minimum workers should wear disks masks whenever handling or dismantling mattresses.*
- *Lifting and moving equipment to reduce back injury are commonly used in new mattress delivery and removals operations. Collection vehicles should be fitted with hydraulic lifters and dollies used for moving mattresses. On site mattresses should be moved via conveyor belts or earth moving equipment.*
- *Recycling operations should ensure dismantling areas are isolated from general work areas, dismantlers should be required to wear goggles at all times.*

Disclaimer

The report contains information about the extent to which TIC Mattress Recycling (TMR) 's operations reflect state and local government regulations and the standards considered by Boomerang Alliance to represent a minimum or best practice standard established during the course of this study into mattress recycling.

This review, represents our best efforts to reflect our opinion of the operations at the site/s identified above and are limited by what we were shown and by the information presented and available to us. As such we are unable to represent that the information in the report is correct, accurate, or complete.

This information is not advice, and should not be treated as such. You must not rely on the information in the report as an alternative to the opinions of local government, state regulatory authorities or fire service officials. Any conclusions and/or recommendations are our opinions based on what we observed at a particular moment in time. To this end, readers should always consult suitable qualified professionals to make final decisions regarding the seriousness of any issues identified and the best course of corrective action.

Boomerang Alliance – February 2016.

APPENDIX 1: PRODUCT STEWARDSHIP PRINCIPLES:

The best solution for problem waste is the development of an Extended Producer Responsibility Program (EPR) and/or Product Stewardship (PS) scheme. These have been deployed to great effect in Europe, Canada and the US.

Product stewardship is an environmental management strategy which requires the producer to take responsibility for minimising the product's environmental impact throughout all stages of the product's life cycle, including end of life management. However, all parties within the supply chain have roles.

The key objective is a long-term solution to manage waste products by shifting the responsibility for collection, transportation and management of such products away from local governments to the manufacturers.

Sustainable businesses that wish to adopt stewardship standards need to recognise that obligations don't just stop with managing their waste – good stewardship extends to managing a triple bottom line approach (social, environmental and economic impacts) to a product's manufacture, distribution, sale, recovery and disposal.

The Boomerang Alliance uses 10 principles of product stewardship to assess whether a scheme is effective and equitable. This approach has been informed by a number of principles developed across North America and Europe over many years. In particular, Boomerang Alliance acknowledges the fine work of both the Product Stewardship Institute (PSI) and North West Product Stewardship Council.

The Boomerang Alliance's 10 Principles of Product Stewardship are:

01 PRODUCER RESPONSIBILITY AND SHARED COMMITMENTS

Producers are required to design, manage and finance programs for the safe and environmentally responsible manufacture, distribution, sale, use and end of life management of their products and packaging. Programs need to cover an entire sector's products in a given category, as opposed to individual company approaches.

The program should include dealing with products from companies no longer in business and from companies that cannot be identified and/or legacy products and allied wastes from earlier times.

While Boomerang Alliance advocates that product stewardship requires the producer to be ultimately responsible for the management of a product across its life cycle, it also acknowledges and encourages all players across the sales and recovery chain to accept shared responsibilities with the producer. However, for a producer to be regarded as a genuine steward who manages the 'triple bottom line' adequately, they must enshrine and enforce these responsibilities as a condition of supply to the retail chains and ensure individual and corporate customers are aware of appropriate disposal outlets.

Equally, good product stewards will also pass on any costs they incur throughout their supply chains in a transparent manner.

Finally, custodians within the supply chain) should seek to only sell products supplied by responsible producers if they wish their social, environmental and safety claims to be credible.

02 A LEVEL PLAYING FIELD

Stewardship inevitably comes at a cost and it is difficult for any company to be a responsible steward if they have to compete with rogue traders who can gain a price advantage over legitimate business. To this end, it is the obligation of federal and state government agencies to ensure a level playing field.

While it may be the case that a single organisation is the only player that meets established standards, no producer responsibility scheme should avoid monopolistic behaviour and encourage competition within the waste and recycling market.

In particular, it is important to ensure that alternative products and approaches are assessed on environmental merit and that the scheme does not restrict trade – particularly where manufacturers may seek to exclude second hand products and / or remanufactured goods.

03 INTERNALISED COSTS

All product lifecycle costs – from extracting resources, to reducing health and environmental impacts throughout the production process, to managing products at the end of life – should be included in the total product cost.

This places the financial burden of managing the environmental impacts of product manufacture, use, and end of life management on the consumer of the product, rather than a tax or ratepayer based model where those individuals who do not consume a product unfairly share the same burden as a heavy user.

In the medium to long term this also creates a direct financial incentive for manufacturers to redesign their products to reduce their impacts on the community and environment.

04 TRANSPARENCY AND INTEGRITY

Effective product stewardship requires producers and operators across the supply chain and schemes to commit to high levels of transparency and integrity, including information on:

» Any charges to manage and implement the stewardship program;

» How the stewardship scheme operates and its results;

» How products are managed at the end of their life (and who manages this);

» Any penalties or regulatory infringements and corrective actions;

» The content of relevant meetings (minutes published on a website); and

» Any rules or policies that restrain trade to ensure compliance with the scheme.

No organisation that participates in a product stewardship scheme should be allowed to make any performance claim unless it is operating in a manner consistent with the scheme's policies and guidelines, or use any symbols or logos that denote stewardship without being independently verified that it is compliant.

05 ACCOUNTABLE

Producer Responsibility Organisations (PROs) must ensure they remain credible by being publicly accountable and transparent.

This requires clear goals and targets being regularly published; periodic reporting on progress to meet these goals; plans for the future; handling of specific complaints from the community in a prompt timeframe; and audited and published annual accounts.

06 EQUITABLE GOVERNANCE AND PARTICIPATORY DECISION MAKING

Producer responsibility and product stewardship schemes need to ensure equitable representation from the supply chain as they can often over-represent polluters who then use the PRO to manipulate market outcomes or 'green wash' efforts and results. This is also important to ensure staff members are able to act professionally and not be 'captured' by particular interests.

To achieve schemes that are fair and equitable, different stakeholder bodies should be equally represented at the board level and all participants and stakeholders should be fully briefed and provided with the same information.

To eliminate any 'pilfering' of confidential information collected by the scheme, no individual who is 'in the trade' should have access to any information regarding sales, pricing or market segmentation information.

07 GOVERNMENT INDEPENDENCE

Government should not participate in the running of product stewardship schemes or be represented on their governing bodies. It is critical they remain impartial rather than become co-opted. Rather, government should:

» Ensure that governance structures are to a high standard and facilitate both independent and community representation within the governance structure;

» Conduct independent reviews and undertake regular broad consultation to ensure stakeholders have opportunities to air and consider any grievances regarding the PRO;

» Ensure all claims made are honest and based on verified information and that all participants have earned the right to call themselves product stewards; and

» Conduct audits to see whether the scheme is meeting its targets and community expectations.

Under no circumstance should government extinguish its right to further regulate or impose penalties on participants – when necessary – as this is an abdication of its responsibility to protect the public interest.

08 RESULTS ORIENTATED AND FACTUALLY BASED

Obviously, the success or failure of any producer responsibility scheme is based on genuine results. It is paramount that any stewardship scheme has clear time-bound targets that reflect the public's expectations and ensure protection of the environment.

Regular milestone (quarterly) reporting is needed to allow success to be reviewed in a timely manner.

09 KNOWLEDGEABLE

Responsible stewards and PROs should clearly understand the potential environmental, health and safety risks of their products and actions. In addition, they should know how other participants in the product's lifecycle impact on that risk. The biggest burden for developing knowledge of a product's hazards falls on the manufacturer because it defines the product's content and potential to cause damage.

10 INDEPENDENTLY VERIFIED

It is well established that the community is sceptical of both industry and government claims regarding environmental health and community safety. To this end it is important that any claims be independently verified by a credible third party which has no financial connection with any members of the scheme itself.

APPENDIX 2: STANDARDS FOR REFURBISHMENT

See "Best Practice for Bed Bug Management of Mattresses, Bedding and Upholstered Furniture. Guidance Document for the Reuse/Resale and Recycling Industries in Connecticut (2011)" - Attached

APPENDIX 3: AN EXAMPLE OF AN INDUSTRY RECYCLING STANDARD

See "Performance Requirements excerpted from The e-Stewards Standard" - Attached.