TE230/3

Scoping waste in the residential built environment

Final

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About This Report

Title

Scoping waste in the residential built environment

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Abstract

Scoping report on level and composition of solid waste in New Zealand, current waste policy and regulation, measures taken to minimise construction and demolition waste and household waste with recommendations for areas which Beacon might want to influence.

Reference

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There is limited baseline information on the level and composition of solid waste in New Zealand. However, the existing data indicates that, despite the introduction of numerous waste minimisation initiatives over the last decade, solid waste disposal to landfill appears to be continuing to increase (on a per capita basis). This points to the need for a major step-change, including improved design for sustainability, waste reduction at the front-end and improved extended producer responsibility and product stewardship.

Landfills remain the most common type of waste disposal facility in New Zealand. However the number of landfills is reducing, as smaller and poorly designed tips are replaced with larger and engineered sanitary landfills. Despite its isolation and size, New Zealand also has a significant recycling and commercial composting industry. This industry is expected to grow as landfill costs rise, either as a result of market forces, or through the implementation of economic instruments such as solid waste levies.

Local government has the key responsibility under law for managing solid waste collection, disposal and for promoting diversion from landfill. Recent policy submissions by the Green Party has required central government to progress targeted but non-completed work on the use of legislative and economic instruments to reduce waste disposal to landfill.

Construction and Demolition Waste

Wastes generated from the Residential Built Environment (RBE) include both construction and demolition (C&D) wastes and domestic wastes. C & D wastes are "any product or material resulting from the construction and demolition process that is surplus to, or not included in, the final building". C & D wastes are the predominant type of wastes associated with the activities that Beacon seeks to influence.

The reviewed data showed the key components of C & D waste to be wood waste (around 40 percent by weight), concrete/cleanfill (13 – 25 percent by weight) and wallboard/ plasterboard (around 18 – 26 percent, by weight). Cardboard and paper is relatively high in terms of volume (around 40 percent) but only a small contributor by weight (3 – 4 percent). The amount of C & D waste generated from residential projects varies, however, reductions in the order of 30 to 40 percent of waste to landfill has been shown to occur when long-term waste reduction programmes and incentives are in place.

The severity and likelihood of hazardous materials being contained within C & D wastes should be considered at an early stage of the construction process, as it could result in additional sorting requirements and reduced options for the reuse and recycling of waste materials.

Domestic Waste

Domestic waste is the solid material originating from housekeeping activities taking place within the home and primarily includes packaging wastes, organic kitchen and garden wastes and other discarded household objects (excluding trade or commercial wastes). Organic waste is the largest domestic waste stream. Home composting is no longer seen as the only solution to reducing organic waste to landfill and organic waste kerbside collection and regional composting schemes are emerging around the country. However, barriers remain around siting of organics facilities, market use of compost, collection costs, and interest by some in keeping organics in landfill to maximise methane gas capture.

The potential for recycling or beneficially reusing wastes at the neighbourhood scale is recognised, such as a neighbourhood composting facility. However there are a number of issues that would need to be considered, such as the cost and responsibility for ongoing management and possible contamination of separated wastes. Neighbourhood scale facilities may also require resource consents, which add to both the complexity of environmental control requirements and ongoing monitoring, as well as to up-front costs. This means that for organics, regional facilities may be a more socially and economically viable option.

The advantages and disadvantages between providing options at the home/neighbourhood or regional level require further consideration. In addition, one solution will not be suitable for all household sizes and types, e.g. recycling and reuse options for single households would be quite different to that which would suit multi-unit dwellings. The best option is likely to vary between regions and with other factors such as housing type. The key is to clearly identify the intended outcome and to consider options on a case-by-case basis.

Opportunities and Possible Actions for Beacon

Direct Action

- Allocate a role within Beacon to identify and promote opportunities for shareholders to minimise wastes. Also ensure that there are methods of communication regarding waste issues and waste reduction in place for stakeholders.
- Revise Beacon targets and the HSS document to recognise the value of providing options for both home composting and for the collection of source separated materials (such as the provision of suitable storage and collection space). Beacon Targets and HSS documentation should also recognise the differences for waste reduction at the single household and the multi-unit dwelling levels.
- Ensure that the Sustainable Residential Building Manual includes a section that addresses the allocation of space for waste collection / treatment (to be compatible with revised Beacon Targets and the HSS document).
- Support Council shareholders in promoting waste minimisation initiatives, including for multi-unit dwellings and/or at a neighbourhood level.
- Consider becoming a member of WasteMINZ, to keep up with industry developments and to raise Beacon's profile in the waste industry.

- For any future construction projects, consult with local government on current and future waste collection and treatment options in the district.

Regulation and Policy

- Take up opportunities to provide submissions on waste related policy and work with shareholders and partners to understand relevant, individual issues.
- Any lobbying Beacon is involved in for waste minimisation should also highlight the work that shareholders and partners are doing in this area.
- Continue working on submissions for the Building Code Review and Waste Minimisation (Solids) Bill (should further submission opportunities be available).

Advocacy

- Continue to promote the use of waste minimisation practices during construction and demolition (as per the REBRI guidelines). These need to be demonstrated for both new home construction and renovation / refit projects.
- Look to reduce materials packaging associated with C & D materials, through applying REBRI guidelines and by working with suppliers on improving the recyclability or reuse of the packaging used for their products.
- The NOW Home® is indicative and has provided Beacon with first hand experience on the practical application of REBRI guidelines. This experience and knowledge should be shared through working more directly with Beacon's stakeholders, particularly the councils and Fletcher Building, with the ultimate aim of ensuring that the REBRI guidelines become standard practice for all construction and deconstruction projects.

Community engagement and behaviour change

- Consider getting Christchurch and North Shore City Councils involved as Beacon shareholders or partners, to make use of their experience with the 'hands-on' application of REBRI guidelines and consultation with industry in this area (including pilot studies to promote and educate the C & D industry).
- Work directly with developers and homeowners on projects around implementation of the REBRI guidelines and incorporation of the Beacon HSS waste features. This will also provide opportunities for measurement and research projects.

Leading by example

- Promote the REBRI guidelines in all Beacon projects and work with suppliers on improving the recyclability or reuse of the packaging used for their products. [This is an opportunity for direct action should Beacon be involved in more demonstration projects such as the NOW Homes® or renovation/refit activities.]
- Look at areas where recycled domestic waste can be integrated into building materials to demonstrate examples, such as PET into carpets, glass bottles recycled into bench tops and floor tiles etc. These types of recycled products require support for market development

and, through incorporation into Beacon 'THEN Homes', would also support work being done in this area by Beacon's shareholders.

- Consider product stewardship from a product selection focus when it comes to future NOW Homes®.
- Utilise REBRI and the Sustainable Residential Building Manual to minimise waste from materials through good design, and through proper waste minimisation practices during construction and/or demolition activities for all Beacon sponsored projects such as NOW Homes®, renovation, retrofit or neighbourhood projects.
- Should Beacon be involved in further construction demonstrations, they should consider a test site for multi-unit dwellings, with REBRI applied at this scale. There would also be associated opportunities to test factory-build approaches, as these are likely to offer improved efficiencies for multi-unit developments compared with single homes.

Measuring progress

- If Beacon were to do a large scale retrofit/renovation project, then they could also measure waste from this process and use the REBRI guidelines for appropriate on-site waste management practices. The results of this type of trial should be compared with waste generated from similar projects but without waste management practices in place.

Research and Technology

- Provide further research on the levels of waste generated internationally by countries that are spearheading design for the environment, such as parts of Asia and Europe. This research should help to identify why New Zealand's waste generation per capita is still increasing, despite increased and continuing work in the resource recovery area.
- Look to carry out research to determine C & D wastes quantities and composition from renovation and refit activities. This could potentially be achieved by focussing on data that could be provided with the help of the waste industry, such as from skip bin providers or from existing retrofitting projects such as the MfE-supported Warm Homes programme.
- Consider carrying out research, or supporting research by others, to investigate options for resource recovery of materials within emerging markets, such as Winstone Wallboard's work in the use of gypsum within composting or other potential options for recycling of used gypsum into other products. This type of research should also include a benefit cost analysis and should determine the level of landfill disposal costs where recycling options would become economically viable.
- Consider carrying out research on the structural and economic feasibility of using building materials made from recycled residential wastes, particularly as the costs of landfill disposal increase.
- The benefits of modular and/or factory built homes have not been significantly tested yet in terms of waste reduction potential, primarily due to the fact that this approach is not yet commonly practised in New Zealand. Further research is also likely to be required on a life cycle assessment basis, to review the cost benefit analysis of this design and construction approach. There may also be some data available from commercial modular refits that could be applied to determine the value for residential construction.

- There are opportunities for long term technology improvements to minimise or beneficially reuse wastes, including at the household and neighbourhood level (such as small-scale waste to energy and composting plants). However, it is important that Beacon promotes the 'full package' approach, where the product/service comes with a well-prepared and structured maintenance programme to ensure that the technology can be operated successfully at the micro level. This approach also incorporates the extended producer responsibility (EPR) philosophy.

Closing

The distinct relationship between growth and solid waste generation has not been broken by the waste minimisation actions of the last decade such as the broad introduction of kerbside recycling. This is alarming in that it signals the need for a major change - not just in the way that waste is managed at the end of its life-cycle, but a systemic and cultural shift in thinking that sees materials ultimately taken back into the system for reuse. Beacon's view should look beyond recycling, to see the home as a consumer item that produces zero waste during construction and upon deconstruction, as well as being a product that maximises opportunity for residents to reduce, reuse or see their waste recycled or composted.

1 Introduction

1.1 Research Aim

The overall aim of this report is to give Beacon a better understanding of the current solid waste management framework and to define potential opportunities for Beacon with respect to waste minimisation in the Residential Built Environment (RBE). The research will also assist Beacon in refining its existing targets for solid waste and materials. Opportunities will be highlighted with regard to improving the overall sustainability of the RBE and the potential for developing value for Beacon and its shareholders.

1.2 Research Scope

This report is focused on solid waste management in the RBE and opportunities as relevant to Beacon's overall strategy.

For the purposes of this report, the RBE is defined as the buildings and supporting infrastructure that together constitute the surroundings in which people dwell[1]. It includes not only people's dwellings but other neighbourhood buildings. It also includes the arrangement of infrastructure that service dwellings and the neighbourhoods in which those dwellings are situated.

The report will be structured around solid waste management issues with consideration given to the following categories:

1) C & D Waste: Solid waste created during construction of new homes, as well as during renovation, retrofitting and deconstruction of existing homes. This waste will be referred to as 'construction and demolition waste' (C & D waste). Beacon refers to this as 'materials waste'.
2) Domestic Waste: Solid waste that is created by consumers during the life of a home, as termed 'domestic waste'. Beacon sometimes refers to this as 'household waste.'

The report excludes liquid and gaseous wastes such as stormwater and wastewater; however the impacts of some domestic wastes on water may be included such as used oil disposal or use of in-sink waste disposal units.

It is important to emphasise that this report is suitably titled "Scoping Waste", therefore it is inherently 'end of life' focused, in that waste in the RBE often occurs at the end of the life cycle of various products. We do acknowledge that solid waste is potentially a resource for beneficial reuse or for the creation of recycled products or materials.

For the purposes of this report, materials selection and the housing design process were considered outside the scope, as we are neither building materials scientists nor housing design

[1] ***Definition of the Residential Built Environment adopted from the Beacon Pathways Strategic Plan, dated April 2006.***

specialists. We do however recognise the need for 'closed loop' thinking, in that materials selection and building design are essential elements in reducing construction and demolition waste. Design may also play a role in facilitating reuse and recycling of some domestic waste materials. Therefore we have dedicated a section of this report to drawing synergies and linkages

1.3 Research Objectives

The primary objective of the research is to better understand solid waste issues as relevant to the RBE and to assist Beacon in achieving a high level of sustainability in this environment. More specifically the objectives are:

1) To better understand the solid waste stream arising from the RBE and the issues and opportunities associated with these wastes;
2) To more fully understand the New Zealand waste management framework including the role and initiatives of government, industry and NGOs;
3) To make comparisons to overseas data and best practices where information is available;
4) To define opportunities for Beacon from both a technological and change management perspective, including possible topics for further research study.

1.4 Approach

There is a copious amount of information publicly available regarding the New Zealand and international solid waste situation as well as management policies, programmes and practices. It is important for Beacon to understand the overall solid waste management framework, but it is the opinion of the authors that the information provided must be concise and highly relevant to the RBE and Beacon's aims. For that reason, brevity is an essential element to the approach taken in this research, as a broad range of key players, policies and programmes must be covered sufficiently but concisely enough to avoid overload. Most important for Beacon is not knowing everything about solid waste management, but knowing enough to effectively define its opportunities and make key decisions.

The key questions applied in compiling this research report were:

1) How or why is this issue, policy, programme or technology relevant to waste from the RBE?
2) How is it then relevant to the aims of Beacon Pathway?
3) What can Beacon learn from this information?
4) What might Beacon do with this information?
5) What action might Beacon take as a result?

These questions have been the essential tenets in the development of this report, the answers to which have been included particularly in the sections highlighting opportunities for Beacon.

1.5 Waste Minimisation Concepts

This section describes the key concepts and terminology applied to waste management and minimisation. These concepts are often referred to by both regulators and industry, so it is useful to have an understanding of their meaning and application.

Solid waste is in itself unique because it acts as one indicator of sustainable development as well as provides feedback regarding the efficiency and effectiveness of overall development strategies.

1.5.1 Waste Management Hierarchy

The diagram in Figure 1 is the internationally recognised waste management hierarchy. The aim of the waste hierarchy is to extract the maximum practical benefit from products and to generate the minimum amount of solid waste.

Solid waste management is described as the collection, transport, processing (waste treatment), recycling or disposal of solid waste materials, usually ones produced by human activity, in an effort to reduce their effect on human health, local aesthetics or amenity. A sub-focus in recent decades has been to reduce waste materials' effect on the natural world and the environment and to recover resources from the waste.

Waste management practices differ for developed and developing nations, for urban and rural areas, and for residential, industrial, and commercial producers. Waste management for non-hazardous residential and institutional waste in metropolitan areas is usually the responsibility of local government authorities, while management for non-hazardous commercial and industrial waste is usually the responsibility of the generator. The principle of 'polluter pays' or 'waster pays' meaning the cost of solid waste management/disposal should be borne by those who produce it.

Figure 1: Waste Hierarchy Model

1.5.2 Product Stewardship

Product stewardship is also sometimes referred to as ‘extended producer responsibility” and is a concept that describes a situation where all parties involved in producing, selling or using a product take responsibility for the full environmental, and socio-economic impacts of that product. The concept is an example of how products and services can be better designed and managed through the involvement of the entire value chain with the end result being waste-free products.

1.5.3 What is ‘Cradle to Grave’ Thinking?

Cradle to grave is a management concept that is typically applied to the use of a product or material which is known to result in the production of a waste. Cradle to grave is a term also given to tracking systems for hazardous wastes in particular to ensure that their movements are tracked from creation to final disposal of waste products.

Some view current human technology as products of cradle to grave design, where products are created from mining finite resources, shaping them into products for short term use, and then discarding the remains.

1.5.4 What is ‘Cradle to Cradle’ Thinking?

In the book 'Cradle to Cradle,' architect William McDonough and chemist Michael Braungart have crafted a compelling explanation for why humans need a completely new framework for how we interact with the world around us. The authors envision a world where product design is the key to the next industrial revolution- a revolution that will transform human industry from a system that takes, makes, and wastes to one that celebrates natural, economic, and cultural abundance. Cradle to cradle thinking revolves around the idea that in nature, waste equals food. All products are seen as nutrients within biological (natural) or industrial (technical) metabolisms. In short, the book describes a world where when a material item gets worn out, you simply throw it on the ground to decompose.

1.6 Acronyms

C & D	Construction and Demolition
HSS	HSS High Standard of Sustainability (as defined by Beacon Pathway Limited, June 2006)
MfE	Ministry for the Environment
LGNZ	Local Government New Zealand
NZWS	New Zealand Waste Strategy, 2002
RBE	Residential Built Environment
SWAP	Solid Waste Analysis Protocol
WMP(s)	Waste Management Plan(s)

A glossary of solid waste terminology is contained in111.

1.7 Acknowledgements

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2 The Waste Problem

2.1 Overview: the Waste Mountain

As stated in the New Zealand Waste Strategy 2002,

> *"Waste is bad for the environment, bad for our health and bad for our economy. Numerous adverse environmental and human health effects can be attributed to waste."*

Negative effects can include the emission of greenhouse gases and toxic leachate escaping into or over the ground from waste decomposing in poorly managed landfills. Waste requires valuable open space to be allocated for sanitary landfills, creating a nuisance for neighbours and limiting future land use. Waste also symbolises economic inefficiency and is the evidence of an unsustainable use of resources. As more solid waste is produced and landfill space becomes scarcer, the costs of disposal in New Zealand will continue to rise.

Available data regarding waste generation tells us that **despite waste minimisation initiatives in the last decade such as the introduction of recycling and cleaner production techniques, the amount of solid waste being disposed of to landfills in New Zealand continues to rise[2].** Estimates indicate that the majority of all solid waste to landfills (and cleanfills) has its origins in the RBE through a combination of home construction / demolition and household domestic activity[3].

This section contains a summary description of the solid waste stream generated in the RBE and the associated issues. A review of available data, gaps in data and the limitations to the data is also included where the information was available. The key factors expected to influence change in the future waste stream are also discussed.

It assumed that Beacon is already familiar with some of the solid waste data and issues highlighted in this section. The purpose is to condense this information into a single report to make it easy to understand and to fill any gaps in Beacon's understanding of solid waste issues in the RBE.

2.2 Waste Facilities

Waste disposal occurs at the end of a product's life cycle, where the item holds no further use and is typically either buried or burnt. Ideally this action of disposal will take place at a purpose-built facility. However, disposal may also take place at the neighbourhood or household level, typically as backyard burning or burying.

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[2] As summarised in the New Zealand Waste Strategy 2002, based on Auckland Regional waste data and the 1997 State of the Environment Report (MfE).

[3] As interpreted from the 1997 Waste Data Report and the State of the Environment Report (MfE).

2.2.1 Facility Types and Terminology

Below is a discussion of the types of waste handling and disposal facilities and key issues that are associated with those facilities. Terminology used to describe these types of facilities tends to vary. Table 1 summarises facility types, terminology and activities.

Table 1: Common Terminology Functions for Waste Facilities

Facility name / description	Materials Accepted	Key Facility Function			Comment
		Sorting / transfer	Recycling / Reuse	Disposal	
(Waste/Refuse) transfer station	May exclude hazardous wastes	✓			Traditionally transfer stations were for consolidating smaller loads and transporting to landfill.
Resource Recovery Park	May exclude hazardous wastes	✓	✓		This is one of the 'new generation' names for a transfer station, as they focus on recovery with minimal waste transferred to landfill.
Eco Industrial Park / Eco Park	May exclude hazardous wastes	✓	✓		Similar to Resource Recovery Park
Landfill	May exclude hazardous wastes			✓	May include sorting/ recycling activities (e.g. composting), although not generally the case for New Zealand landfills.
Cleanfill	Inert, cleanfill material (refer to Section 2.4.2)			✓	Some sorting/recycling may also take place
Waste-to-energy Plant	Technology dependent		✓		There may also be associated disposal functions involved, e.g. ash may need to be landfilled.

Incinerator	Typically all			✓	Internationally incinerators are used extensively for waste disposal, including for hazardous wastes
Composting Plant	Organic material. Restrictions depend upon method or technology		✓		Either stand-alone or often incorporated into Recycling/Reuse facility.
MRF (materials recovery facility)	Recyclables (e.g. tin, aluminium, plastic and glass containers, paper)	✓	✓		A facility dedicated to sorting, baling and preparing recycled materials for sale on the commodity market.

Notes:

1. The stated function/s for each facility type is for the 'typical' case only and some facilities may incorporate more or less functions than what is indicated.
2. Waste transfer, recycling/reuse and/or waste disposal activities may all take place on the same site.

2.2.2 Landfills - The Necessary Evil?

There is a common perception that landfills are 'bad', in terms of both the wasted potential for reuse or recycling of materials and in terms of adverse environmental impacts, such as odour and noise generation and the potential discharge of leachate to land or water. However, it should be noted that, in some instances, the adverse impacts of recycling or reuse of wastes may outweigh the benefits, e.g. energy and discharges associated with the recycling of a material may greatly exceed those from both landfilling the material and sourcing new raw materials. Similarly, the environmental and social impacts of modern appropriately sited and designed landfills are expected to be minor.

While it may defy the 'conventional wisdom' of waste minimisation advocates, waste reduction, reuse and recycling options need to be carefully selected in consideration of the whole of life cost including a life cycle assessment.

Waste disposal is about identifying the best solution on a case-by-case basis, taking into account material, regional and market factors.

In some situations the costs and adverse impacts associated with diverting and recycling wastes may be more significant than those associated with landfill disposal. Of course this would vary from location to location and with waste type and recycling/reuse options. The point here is not whether landfills are good or bad but rather that the best solution needs to be considered on a case-by-case basis, taking into consideration material, regional and market factors.

2.2.3 The Issues

There are a number of general issues and influencing factors that impact on the number, type and management of New Zealand's waste facilities. These points are discussed below:

- Landfills remain the most common type of waste disposal facility in New Zealand. This is a reflection of both our 'throw-away' culture and on the economic benefits of waste disposal versus reuse and recycling options.
- Currently there are 115 operating landfills within New Zealand[4]. By 2010, this number is expected to be down to 43, as more of the small local tips close. This is a continuation of the trend toward reducing the number of tips and moving to engineered sanitary landfills. Many of the closed landfills are those that were sub-standard, and lacked modern design aspects such as landfill liners, effective capping materials etc.
- As landfill disposal charges increase, the number of commercial cleanfills has also increased. However, in many areas of New Zealand Councils allow cleanfills to operate as a permitted activity, (provided that only inert wastes are accepted onto the site) which makes it difficult to track the number of cleanfills in operation.
- Existing waste facilities tend to display differing levels of environmental control, resulting from the lack of national legislation for the siting, design, waste acceptance, operation and closure of waste management facilities[5];
- Facilities have different social and cultural impacts, due to the level of variation in siting, design and operational aspects.
- There are different ownership relationships in place, including private versus public ownership or a combination of the two (e.g. through joint venture arrangements, which can be very complex).
- Different cost structure and charging regimes are in operation throughout New Zealand, potentially leading to cross-transfer of wastes within and between regions. Charging regimes can also limit benefits of increased diversion, e.g. a fixed annual cost for landfill disposal will not incentivise resource recovery, particularly if other reuse/recycling options incur a higher unit rate per tonne.
- Availability of, and access to, disposal and/or recycling/reuse facilities limits options for some regions, particularly in remote, low population areas due to the impacts upon transport and cost requirements.
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[4] Ministry for the Environment National Landfill Audit 2002. http://www.mfe.govt.nz/issues/waste/landfills/audit.html

5 There are some national guidelines available, however these are not supported by legislation. Available guidelines include "The Hazardous Waste Guidelines: Landfill Waste Acceptance Criteria and Landfill Classification" (MfE, 2004), "The Landfill Full Cost Accounting Guide for New Zealand (MfE, 2004)", "The Solid Waste Analysis Protocol: (MfE, 2002), "The Guide to Managing Cleanfills" (Mfe, 2002), "The Guide to Landfill Consent Conditions" (MfE, 2001), "The Guide to Closed and Closing Landfills" (MfE, 2001) and Landfill Guidelines (CAE, 2000).

The extent of these issues tends to vary throughout the country and can have significant impacts in terms of social, environmental and economic factors.

2.3 Best Practice for Waste Facilities

As mentioned in Section 2.2.2, New Zealand does not have national legislation for the design, construction and operation of waste facilities, with these aspects to be assessed and controlled under Resource Management legislation and consent conditions. This local level of control over site requirements accentuates regional variations in how these facilities are designed and operated. The exception to this lack of national legislation is a suite of air quality national environmental standards, which were released in October 2004 to improve air quality and reduce toxic emissions, including those generated from landfills. With 14 standards in all, the air quality National Environment Standards include a requirement for landfills containing over 1 million tonnes of refuse to collect greenhouse gas emissions.[6]

New Zealand does have a series of national guidelines in place for the best practice management of waste facilities. Produced by MfE, these guidelines are:

- The Hazardous Waste Guidelines: Landfill Waste Acceptance Criteria and Landfill Classification (2004);
- The Landfill Full Cost Accounting Guide for New Zealand (2004);
- The Solid Waste Analysis Protocol (2002);
- The Guide to Managing Cleanfills (2002);
- The Guide to Landfill Consent Conditions (2001);
- The Guide to Closed and Closing Landfills (2001).

It is noted that these guidelines relate to waste disposal facilities only and do not include direct guidance for waste reuse or recycling facilities. However, there are a number of best practice guidelines in place within Australia, which can provide useful direction for the design and operation of New Zealand facilities. Examples include:

- Environmental Guidelines For Composting And Other Organic Recycling Facilities (EPA Victoria, 1996);
- Guide to Best Practice At Resource Recovery and Waste Transfer Facilities (EcoRecycle Victoria, 2004);
- Environmental Guidelines: Composting and Related Organics Processing Facilities (Department of Environment and Conservation NSW, 2004);
- Handbook for Design and Operation of Rural and Regional Transfer Stations (Department of Environment and Conservation NSW, 2006).

[6] ***For further information on the Air Quality National Environmental Standards, refer to http://www.mfe.govt.nz/laws/standards/air-quality-standards.html***

2.4 Construction and Demolition (C & D) Waste

This section overviews the C & D waste stream, including defining C & D waste, its composition, origins and overall amounts. The section also looks at some of the issues and problems associated with C & D waste management and disposal.

2.4.1 Definitions

New Zealand does not have a nationally consistent definition for C & D waste. Christchurch City Council defines C & D waste as "Materials in the waste stream which arise from construction, refurbishment or demolition activities including roading, earthworks and civil engineering"[7], whereas Marlborough District Council says that "Construction and demolition waste consists of waste building materials, packaging, and rubble from the construction, renovation, and demolition of buildings and roads (e.g.; concrete, wood, metals, and asphalt)."[8]

C&D Waste from the RBE is: … any product or material resulting from the construction and demolition process that is surplus to, or not included in the final building.

A further definition provided by the Ministry for the Environment (MfE) says that "C & D waste is a complex waste stream, made up of a wide variety of materials including concrete, plasterboard, wood, steel, brick and glass."[9] MfE has also prepared a comprehensive list of waste materials, compiled on a sector basis that includes a range of materials that are considered to be C & D wastes. This list is referred to as the "New Zealand Waste List" and a copy of the relevant portion is included in Appendix B of this document.

Resource Efficiency in the Building and Related Industries (REBRI) is an organisation with the purpose to promote, advocate, and assist resource efficiency measures in the building and related industries. REBRI has recently developed a set of guidelines for managing C & D waste and in this work provides the following definition for what they term "construction site waste" (having essentially the same composition as C & D waste):

"any product or material resulting from the construction and demolition process that is surplus to, or not included in, the final building".[10]

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7 Definition adopted from the Christchurch City Council Draft Waste Management Plan 2005

8 Source: http://www.marlborough.govt.nz/content/docs/waste/Waste_Strategy_&_Plan_2005-2010.pdf#search=%22construction%20demolition%20wastes%20definition%22

9 Source: http://www.mfe.govt.nz/issues/waste/construction-demo/index.html

10 Definition sourced from the Guide for Construction Waste Audits (Rebri, May 1999), footnote No. 1.

Unlike the MfE and Marlborough District Council definitions which use examples of specific type or composition of waste materials, the REBRI and Christchurch City Council definitions are based upon the process that creates the material for disposal. This process-based definition appears to be a useful approach for defining C & D waste; therefore, for the purposes of this study, the REBRI definition for construction site waste is adopted.

2.4.2 Comparison Between C & D Waste and Cleanfill Material

The distinction between C & D waste and cleanfill material is worth noting. The MfE defines cleanfill material as being "material that when buried will have no adverse effect on people or the environment. Cleanfill material includes virgin natural materials such as clay, soil and rock, and other inert materials such as concrete or brick that are free of:

- combustible, putrescible, degradable or leachable components;
- hazardous substances;
- products or materials derived from hazardous waste treatment, hazardous waste stabilisation or hazardous waste disposal practices;
- materials that may present a risk to human or animal health such as medical and veterinary waste, asbestos or radioactive substances;
- liquid waste."[11]

Therefore, the 'human-made' components of cleanfill material are also C & D wastes.

C & D wastes that would not be accepted at a cleanfill include (but are not limited to):

- timber (treated or untreated);
- reinforcing steel;
- roofing iron;
- old cladding or roofing materials containing asbestos fibres and paper packaging.

2.4.3 Relevance to the RBE

Almost all types of wastes mentioned as examples of C & D waste (concrete, asphalt, plasterboard, wood, steel, other metals, brick, glass and packaging) could originate from the RBE and could be generated not only from the buildings but also from the surrounding constructed environment, such as driveways, paths and retaining walls. The adopted definition for C & D waste is relevant to both the construction of new residential buildings and environments and renovations or refit-out of existing residential buildings and environments.

Beacon aims to improve the design and construction of both new homes and New Zealand's existing housing stock, at both a single dwelling and neighbourhood level. Considering this

http://www.rebri.org.nz/links/WasteAuditGuide.pdf#search=%22definition%20construction%20waste%20rebri%22

[11] Source: http://www.mfe.govt.nz/issues/waste/landfills/cleanfill/definitions.html

design and construction element (including both new design/construction and refit/renovation projects), C & D wastes are the predominant type of wastes associated with activities that Beacon seeks to influence.

2.4.4 Existing Data, Gaps and Limitations

This section outlines existing data that is available for C & D wastes generated from the RBE, including both New Zealand and overseas information. C & D waste data is presented for both waste composition and for quantities of C & D waste disposed of to landfill. Where possible, data is presented at a household level, for example, C & D waste generated from the construction of a 'typical' residential building. However, in many cases, particularly with New Zealand data, information on C & D waste is presented on a regional or national basis and may include combined residential, commercial and industrial C & D waste.

2.4.4.1 C & D Waste Composition

Based upon case studies and wastes audits for a range of residential building sites in the United States, the Oikos[12] website (http://oikos.com/library/waste/types.html) provides the following information on the composition of RBE C & D wastes (Figure 2). New Zealand C & D composition is also based on case studies, with data contained in Figure 3.

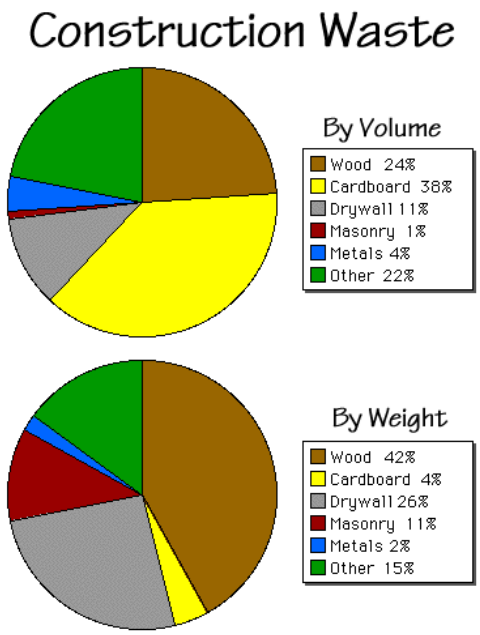

Figure 2: Composition of Residential Construction and Demolition Wastes

(Based upon Case Studies / Waste Audits from United States residential building sites)
Source: http://oikos.com/library/waste/types.html

[12] ***Oikos is a website that has been developed to provide information on sustainable design and construction.***

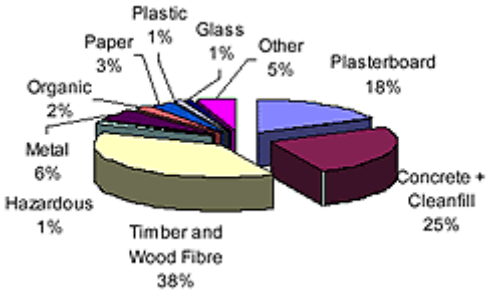

Figure 3: Composition of New Zealand C & D Wastes (by weight)

Source: http://www.mfe.govt.nz/issues/waste/construction-demo/index.html

Based on the information presented above, the key components of C & D wastes are:

- Wood waste – around 40 percent, by weight;
- Concrete / cleanfill – around 13 – 25 percent, by weight;
- Drywall / wallboard / plasterboard – around 18 – 26 percent, by weight.

Due to the nature of the material, the cardboard and paper component is relatively high in terms of volume (around 40 percent) but only a small contributor by weight (3 – 4 percent). The existing markets for paper and cardboard are well-developed; therefore the key to maximising the amount of packing wastes recycled from construction and demolition projects is to make adequate provision for source separation of these materials on the site and to ensure that this material is collected in an appropriate manner. In practice this would generally involve the provision of separate waste containers for paper and cardboard and engaging appropriate collection and recycling contractors.

Other types of packaging materials are also likely to contribute to C & D site wastes, such as plastic wrap, straps, polystyrene etc. These wastes are not significant contributors in terms of wastes to landfill by weight. However, product stewardship programmes that require the supplier of products to remove all packaging material is a sensible option and a potential tool to drive improved design to reduce packaging wastes upfront.

2.4.4.2 C & D Waste Quantities

In Edmonton, Canada, in 1991 an industry consortium called Partners in Clean Construction began a study to measure wastes from 33 housing sites[13]. The first four sites were monitored in 1992 prior to the introduction of an industry challenge to reduce waste from building sites. The average of those four sites was 18.0 kg of waste produced for each square metre of floor area. Following the introduction of the industry challenge, waste generation measured from a further four sites averaged 14.5 kg/m^2. The programme to reduce wastes continued and results of waste audits conducted three years later over 25 sites showed a further reduction to 11.6 kg/m^2.

Further estimates for waste from RBE construction sites have been sourced from Saskatchewan, Canada. These estimates are based upon a study that was undertaken by the Regina Home Builders' Association in the early 1990s, converted from imperial to metric measurements as required. The lower results from the Regina, Saskatchewan study are similar to the results shown by the Partners in Clean Construction prior to the introduction of the industry waste reduction challenge.

A study in Tauranga in 2004 indicated that up to six tonnes of waste is generated during the construction of a new, average sized three-bedroom home[14] and that up to 85 per cent of building sites' waste could be reduced, re-used or recycled, so long as existing markets were available and worksite practices were suitably adapted to provide for separation at source and/or decontamination of separate waste streams.

In 1997 a waste audit was conducted on a residential building site for Maddren Homes[15] and showed that 4.5 m^3 of waste was generated per house.

Waste generation (including waste to landfill and recycled waste) was more recently measured during construction of the NOW home in Waitakere City. The total amount of waste generated during construction was 2.4 tonnes, equating to 16.8 kg per square metre of floor area. This rate was notably lower when compared with international results reported in "Residential

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13 The Partners in Clean Construction Study and findings are described within the report titled "Sustainability in Practice: Reducing Construction Waste in the Ontario Residential Construction Industry (1997), weblink: http://www3.gov.ab.ca/env/waste/aow/crd/publications/OHBA-Sustainability_In_Practice.pdf#search=%22residential%20construction%20waste%20pro.

14 The study was commissioned by Tauranga City Council and Environment Bay of Plenty and was conducted by the Environmental Education for Resource Sustainability Trust (EERST). Source: Article produced on the Business Care website, http://www.businesscare.org.nz/bookshelf/articles/index.htm.

15 Maddren Homes is an Auckland-based house building company who constructs a variety of house types and sizes, ranging from economy kitsets to large completed homes.

Construction Waste Management: A Builder's Field Guide"[16], which measured between 14.7 and 25.4 kg of waste per square metre, but are higher than the Edmonton results.

It is noted that the NOW Home® was constructed using the following key principles and guidelines to minimise environmental impacts and costs during the construction process:

- accurately determining material quantities to avoid material wastage;
- encouraging site workers to separate waste as it is produced (to avoid double handling);
- providing recycling containers within easy access;
- setting achievable and measurable waste reduction targets;
- appointing one person to be responsible for waste management on-site;
- gaining agreement from sub-contractors and suppliers to comply with waste management procedures.

Putting such measures and concepts into place prior to, and during, construction is not common practice. Therefore the average quantities of waste generated from RBE construction sites is expected to be higher than that recorded from the NOW Home™ site.

David Mansel, Director of Generation Developments, a property developer operating in the central North Island, reported that research on their building sites showed that an individual three bedroom home would produce 27 cubic metres of refuse[17]. Using a standard volume to weight conversion for C & D waste, this equates to roughly 5.6 metric tonnes of refuse per home[18]. In many cases, the developer found that the placement of skips on site would attract other refuse and illegal dumping, and acted as a disincentive to materials efficiency for the subcontractors.

Table 2 provides a summary of the range in waste quantities that have been measured from RBE construction sites both in Canada and in New Zealand.

Based on the information presented, the following conclusions are made with respect to C & D waste quantities:

- there is considerable variation in C & D quantities generated from residential construction projects, ranging from around 12 to 25 kilograms of waste per square metre of floor area;
- industry waste reduction programmes appear to be successful in reducing waste quantities to landfill. Examples listed above indicate that a reduction in the order of 30 to 40 percent is possible, with education and incentives for waste reduction in place.

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16 published by the US NAHB Research Center.

17 By personal communication with David Mansel and William Carter of Generation Developments, September, November 2006.

18 Adapted from the Ministry for the Environment, as used in the National Waste Data Pilot.

Table 2: Summary of Estimated Waste Volumes From Residential Construction

Project / Source	House area (ft^2)	*House area (m^2)**	Estimated waste volume	Estimated waste tonnages	Average volume of waste generated	Average kg of waste generated
Partners in Clean Construction, Edmonton, Canada	Average waste generation for four sites monitored in 1992, prior to introduction of industry waste reduction programme					18.0 kg/m^2
	Average waste generation for four sites monitored soon after the introduction of an industry waste reduction programme					14.5 kg/m^2
	Average waste generation for 25 sites monitored three years after the introduction of an industry waste reduction programme					11.6 kg/m^2
Regina Home Builders' Association, Saskatchewan, Canada[12]	1200 ft^2	*111 m^2*	14.5 m^3	2.6 T	0.13 m^3/m^2	23.4 kg/m^2
	1800 ft^2	*167 m^2*	19.9 m^3	3.6 T	0.12 m^3/m^2	21.6 kg/m^2
	2400 ft^2	*223 m^2*	22.9 m^3	4.1 T	0.10 m^3/m^2	18.4 kg/m^2
Tauranga City Council, Environment Bay of Plenty and the Environmental Education for Resource Sustainability Trust	Average sized 3 bedroom home			6 T	-	-
Maddren Homes, Auckland	Average sized home		4.5 m^3	-	-	-
NOW Home, Waitakere City, Auckland	Average sized 3 bedroom home			2.4 T		16.8 kg/m^2

"Residential Construction Waste Management: A Builder's Field Guide"19	Details unknown				14.7 - 25.4 kg/m^2
Generation Developments, central North Island	Average sized 3 bedroom home	27 m^3			

Notes:
**** Imperial*** measure of house area has been converted to metric for the purposes of this report.

2.4.4.3 Gaps and Limitations

New Zealand data on total waste quantities is limited, due to the cost and complexity of gathering data from a large number of dispersed sources including private and publicly owned waste disposal facilities, many with varying approaches to charging and waste measurement. This limits the accuracy of assumptions on C & D wastes being disposed of or diverted for reuse or recycling.

Although MfE states that "C & D waste may represent up to 50 percent of all waste generated in New Zealand, 20 percent of all waste going to landfill and 80 percent of all waste going to clean-fill" with a typical composition background as indicated by Figure 2-2, it is not clear what proportion of New Zealand's C & D waste is derived from the RBE, rather than from other C & D sources such as commercial, industrial or infrastructure construction sites. Therefore, it is difficult to draw any direct and overly meaningful comparisons between C & D waste compositions for New Zealand and for the United States. For example, although Figure 2-2 indicates that there is a significantly greater proportion of concrete and cleanfill in New Zealand C & D waste, compared with United States results, it may be that much of this waste stream is generated from non-residential sources (in fact this seems highly likely).

In the absence of New Zealand data on the residential contribution to C & D waste, overseas information has been considered. A 1996 study conducted for the Environmental Protection Agency (EPA) concluded that the annual generation of all C & D wastes in the United States was 136 million tons[20]. The study also concluded that the split between residential and non-residential sources of C & D waste was 58 million tons, or 43 percent, residential and the

[19] published by the US NAHB Research Center.

[20] Assumes that waste sources included residential/non-residential buildings, roads, and bridges.

remainder non-residential. Furthermore, of the 58 million tons of RBE C & D wastes, 34 percent was generated from site demolition and 55 percent from renovation activities. Therefore, only 11 percent of the waste stream was found to be generated from the construction of new residential buildings.[21] This split between C & D waste sources is presented within Figure 4.

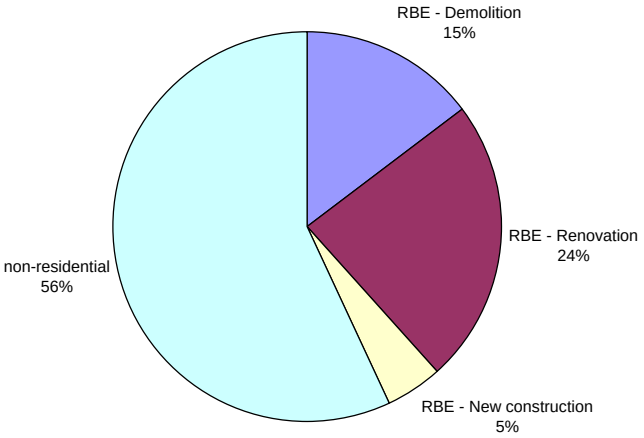

Figure 4: Source of Construction and Demolition Wastes (US EPA Study, 1996)

Caution should be exercised in applying these waste source breakdowns directly to the New Zealand situation, as there are many differing and relevant factors between New Zealand and the United States (and indeed from region to region, for both countries) – e.g. differing costs of new construction versus second-hand house purchase, differing levels of economic growth, differing cultural factors influencing residential activities / locations / house size / house style, geographic conditions etc. However, the general finding that waste quantities from residential renovations/refits exceed those from new construction may indeed also be true for New Zealand.

21 Source: http://www.harc.edu/Projects/CultivateGreen/Events/20050518 (units converted to metric).

2.4.5 The Issues

2.4.5.1 The New Zealand Waste Strategy and C & D Wastes

The New Zealand Waste Strategy 2002 set the following targets for C & D wastes:

Target 4.1 By December 2005, all territorial local authorities will have instituted a measurement programme to identify existing construction and demolition waste quantities and set local targets for diversion from landfills.

Target 4.2 By December 2008, there will have been a reduction of construction and demolition waste to landfills of 50 percent of December 2005 levels measured by weight.[22]

In February 2004 MfE released a report which evaluated the level of progress in meeting each target set within the New Zealand Waste Strategy[23]. When considering progress against Target 4.1, the review report concluded that although the Solid Waste Analysis Protocol has provided a nationally consistent approach to the measurement of C & D wastes, there may not be an appropriate system in place for measuring and recording C & D disposal quantities. It was also noted that MfE was providing funding for a series of C & D waste projects through the Sustainable Management Fund, which became the REBRI projects.

As Target 4.1 has not yet been met, there is no baseline available against which to measure the progress made for Target 4.2. However, a number of issues were noted for the diversion of C & D wastes from landfill, which can be applied to both general C & D wastes and those generated specifically from RBE construction. These issues include:

- [current] disposal charges, both at landfills and dedicated C&D waste sites providing little economic incentive to find alternative disposal methods such as recycling or reuse;
- [availability of and access to] markets for the diverted materials;
- site logistics (the practicality of sorting waste materials on-site);
- [impacts of] building design, selection of materials and the deconstruction process.[24]

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22 Source: http://www.mfe.govt.nz/issues/waste/construction-demo/faq.html
23 A series of reports on C & D wastes and related issues were prepared by SKM Limited during 2004. Report topics included market development strategies for selected regions, sector group's issues and options, market assessment, review of regulatory tools, guides for reducing C & D wastes and a wastes auditing guide. Copies of these reports are available through the REBRI website, http://www.rebri.org.nz/
24 Source: http://www.mfe.govt.nz/publications/waste/review-targets-waste-strategy-feb04/html/index.html

2.4.5.2 Benefits of Minimising / Diverting C & D Wastes

Minimising C & D wastes during residential construction and demolition projects has a number of benefits:

- Increased efficiency of resource use, resulting in reduced project costs (cost savings primarily from reduced material wastage, rather than from decreased disposal costs);
- Minimising negative environmental impacts through reduced waste to landfill;
- 'Closed loop' thinking, with wastes instead viewed as resources for beneficial reuse and/or recycling.

It should be noted however, that although waste minimisation implies the efficient use of resources this may or may not equal resource efficiency. For example, options for reuse or recycling of C & D wastes should be measured in full life cycle terms and consideration should be given to impacts such as the energy requirements and economic implications of reusing or recycling that material.

The REBRI / Maddren Homes waste demonstrated cost savings related to the reduction of C & D wastes and diversion from landfill. Although savings directly related to disposal costs were only $175, costs related to wastage or damage to building materials were estimated at around $1,700, which was over 2 percent of the overall cost of construction.[25] This indicated that improved site management practices could offer both reductions in waste generation and economic benefits.

2.4.5.3 Problems Associated with C & D Wastes

The New Zealand Waste List identifies those C & D wastes that are considered to be hazardous. A full list of hazardous C & D wastes is provided within Appendix B of this document; however, those most relevant to C & D wastes generated from the RBE are listed below:

- concrete, bricks, tiles and ceramics containing hazardous substances;
- glass, plastic and wood containing or contaminated with hazardous substances;
- metal waste contaminated with hazardous substances;
- cables containing oil or coal tar;
- soil and stones containing hazardous substances;
- insulation materials containing asbestos (issue for older homes in particular);
- other insulation materials consisting of or containing hazardous substances;
- construction materials containing asbestos (issue for older homes in particular);
- gypsum-based construction materials contaminated with hazardous substances;
- construction and demolition wastes containing mercury or lead based paints;
- C & D wastes containing PCB (e.g. *som*e sealants, resin-based floorings, sealed glazing units, capacitors and cables);
- other construction and demolition wastes containing hazardous substances.

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25 Source : REBRI case study, http://www.rebri.org.nz./case-studies/domestic.html

The severity and likelihood of hazardous materials being contained within C & D wastes should be considered at an early stage of the construction process, as it could result in additional sorting requirements and reduced options for the reuse and recycling of waste materials.

2.5 Domestic Waste

2.5.1 Definition of Domestic Waste

Domestic waste is defined as solid material originating from activities taking place within the home and generally collected (often at kerbside) for disposal to landfill or for recycling. Domestic waste primarily includes packaging wastes, organic kitchen and garden wastes and other discarded household objects, excluding trade or commercial wastes. In this context it also excludes any wastes generated during the construction, renovation / refit or demolition of the home and/or surrounding residential environment (including paths, garden soil etc.), although small amounts of this waste is also collected at kerbside. Domestic waste is the portion of Municipal Solid Waste that is generated by households.

2.5.2 Existing Data, Gaps and Limitations

2.5.2.1 Domestic Waste Composition

Like C & D waste, detailed data regarding the composition of household domestic waste in New Zealand is limited. Local authorities and private waste companies are the primary owners of waste data. The MfE has collected some information from local government authorities regarding their kerbside waste collections and publicly owned landfills toward developing a baseline of domestic waste composition. However, there are many gaps in the data due to the increasing privatisation of the waste industry and commercial sensitivity.

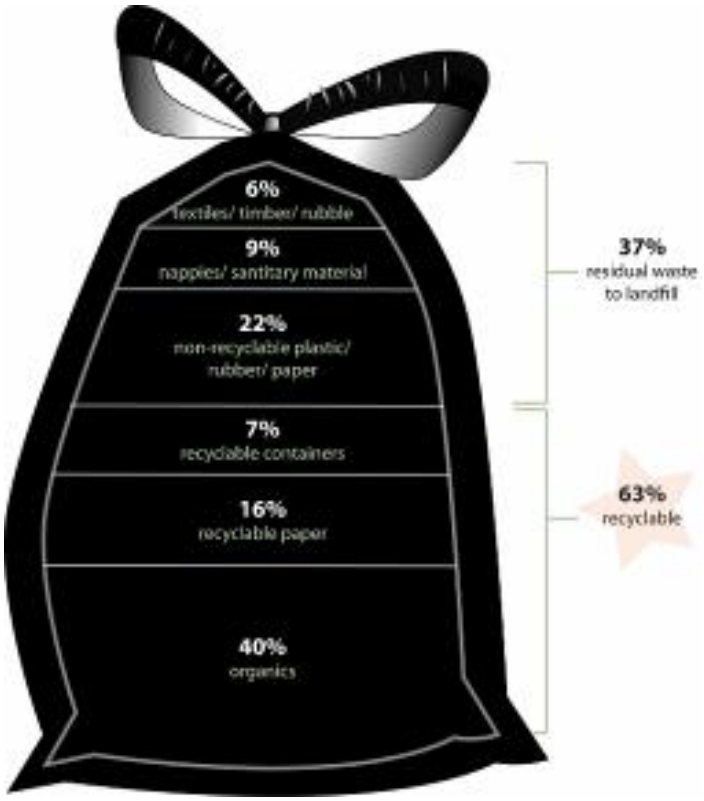

Figure 5: Contents of a "Typical Refuse Bag" in 2004[26]

The data in Figure 5 has been derived from the combined tabulation and analysis of Solid Waste Analysis Protocol (SWAP) results conducted by five local authorities for 2003. It shows the typical composition of domestic waste that is collected for landfill. This is the material put out for collection and disposal from a household refuse bag or wheelie bin collection. Organic waste (meaning the combination of kitchen putrescibles and garden waste) continues to be the highest proportion of waste to landfill from households, with paper and plastic materials being the next highest.

[26] ***Adapted from 2005 SWAP data for waste management plans of North Shore City and Rodney District Councils' waste management plans.***

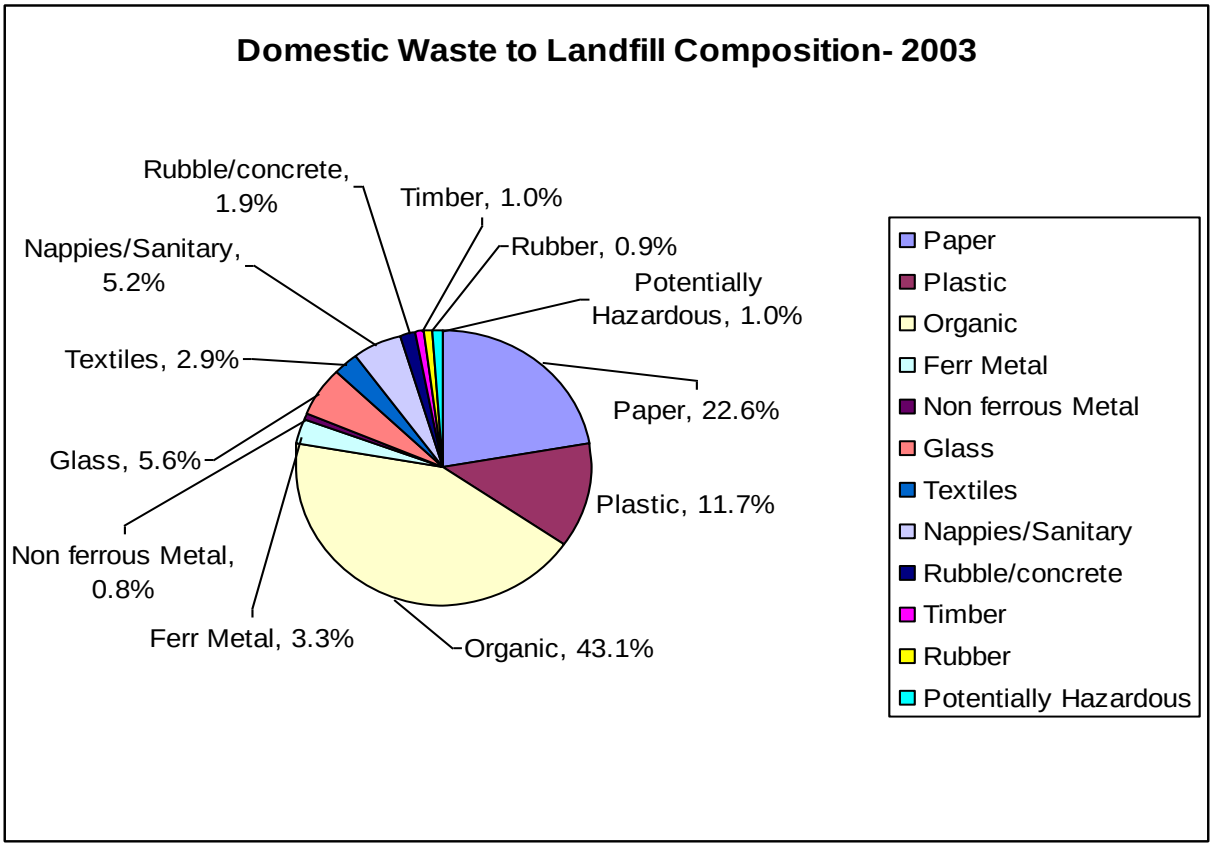

Figure 6: Domestic Waste to Landfill Composition – SWAP Baseline Data 2003

2.5.2.2 Domestic Waste Quantities

Available data regarding waste generation suggests that, despite waste reduction activity introduced since the 1980's such as kerbside recycling, cleaner production improvements and the promotion of home composting, the amount of waste disposed of to landfill in New Zealand has continued to increase on a per capita basis. While this may be discouraging to waste minimisation advocates, it should be noted that there have been significant improvements during the same period with respect to public and environmental health issues associated with solid waste collection and disposal.

Definition
"Waste per capita" *is an indicator for waste generation that looks at the total amount of waste produced divided by the total number of people in a defined area.*
It is an indicator of average waste production on a 'per person' basis, but is not directly equivalent to the amount of a waste an individual throws away each year.

Auckland regional data on overall waste quantities to landfill shows that waste per capita increased by 73 percent between 1983 and 2001[27], which represents a 3.1 percent annualised

[27] ***The New Zealand Waste Strategy- Towards Zero Waste and A Sustainable New Zealand 2002. Ministry for the Environment.***

average increase per capita. In addition, the Auckland region has an average annual population growth rate of over 1 percent[28] This means that not only are there more people generating waste but, each year, the average amount of waste being produced per person is also increasing. Data collected in 2001 by the Auckland Regional Council indicates that Aucklanders produce, on average, approximately 786 kilograms of waste to landfill per person each year[29].

Internationally, research shows a strong link between consumption and waste production. For the last 30 years, growth in Gross Domestic Product (GDP) has been accompanied by a corresponding percentage increase in municipal waste[30]. In other words, as wealth increases (as currently measured by GDP), so does solid waste. Breaking this link between wealth creation and solid waste is therefore the focus of current waste minimisation activity and should be the key question Beacon aims to answer.

2.5.2.3 Gaps and Limitations

While there has been significant attention given to waste data in New Zealand, limited information exists as to total waste amounts. The most detailed waste data survey to date was conducted in 1997 and refers to 1995 waste data. This data was compiled in the National Waste Data Report (MfE 1997), and has not been replicated since, due to the high cost of the waste sampling exercise used in the process. Despite its limitations this report is still useful and the data is still useful when compared to more recent SWAP data collected by local authorities.

A summary of the information about domestic (household generated) waste to landfill is below.

- In 1995, approximately 3,180,000 tonnes of waste was landfilled in New Zealand of which approximately 1,420,000 tonnes was residential waste and approximately 1,760,000 tonnes of industrial waste. It was also estimated that over 3,000,000 tonnes of C & D waste went to cleanfills.
- Organic waste is the largest proportion of waste going to landfills and the largest proportion in residential rubbish bags and bins.
- Paper and construction and demolition waste represent the next largest categories, although the construction and demolition waste disposed of into cleanfills is expected to be at least equal to or greater than that disposed of to landfills.
- Packaging is estimated to be between 10-14 percent of the waste going to landfills.
- Solid waste to landfill is strongly correlated with economic growth.

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28 Source: Auckland Regional Council website: http://www.aucklandcity.govt.nz/auckland/introduction/people/population.asp
29 Auckland Region Waste Data Report 2003. Waste Not Consultants, for the Auckland Regional Council. Solid waste (from both domestic and commercial sources) arising data for the Auckland Region: 968,000 estimated tonnes per annum (2001) . Auckland Regional Population census statistic for 2001 is 1,231,500 people.
30 Adapted from the OECD Environmental Outlook 2002, published by the Organisation for Economic Development and Cooperation.

2.5.3 Relevance to the RBE

The relevance of domestic waste to the RBE is obvious in that this waste is created by the consumption that takes place in the home. It is assumed that Beacon does not aim to directly influence consumption of the various consumer products and services in the home that are the source of domestic waste. However this discussion gives rise to the question of what Beacon *can* influence with respect to domestic waste minimisation in the RBE. To answer this, Beacon must consider options for reducing domestic waste by ensuring that options for diverting waste from landfill to beneficial reuse or recycling are maximised and through cooperation with other key players who are working to influence consumer behaviour. For the purposes of this report it is assumed that Beacon's sphere excludes direct action to influence consumption within the home, other than design and construction of the 'home' itself as a consumer item.

It is interesting to note the relationship between domestic waste and the design and construction of new and refurbished residential buildings. The amount and types of domestic waste produced provide some level of feedback on the sustainability of the initial design and construction phase. Although domestic waste is generated independently of the type of building design and construction (such as consumer waste packaging), a sustainable design will encourage diversion of waste from landfill disposal to other end uses. For example, a RBE with adequate provision for the storage and collection of recyclable materials is likely to have increased waste diversion rates compared with an environment that has no provision for recycling. The same is true for provision of on-site organic waste composting facilities or an organics collection service. This type of feedback loop is particularly significant for multi-unit dwellings and more intensive residential developments where recycling and composting facilities and collection services are frequently unavailable because they were not considered in the design stage.

2.5.4 The Issues

2.5.4.1 Problems Associated with Domestic Waste

In considering the composition of domestic waste to landfill and the availability of collection for some recyclable materials, it is noted that between 60-65 percent of a typical household refuse bag or wheelie bin (by weight) is readily able to be composted or recycled. Because this portion of the waste stream can be diverted from landfill using existing systems and technologies, it is noted that most councils have programmes in place to increase recovery of these materials, but with varying levels of success. While local government has been successful in providing kerbside recycling systems resulting in a high level of recovery, they have had far less impact on the recovery of the organic waste stream either through the provision of kerbside collection schemes or through the promotion of home composting.

2.5.4.2 Organics

Organic waste includes kitchen food scraps, lawn/garden clippings, and meat and fish waste. In a landfill, these materials break down under anaerobic conditions and produce methane, which is a greenhouse gas contributing to climate change. Decomposing organic waste produces liquid leachate which must be treated, and is potentially harmful to ground and surface water if incorrectly managed. Research conducted on behalf of North Shore City Council indicated that approximately 25 percent of households in North Shore City report composting some or all of their organic waste[31]. It is likely that this figure overstates the level of home composting, as composting was defined in the study to include the inactive piling of grass and leaf clippings. Market research conducted by Living Earth Limited shows that the level of home composting in terms of those households that use a composting receptacle is much lower at approximately 5 percent of households[32]. This shows the scope for either increasing the level of at-home composting or for providing an alternative such as a kerbside collection and regional composting.

It should be noted that while a significant amount of garden greenwaste is commercially composted in New Zealand, such as through domestic kerbside collections, only two districts have an organics kerbside collection service available at the time of writing that includes the collection of kitchen putrescibles, which is the largest portion of the domestic waste stream. The use of in-sink waste disposal systems (insinkerators, garbage disposal units) has raised concerns about overloading of the wastewater treatment plant/s and elevated nutrient levels. However, as with landfill disposal versus other waste options, the advantages and disadvantages of in-sink disposal systems should be considered on a case-by-case basis. The risk of overloading wastewater treatment plants is highly dependent on the amount and type of organics that the plant was designed to treat. The addition of food wastes through the wastewater system may be well within the plant's design capacity and, in some cases, may even be beneficial to the process by supplying more food for the micro-organisms.

During a 2006 MfE/industry workshop on the potential implications of a solid waste disposal levy, the impact of a levy on in-sink waste disposal use was discussed. The concern was raised that increasing the cost of solid waste disposal could lead to an increased use of waste disposal units, shifting the organics from the solid waste stream to the liquid waste stream and increasing the demand on wastewater treatment plants. Deborah Morley from Watercare Services Limited provided the following comment in response:

> *"Insinkerators can only assist in disposing of the liquefiable waste from households and as such this would not pose an issue to wastewater treatment plants...'*[33]

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31 North Shore City research on uptake of waste minimisation behaviours conducted in 2004. No national data regarding uptake of composting is available.
32 By personal communication with Dave Perkins, Director of Living Earth Limited.
33 Source: http://www.mfe.govt.nz/publications/waste/waste-levy-discussion-nov06/html/page6.html

This issue is likely to require further study before advocating against the use of in-sink disposal systems as a Beacon target.

2.5.4.3 Packaging

Packaging makes up a relatively minor proportion of the waste stream (10-14 percent by weight) when compared to organic waste, however it represents a frustrating problem and continually attracts the attention of New Zealanders. **While packaging is inherently useful in preventing waste and spoilage**, some packaging types are over designed or are not able to be efficiently reused or recycled. Because of the voluminous nature of packaging and its high visibility, it perhaps attracts more attention from waste minimisation advocates than is justified if considering tonnage and harm in prioritising waste.

Yet recyclable packaging like paper, cans, bottles and other recyclable containers could be reduced further through improved recycling habits within the household. SWAP data from several local authorities indicates that up to 15 percent of domestic refuse currently going to landfill could be recycled in some cities using the existing kerbside recycling services available[34].

There are a number of 'myths' about packaging and recycling in particular. In the past recycling has received negative press when, in isolated circumstances, materials have not been recycled but have been landfilled, generally due to a market fluctuation or private industry failure. While these cases have generally been the exception rather than the rule, they are very damaging to the image of recycling. Fortunately recycling participation in New Zealand is generally relatively high, with rates of kerbside recycling in some cities reaching nearly 90 percent of households[35].

Due to its remoteness and size, New Zealand has a particularly turbulent market for recycled materials, as the economic viability of recycling relies on access to a market for remanufacture. A proportion of domestic waste collected for recycling is recycled into new products within New Zealand. These include steel, glass, plastics (HDPE[36], e.g. milk bottles and LDPE[37]), and paper. Other materials are sent overseas for processing in Australia and Asia, including PET[38] and most other grades of plastic, aluminium and some paper and glass[39]. More details regarding

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34 Based on NSCC and Rodney District data for 2003 as the National SWAP baseline did not contain this level of detail.

35 Refers to Recycling Participation Studies conducted by local authorities including North Shore City Council where recycling participation is defined as putting out recyclable materials for collection a minimum of once per month.

36 High Density Polyethylene

37 Low Density Polyethylene

38 Polyethylene Terephthalate

39 Via NZ Packaging Council and by personal communication with Dave Perkins, General Manager, Recycle NZ (a division of Transpacific / Waste Management) and a member of the NZ Packaging Accord Governing Board.

the New Zealand Packaging Accord, recycled materials and their markets is presented in Section 5.3.2.

Litter is a pervasive social and environmental problem caused by packaging material and studies have shown household waste and construction and demolition sites to be two of 8 primary sources of litter[40]. Litter is unsightly and causes damage to waterways and the marine environment. Some litter can be hazardous waste. The nature of littering behaviour makes it difficult to obtain significant evidence to prosecute offenders through the Litter Act 1979, which is the responsibility of local authorities as defined by the legislation.

2.5.4.4 Household Hazardous Waste

Domestic waste contains small amounts of materials that are potentially hazardous at all stages of their life. While the amount of household hazardous waste in domestic waste is not large, the potential impact on the environment and human health can be significant. Materials may be stored incorrectly in the home leading to injury to householders or collectors as well as environmental pollution. Most landfills are not designed to cope with hazardous wastes mixed with regular domestic waste.

Household hazardous waste is defined by the Auckland Regional HazMobile programme as anything that is flammable, corrosive, toxic, reacts with other materials or can pollute the environment. These products become household hazardous waste if no longer needed or wanted. Household hazardous waste includes:

- household chemicals such as cleaners, disinfectants, polishes and pool chemicals;
- garden chemicals such as pesticides, herbicides and fertilisers;
- automotive products such as waste oil, petrol, diesel and brake fluid;
- DIY products such as paint, varnishes, solvents, glues and wood preservatives;
- fluorescent tubes, energy-saving light bulbs and ultraviolet light bulbs;
- all types of batteries (wet-cell batteries used in cars and boats as well as dry-cell batteries used for appliances and toys);
- mobile phones.

2.5.4.5 Housing Types and Domestic Waste

As the majority of New Zealand homes are single family, this report focuses mainly on the single family dwelling form while acknowledging the impact of increasing urbanisation on housing types.

It is important for Beacon to recognise that each housing type has unique requirements for waste minimisation as well as barriers to be addressed. Experience in the Auckland Region has shown

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40 Adapted from Keep New America Beautiful, see http://www.ccc.govt.nz/Publications/ResourceCatalogueForSchools/WasteLitter/LitterAbatement.pdf.

that most intensive residential developments in urban areas are poorly fitted for waste management and waste minimisation[41].

Multi-unit properties are properties with more than five distinct housing and/or commercial units, such as terraced or high-rise apartments. Urban areas have an increasing number of multi-unit properties, many of which are built without consideration given to refuse and recycling storage or collection. This results in rubbish accumulating on the berm (road frontage) and can lead to obstructed driveways as well as amenity, public health, safety and nuisance issues. In some cases roads and right of ways are constructed in such a way that prohibits the access for collection vehicles. The unfortunate result is the inability for many such developments to participate in kerbside or commercial recycling collections.

Well-planned refuse and recycling facilities provide many benefits that include allowing for recycling of materials, increased amenity value, traffic safety, convenience and efficiency, and can have a significant impact on the successful daily operation of a building. Some councils have developed guidelines or District Plan rules or requirements around these issues to assist planners, developers and their design consultants in considering waste and recycling facilities at the design stage of construction to avoid costly retrospective fit-outs.

Implementation and operation of waste and recycling systems in multi-unit properties is the responsibility of site agents, managers, residents, commercial tenants, solid waste contractors and the council.

It should be noted that because of the differences in housing types, some of the indicators as currently specified by Beacon in its High Standard of Sustainability may be unsuitable for multiple unit dwellings, particularly with respect to home composting or worm farming. The HSS indicators will be discussed in more detail in Section 7.

To facilitate improvements in access to refuse and recycling services, some local authorities have produced guidelines for developers and have specified requirements in the District Plan. One example of such guidelines is included in Appendix C. These guidelines specify the different housing types and demonstrate the mechanisms for providing adequate storage and collection facilities for refuse and recycling. It should be noted that while such guidelines deal with both refuse and recycling, they do not include information with respect to the establishment of on-site composting of organic wastes.

[41] ***Based on the North Shore City Council study "Refuse and Recycling in Multiple Unit Dwellings", 2000 and through personal communication with the Auckland City Council waste management business unit.***

2.5.4.6 Urban vs Rural Influences on Domestic Waste

Solid waste management issues and practices differ between urban and rural New Zealand. Because the vast majority of homes are located in urban areas, this report focuses mainly on the urban RBE and management strategies related to New Zealand centres. However it is worth understanding these differences.

For example, all of the largest urban centres in New Zealand now have access to kerbside recycling through residential collections at kerbside. While recycling facilities are available to rural residents, these are typically drop-off facilities rather than kerbside collections.

Other differences include:

- availability of kerbside collection for refuse and recycling;
- availability and distance to viable markets for recycled materials;
- cost for collection/ drop off of materials;
- backyard burning/ farm burning/ burying;
- availability of space for home composting etc.

2.6 Factors that Influence Waste from the RBE

The key factors understood to influence the production of waste are:

- economic factors, such as wealth and personal consumption or growth, as measured by GDP[33];
- changes in population (which is linked to GDP);
- waste reduction and minimisation activities and initiatives.

New Zealand is at a period of transition following a time of high-economic activity, which was highlighted by the 'building boom' that peaked between 2002 and 2004. While the activity in the residential dwelling sector has slowed considerably since 2004, the growth rate has stayed above the decade average and is expected to continue to grow at a similar rate.[42] This will obviously continue to impact on construction waste from new home development as well as the production of domestic waste.

2.6.1 The Four Well-Beings of Domestic Waste

Solid waste generation may also be affected by various social, cultural, environmental and economic factors at local, national and international scales. These factors have been termed the "Four Well-beings of Domestic Waste".

At a national scale, cultural issues such as the emphasis on home renovation, the interest in 'character homes' and the DIY mentality of New Zealanders may impact future waste

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[42] ***Data on the residential dwelling sector and new building consents via Statistics New Zealand.***

production from renovation and retrofitting. Population increases in major centres, the aging population, housing affordability, urbanisation and density and dwelling life span may also impact on waste generation from this sector.

Siting landfills is becoming increasingly difficult due to constraints around available land, the high costs of meeting resource consent requirements, and increased transportation costs. The continuing trend toward fewer large sanitary landfills is seeing an average increase in the rate per tonne of waste to landfill. This will encourage further diversion of materials to beneficial reuse.

While the average landfill rate per tonne differs across the country, it is rapidly increasing to around $100 per tonne or more in most urban centres. The price increase has affected Auckland in particular with the closure of two major landfills (Rosedale and Greenmount) since 2002. It should be noted that the economics of recovery relies on closing the gap in terms of the cost comparison between collection and landfilling versus recycling or reuse. For example, a study conducted by Winstone Wallboards in cooperation with the MfE showed that the cost of landfill needed to be at $150 per tonne for the recycling of gypsum wallboard to be economically viable[43]. Distance and access to markets for recovered materials is also a major issue, particularly for the more remote areas of the South Island, where it is too costly to recycle glass due to the high transport costs involved in transport to markets in Auckland.

What is being done to address these issues at a local and national level will be discussed in more detail in Sections 4 and 5.

[43] ***By personal communication with Kevin Golding of Winstone Wallboards in November 2006.***

3 A "Who's Who and What they Do" Guide to Solid Waste Management

3.1 Overview

This section provides a concise overview of the waste management and minimisation 'playing field' in New Zealand as relevant to the RBE and Beacon's aims. The section will look at the key players involved at the different scales in the context of both C&D waste and domestic waste. Each key player will be described with respect to their role and functions in solid waste management. The review will not be exhaustive, as there is simply too much information available. Therefore only a summary of the most relevant players, programmes, practices and policies will be included. In the course of preparing the 'who's who' section, case studies and best practice examples of programmes, products, services or legislation of high relevance, success or interest will be highlighted.

For ease of understanding the section has been organised on a stakeholder by stakeholder basis.

3.2 Central Government

Table 3 provides a summary overview of the central government's role in managing and minimising solid waste. Case studies are also provided to illustrate how the New Zealand Government has addressed some of these key actions areas.

Table 3: Summary of Central Government Solid Waste Management Activity

Key Action Category	Description
Direct Action	Central government is not directly involved in resource recovery activities such as landfilling, collection or transport of wastes; however they are involved in developing and sponsoring management systems or programmes around targeted wastes such as used tyres, used oil and other special wastes.
Economic Instruments	There are currently no economic incentives being administered by Central Government in the solid waste area. Economic incentives have been under investigation since 2002. A solid waste levy is being considered as part of the Waste Minimisation (Solids) Bill.
Regulation and Policy	There is no dedicated solid waste legislation, however at time of writing there is a Private Members Bill put forward by the Green Party before Select Committee following submissions. The Waste Minimisation (Solids) Bill contains provisions regarding product stewardship, the creation of a national waste management authority and waste disposal levy. There are also a number of pieces of legislation that affect waste management in a less direct way as well as numerous sets of guidelines such as for landfills and hazardous waste.
Advocacy	Central Government promotes waste reduction issues outsides its direct control, through partnership with industry and local authorities to develop appropriate legislation, programmes and national standards under the umbrella of the NZ Waste Strategy 2002. Examples include voluntary extended producer responsibility programmes, involvement in the voluntary New Zealand Packaging Accord and funding for waste reduction projects such as REBRI through the Sustainable Management Fund (SMF).
Community engagement and behaviour change	Central government has been involved in promoting the awareness and engagement of the wider community in waste reduction behaviour through projects such as the "Reduce Your Rubbish" Campaign and "4 Million Careful Owners" campaigns. These programmes have generally been in partnership with regional and local government and/or other government agencies and have been short term and poorly funded.
Leading by example	Central government is working to 'walk the talk' through its Govt3 programme, which includes objectives and targets to reduce government solid waste and to use green building practices for all new government buildings.
Measuring our progress	Central government does not have access to robust data on waste generation due to the nature and ownership of waste facilities. However this data gap is being addressed somewhat through a number of central government initiatives with limited success.
Research and Technology	Central government provides some research and seed funding for waste related research and technology development on a case by case basis through its SMF fund or through FRST etc.

3.2.2 Overview of Central Government Activity

This section contains some examples of waste minimisation activities being undertaken by the new Government. Due to the role of central government, these examples focus upon the use of regulation and policy, with some additional discussion provided around the use of economic instruments (waste levy) and community engagement.

3.2.2.1 The New Zealand Waste Strategy 2002

One of the most important strategic documents for solid waste management is *The New Zealand Waste Strategy- Towards Zero Waste and a Sustainable New Zealand* (NZWS) adopted in 2002. The NZWS is Central Government's first waste strategy, which defines a long-term vision as well as specific targets for waste reduction and management. The NZWS is non-legislative.

The NZWS targets include reduction aims for overall waste minimisation, organic wastes, hazardous wastes, construction and demolition wastes and residual waste disposal.

The NZWS was developed by the Ministry for the Environment in cooperation with Local Government New Zealand. The NZWS is monitored and administered by the Ministry for the Environment (MfE).

Relevance to Beacon and RBE

While it provides a useful overview of the waste situation in New Zealand, the Strategy and its Targets have been viewed as relatively ineffective to many in the waste minimisation arena because of the lack of legislative backing to date. A review of the NZWS was conducted in 2004 with another review expected for release in December 2006. This information will be incorporated into this report if available prior to finalisation, with updates available at http://www.mfe.govt.nz/issues/waste/.

3.2.2.2 Existing Statutes

The following is a brief summary of the key statutes that impact upon the management of waste in New Zealand, be it in a less direct way than what would be achieved through waste management policy.

3.2.2.3 Resource Management Act 1991

The Resource Management Act addresses waste management through controls on the environmental effects of waste management facilities through local policy, plans and consent procedures. In this role, the Act exercises considerable influence over waste disposal facilities in

view of the potential impacts of these facilities on the environment. The Act has helped drive improvements in the standards of landfills and waste water treatment plants as they transition from low standard to well managed facilities. The Resource Management Act also provides for the development of national policy statements and for the setting of national environmental standards. Further, a number of national environmental standards have been enacted that influence the management of waste in New Zealand.

3.2.2.4 Local Government Act 1974, 1996 Amendment Act and LGA 2002

Part XXXI of the Local Government Act was enacted via a 1996 amendment. It requires territorial authorities to have responsibility for 'efficient and effective' waste management and requires the preparation of waste management plans in their localities. This enactment reflected the key objectives of the 1992 Waste Management Policy and gave them statutory backing. The 1996 amendment effectively established a framework for the systematic development of local government objectives for waste management. It also formalised the use by territorial authorities of the '5 R' waste hierarchy. Furthermore, the Local Government Act contains provisions for each territorial authority to enact bylaws relating to their roles and responsibilities for waste management. This includes the ability to use economic incentives and disincentives in recovering any costs incurred in the administration of these functions and to fund waste minimisation initiatives, although the power of Part XXXI was recently reduced with a High Court decision which resulted in territorial authorities being unable to adopted localised waste levies.

The Local Government Act 2002 Section 127 requires waste management plans are completed by June 2005, including an assessment of sanitary services. The purpose of the sanitary assessment is to ensure that public health is protected in the present and into the future. This assessment must include a description of existing solid waste services in the district, a forecast of future demand for waste disposal in particular, and identification and assessment of options for meeting this demand.

3.2.2.5 Hazardous Substances and New Organisms Act 1996

The Hazardous Substances and New Organisms Act was enacted in 1996. The purpose of this statute is "to protect the environment, and the health and safety of people and communities by preventing or managing the adverse effects of hazardous substances and new organisms". The importance of this Act to waste management relates primarily to the formal controls it brings to the introduction of new hazardous materials and the handling and disposal of waste hazardous substances.

3.2.2.6 Building Act and Building Code

There is nothing specifically in the Building Act regarding solid waste although the solid waste issue was considered in the process as part of the sustainability approach. With the Building Code being currently under review, again solid waste has been looked at in terms of requiring a 'waste management plan' to be included in all consents, but consensus is that it doesn't warrant specific attention in the Code due to constraints around management, administration and

compliance with the regulations suggested. It has been suggested that it is more appropriate for this issue to be dealt with at the territorial level through district plans.

3.2.2.7 The Litter Act 1979

The Litter Act places the control of litter with territorial authorities and aims to regulate litter in public places through litter wardens and an infringement based enforcement system. Due to the nature of littering behaviour, this legislation is seen as largely ineffective at influencing littering behaviour and is largely used to deter illegal dumping.

3.2.2.8 Other Legislation

A range of statutes cover the management of the small volumes of infectious, radioactive and hazardous wastes in New Zealand. These include he Health Act 1956, the Radiation Protection Act 1965, the Agricultural Compounds and Veterinary Medicines Act 1997 and the Ozone Layer Protection Act 1996. In addition, the Building Code (issued under the Building Act) and requirements of the Health and Safety in Employment Act 1992 provide for the safe storage and management of hazardous substances. The Land Transport Act 1998, Maritime Transport Act 1994 and the Civil Aviation Act 1990 all control the transportation of dangerous goods (including categories of hazardous wastes).

3.2.2.9 Relevance of these Statutes to Beacon and RBE

During the review of each of these statutes or during amendment periods, Beacon has an opportunity for influence in terms of involvement in the government working parties or through submissions. Certainly the review of the Building Code is a major opportunity for Beacon to influence the outcomes in terms of solid waste and the other aims of Beacon with respect to the RBE.

3.2.3 Economic Instruments and Future Policy

3.2.3.1 The Waste Minimisation (Solids) Bill 2006

The waste policy debate has become reinvigorated during 2006, with the release of the Green Party's Member's Bill titled "Waste Minimisation (Solids) Bill". This is a comprehensive and prescriptive Bill that covers a wide range of issues associated with solid waste disposal and minimisation, including:

- The creation of a national authority dedicated to waste minimisation;
- The introduction of a waste disposal levy to discourage the disposal of waste and to provide funding for processes, systems and products to minimise resource use and waste production[44];
- The ability to create regulations for compulsory product stewardship / extended producer responsibility programmes;
- Requirement for every business and public organisation to create and implement a waste minimisation plan, including public event organisers;
- Introduction of public procurement and reporting policies, requiring that purchase decisions made by public organisations include provisions to minimise waste.

General feedback indicates support for product stewardship legislation as a backstop to voluntary schemes and potentially also for a national waste levy.

A national levy could drive behavioural change to reduce waste generation, increase the availability and economic viability of reuse/recycling options and provide R & D funds for waste minimisation.

The Bill passed its first reading and was referred to the Local Government and Environment Select Committee for their consideration. Written submissions have been received and verbal submissions are due to be heard early 2007, with March being the indicated timing. General feedback to date indicates that there is support for the intent of the Bill and in particular for the introduction of product stewardship legislation (to provide a legislative backstop to voluntary, industry-led schemes) and potentially also for a national waste levy. It is expected that should any legislation come out of the Bill, then it may be in a markedly different form to the current proposal.

The introduction of a waste levy could prove to be highly relevant to construction in the RBE, partly due to increased disposal costs, ideally driving behavioural change, but also due to the generation of revenue which could be used to increase the availability and economic viability of recycling and reuse options. There is potential for these funds to also be used for research and development purposes and/or at the 'front end' to reduce waste generation.

At the recent WasteMINZ national conference (November 2006), the Bill was discussed by Green Party sponsors and the MfE. It is understood that there is significant multi-party support for the Bill if significant changes are made. It is expected that some form of the Bill will be

[44] ***It is proposed that the levy would be charged at the point of disposal, at $25/tonne and split 50/50 between the local and national waste authorities***

retained, but that particularly onerous and / or contentious provisions, such as the creation of local and regional waste authorities and the requirement for all organisations to have a waste management plan, will be eliminated from the Bill. It is also understood that the proposed waste levy would initially be in the range of $10 per tonne, increasing to up to $30 per tonne over a 3-5 year period[45]. It is expected that half of the funds generated from the levy would be earmarked for local government, while the remainder will form a contestable fund managed at the national level. It was unclear to what degree product stewardship legislation will be incorporated into the Bill, although some legislative backstop legislation is expected for some products in particular where there is industry support to regulate 'free riders'.

It is understood that Beacon did not submit during the Waste Minimisation (Solids) Bill submission period, but that several of the shareholders did put in a submission, some in support of the Bill moving forward, others against.

3.2.3.2 Container Deposit Legislation

Aside from the Waste Minimisation (Solids) Bill, there are some advocates of Container Deposit Legislation who are lobbying central government to include the use of container deposits as an economic instrument for recovery of bottles/packaging. Container deposit legislation is a law passed by city, state, provincial, or national governments that require that a deposit on beverage containers be collected when the beverage is sold. When the container is returned to an authorised redemption centre, the deposit is partially or completely refunded to the consumer[46].

Container Deposit Legislation is currently used in several of the United States as well as South Australia and parts of Asia. Several other states in Australia are considering Container Deposit Legislation and this legislation has been suggested as part of the New Zealand approach with respect to extended producer responsibility legislation around container packaging. It should be noted that there is significant industry pressure against Container Deposit Legislation, particularly from the NZ Packaging Council who recently published an independent report recommending against Container Deposit Legislation due to very high administrative costs and because of New Zealand's already relatively high rates of packaging recovery. While this remains a heated debate, it is the opinion of the author that Container Deposit Legislation is unlikely to form part of the Waste Minimisation (Solids) Bill or the Product Stewardship legislation currently being investigated. It should be noted that the effectiveness of Container Deposit Legislation is hotly debated and the impact of Container Deposit Legislation should likely be determined on a case by case basis in consideration of existing waste minimisation legislation and programmes. More details on both sides of the debate can be seen by visiting: http://www.zerowaste.co.nz/assets/Reports/Beveragecontainers.pdf or http://www.packaging.org.nz/policy/policy_container_deposit_legislation.php.

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[45] By personal communication, Nandor Tanzcos, Green Party MP, at the WasteMINZ conference in November 2006.

[46] Adapted from Wikipedia.

3.2.4 Summary of Central Government Areas of Influence

Central Government seeks to reduce wastes through advocacy, community engagement and by taking on a semi-educational role. Currently, there is no national legislation in New Zealand that is directly aimed to manage and minimise our wastes. However, there are currently two proposed Bills that are under consideration, being the Waste Minimisation (Solids) Bill and the more specific Container Deposit Bill. The Waste Minimisation (Solids) Bill includes the use of both legislative controls and economic instruments (waste levy).

Other existing legislation, such as the Local Government Act and the Building Act, has less direct but potentially still relevant impacts on waste, as within Beacon's sphere of influence.

3.2.5 Relevance for Beacon and the RBE

As the Waste Minimisation Solids Bill is expected to include a waste levy and a national waste authority, Beacon is likely to benefit from the Bill in that a levy will further incentivise reuse and recycling of both building materials and domestic waste. Beacon may also potentially benefit from the creation of a contestable fund that will be the source of project funding for Beacon in the area of solid waste minimisation.

3.3 International Waste Policy and Economic Instruments

As highlighted in Section 3.2, waste levies (landfill levies) and Container Deposit Legislation are economic instruments used in a number of other countries including South Australia, New South Wales and Victoria. These states have state waste legislation, waste authorities and landfill levies. Waste minimisation advocates in New Zealand cite these examples as best practice and they are in fact being somewhat modelled in terms of the proposed legislation. However it should be noted that comprehensive review of the effectiveness of these tools is not available. The alternative to comprehensive review is the comparison of per capita waste to landfill, with figures being available in Australia of 1.1 tonne per person from measurements taken in 1996-1997 which were significantly higher than the New Zealand per capita estimates from that time period. As these policy initiatives were begun during the same period, it is unclear yet their overall impact on waste reduction, while there are indicators showing that recovery of materials has significantly increased. More detail regarding international waste policy and economic instruments can be found in a report prepared for the MfE following the release of the NZWS in 2002 at: http://www.mfe.govt.nz/publications/waste/legislative-basis-policy-instruments-sep02.pdf or see http://www.sustainability.vic.gov.au/www/html/1722-who-we-are.asp.

3.4 Local and Regional Government

Waste minimisation is a key function for local government, largely due to the LGA 1971, 1996 and 2002 requirements, which puts waste management responsibility primarily with local government. At writing, nearly 70 percent of New Zealand's 74 territorial local authorities have committed to a target of zero waste (to landfill) between 2015 and 2020[47] (further details provided in Appendix D). This shows a strong territorial commitment to the vision of zero waste, yet the support and practices put in place in each council vary dramatically from one to the next due to localised factors. Such factors include:

- population size – affecting the amount of waste produced, availability of funds;
- population spread – rural versus urban, affects transport requirements and costs, as well as type and proximity to end-markets available for recycled/reused products;
- cost of landfill (or other) disposal charges – affecting incentives for recycling / reusing wastes;
- emphasis and focus of Council / community driven waste reduction programmes;
- differing methods for waste charging – rates based versus user pays (user pays is assumed to provide greater incentives for reducing wastes / increasing diversion rates);
- availability of recycling, includes range of materials for recycling and proximity to facilities.
- regional industry base, e.g. services, manufacturing, farming etc all produce significantly different waste streams.

Table 4 provides a summary of local government activity within New Zealand's solid waste sector.

Table 4: Local Government Solid Waste Activity

Key Action Category	Description
Direct Action	Programmes or services that divert waste away from disposal - examples include resource recovery and recycling services. Relatively few councils now directly provide these services, as many local government-owned solid waste services were largely divested in the 1990's and are privately owned. Councils must ensure that waste is collected and disposed of safely but are not required to provide these services themselves. Council involvement may be limited to management of waste collection service contracts or in some areas waste services are completely privatised but under the authority of the council bylaw and licensing system for operators.

47 Source: http://www.zerowaste.co.nz/default,councils.sm

Economic Instruments	Economic incentives / disincentives can be used as tools to promote waste reduction and/or to fund waste minimisation activities - generally speaking this may be the use of user-pays charges on services such as pre-pay refuse bags, or other polluter-pays charges at Council owned landfills and waste transfer facilities. The adoption of these instruments differs greatly from district to district. Recently a High Court decision overturned the use of localised waste levy instruments for the funding of waste minimisation activities and waste management plans, reinvigorating the debate for a national waste levy. Generally local government is strongly in favour of a national waste minimisation / landfill levy.
Regulation and Policy	Development and use of legal mechanisms such as Council bylaws and District Plan rules that promote waste minimisation and the aims of this Plan - an example is a District plan rule to require all new intensive developments to have a waste management plan as part of consenting process; or bylaws that prohibit junk mail or require garden waste to be excluded from council refuse collection.
Advocacy	The promotion of waste reduction issues that are outside a council's direct control, such as lobbying or partnership with local or Central Government to develop appropriate legislation, programmes and national standards - examples include extended producer responsibility partnership programmes between industry and councils, assistance in developing best practice guidelines and lobbying central government via legislation submissions and LGNZ processes. Generally local government is in support of national waste legislation, although with significant changes to the current Bill in Parliament.
Community engagement & behaviour change	Promoting the involvement, awareness and engagement of the whole community in waste reduction behaviour - this includes community feedback and consultation, council grant schemes, education and participation programmes to schools, businesses and the community. These vary widely in terms of funding and participation from one council to the next, although generally local government is very active in this area.
Leading by example	Some councils are 'walking the talk' by applying waste reduction actions to their own operations and by being a leader in waste minimisation. For example, through internal recycling schemes, council waste composting and development of procurement policies to reduce waste and green building policies.
Measuring our progress	This involves the ongoing collection and management of data and information, which allows councils to monitor, evaluate, modify and report on progress toward our waste reduction aims. The success in monitoring data effectively is strongly determined by whether the council is directly involved in providing waste services, such as through ownership of landfills. Many councils who rely on private waste services have little access to data regarding waste from their area unless they have developed rigid operator licensing systems.

Research and Technology	Local and regional government are not generally involved directly in this sector, however some research funding and seed funding has been made available for research and technology development on a case by case basis in some areas through council grant funds. These are often small scale and administered at a local level.

3.4.2 Examples of Local and Regional Activity

This section contains case studies of waste minimisation activities being undertaken by New Zealand local and regional councils. This list is by no means exhaustive but provides a few 'real life' examples of some of the approaches outlined in Table 3-2. The purpose of these brief case studies is to highlight current 'best practices' by Councils and to provide an idea of activities and trends in waste management and minimisation.

3.4.2.1 Christchurch City Council

Christchurch City has retained ownership of many of their waste disposal and recycling operations, including all city transfer stations, a large-scale composting plant and part/full ownership of two landfills (Burwood Landfill and the new Kate Valley Landfill). This contrasts with Councils such as those within the Auckland region, where the vast majority of the waste services have been privatised and Councils subsequently have limited control, other than through collection and disposal contracts and legislation (e.g. District plans, bylaws).

In November 2006 Christchurch City Council adopted its 2006 Waste Management Plan. Included within that plan are a number of waste minimisation targets for the city and a commitment to work towards the provision of a kerbside waste collection service for separated recyclables, organics and refuse.

Current waste collection contracts expire in August 2008, with council staff now working towards having the required infrastructure in place to both collect and treat/dispose of those three separated waste streams. A registration of interest for those services is expected to be released into the marketplace in February 2007[48].

Christchurch City were also leaders in the fact that they were the first Council to implement a waste levy at their transfer station and landfill gates, although a recent high court case taken against Christchurch, North Shore City and Waitakere City deemed this system ultra vires in that the Councils do not have the power under current legislation to impose local landfill levies. This issue will be addressed as part of the national bill currently in Parliament. Funding that was generated by the levy is now taken from Christchurch rates and is used to fund a number of waste minimisation programmes including the Recovered Materials Foundation, the Supershed and REBRI programme pilot projects to name a few.

48 Source: http://www.scoop.co.nz/stories/AK0611/S00102.htm

For more detail on Christchurch's waste minimisation strategy, programmes and projects see: http://www.ccc.govt.nz/waste/

3.4.2.2 Mackenzie District Council

Mackenzie District Council faces the challenge of providing waste services to a relatively low population spread over a large geographical area. This increases costs for waste collection whilst lowering the rates base from which to fund waste-related activities. In 2002, Mackenzie District Council replaced their small, sub-standard landfills with a new waste management system, focused on resource recovery and including a 'three-bag' kerbside collection system (refuse, organic waste and recyclables) and a new recycling and in-vessel composting facility in Twizel. Transfer stations are also provided at Twizel, Lake Tekapo and Fairlie.

The Mackenzie System is based on the following principles:

- separation of waste at source;
- viewing wastes as a potential resource;
- ensuring that wastes are handled in a hygienic manner;
- ensuring the quality of the environment is preserved;
- providing good customer service and an efficient, responsive service;
- affordability and the use of incentives to encourage community participation;
- "user-pays" fee structure for refuse;
- flexibility to allow for technology changes;
- maximum freedom of choice for users.

3.4.2.3 Timaru District Council

Timaru District Council is a zero waste council and is committing to reducing their wastes to landfill. To assist in doing this, Timaru District Council has introduced their "Three-Two-One-ZERO waste strategy", which is supported by a three-bin kerbside collection system, a recycling centre and regional composting facility. The collection system requires residents to sort their wastes at home into a red bin for refuse/rubbish, a yellow bin for recyclable waste and a green bin for commingled kitchen and garden waste.

These combined initiatives have produced outstanding results in a very short time, with 74 percent of domestic waste diverted from landfill in the first three months. Of the tonnes diverted within those first three months (approximately 3,000 tonnes in total), 852 tonnes were recycled and 2,100 tonnes of greenwaste was processed in the new composting facility.

Timaru District Council is paying Envirowaste around $60 million to manage the waste collection and disposal/treatment over the next 15 years. The increased recycling and composting rates will significantly extend the life of the Timaru landfill, which is now estimated

to have a further 50 year's capacity. It has also been estimated that up to $30 million will be saved through avoided landfill costs.[49]

3.4.3 Changes in New Zealand Kerbside Recycling Systems

Over 90% of New Zealand households have access to recycling facilities for their domestic waste (including generally paper, cardboard, aluminium, steel, plastics and glass)[50]. All of the largest urban centres have introduced kerbside recycling, including but not limited to: Auckland Region (e.g. Auckland City, Franklin District, Manukau, North Shore, Papakura, Rodney, Waitakere), Christchurch, Dunedin, Hamilton, Nelson, New Plymouth, Queenstown, Taupo, Tauranga, Timaru, Wellington, Whangarei, and Invercargill. While kerbside recycling is not available in every city, there is very broad accessibility to recycling throughout the country.

There are several methods used in New Zealand for the collection of recycled materials at kerbside for households. The dominant method in New Zealand is currently the use of open top 40L crates with paper and cardboard placed in bundles separately on the kerbside. Fully commingled recycling is common in Australia and internationally, and is where all recyclable packaging (paper, cardboard, aluminium, tin, glass and plastic) is collected in a 240L wheelie bin for sorting at a Materials Recovery Facility. While this system is common overseas and is viewed as "Best Practice" by EcoRecycle Victoria, the system is still gaining traction in New Zealand with only 3 councils adopting a wheelie bin collection method at time of writing. It is expected to become more common with the Auckland/Manukau City and Christchurch collection tenders expected in 2007.

Example of a three-bin recycling system

Example of an open crate system (two-bin)

49 Source: http://www.beehive.govt.nz/ViewDocument.aspx?DocumentID=27619

50 From the MfE's report titled Review of the New Zealand Waste Strategy- a decade of progress. (Oct 2005)

The key drivers for commingled collection of materials in wheelie bins is the automated collection system is safer than manual collection at kerbside, reduced litter from open crates, increased capacity for recycled materials at kerbside and fewer truck movements from fortnightly collections. Drawbacks include higher contamination of materials due to illegal dumping in wheelie bins and glass breakage if the materials are mishandled, resulting in glass that cannot be recycled using current methods.

3.4.4 Household Organic Waste Collection

As home composting appears to have a low participation rate, even with education programmes in place (estimated at 5-10 percent participation), there is a significant amount of interest within New Zealand councils for a regionalised composting approach supported by kerbside organics collections. As mentioned above, kerbside organics collections are already in place for Timaru and Mackenzie District Councils and there are a number of other councils who are considering, or have considered such practices, including North Shore, Waitakere[51] and Christchurch City Councils.

The main driver for regionalised organic waste collection and treatment is the consistently high volume of organics that are collected from kerbside for landfill disposal. The potential value for the composted product is also a driver, although in most cases there is further market development required to be in a position to fully recognise this economic benefit.

As mentioned in earlier sections of this report there are a number of issues associated with organic material, be it in a landfill or at a composting facility - odour, leachate and other gas releases. These issues lead to difficulties for siting, consenting and ongoing management of such facilities and as a result the options for establishing new composting facilities are likely to be limited and costly, particularly in urban areas. Clearly, these issues need to be overcome and composting facilities established before organic collections at kerbside are viable.

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51 North Shore and Waitakere City Councils also have actions in their Long-Term Community Council Plans (LTCCP) stating their intent to introduce a household kerbside kitchen waste/organics collection in the future, although it is understood that a combination of funding and the availability of compost processing facilities are limiting factors at this time.

3.4.5 Regionalisation of Auckland Waste Services

In past years waste services in the Auckland region became somewhat fragmented and open to privatisation of collection, treatment and disposal services, particularly within North Shore, Manukau and Auckland Cities. However, a number of Auckland's local councils have made a shift towards regionalisation of services, to increase cost effectiveness and impose a greater level of influence over the private waste sector. This has been the model used in Canterbury for a number of years and has been viewed as highly successful.

In 2005, North Shore and Waitakere City Councils established a refuse and recyclables collection system through a combined tendering of services. Refuse is collected on a weekly basis from both cities in pre-paid plastic bags (user – pays or 'pay per bag' system) or through private rubbish wheelie bins services. Recyclables (glass, aluminium, steel and plastics) are collected fortnightly in a 140L wheelie bin with paper remaining a separate collection. This allows streamlining of the collection and sorting/treatment services with North Shore City recyclables collected one week and Waitakere's the next. The recycled materials collected (excluding paper) are transported to the Waitakere City Refuse Transfer Station for sorting, baling and on-sale to markets. The combined services contract also makes provision for Rodney District Council to join in 2007. It has come to light that there are some issues associated with this contract with respect to glass breakage due to the methods for handling the materials and the exclusion of paper and cardboard in the wheelie bin. This contract is due to expire in 2015, although it is understood that the company that owns the contract (Onyx Group) is currently attempting to sell the contract and the materials recovery facility located in Waitakere City. North Shore and Waitakere City Councils also have actions in their Long-Term Community Council Plans (LTCCP) stating their intent to introduce a household kerbside kitchen waste/organics collection in the future, although it is understood that a combination of funding and the availability of compost processing facilities are limiting factors at this time.

In November 2006 the Auckland and Manukau City Councils released a request for tender for a combined waste sorting/treatment facility, in the form of a Materials Recovery Facility. The Materials Recovery Facility will be designed with the fully commingled collection of recycled materials in mind. Request for tenders for the collection services are expected in February 2007. These contracts are further examples of amalgamation of services with the aim to improve economic efficiencies and economies of scale and are expected to become more common across New Zealand in the remainder of the decade.

3.4.6 Environment Waikato Regional Waste Strategy

In 2003 Environment Waikato produced a regional waste strategy, which is a non-statutory document intended to assist territorial local authorities to implement waste reduction initiatives. The strategy was developed to provide a regional context for waste management decisions and is based upon the reduction targets set out in the New Zealand Waste Strategy (NZWS), 2002.

Although regional councils are not responsible for formal waste management planning or waste collection, they do have a responsibility under the Resource Management Act to achieve

integrated management of natural resources in their own region and to regulate any discharges into the natural environment from human activities. The effects of waste management decisions clearly have impacts in those two areas. This regional approach displayed by Environment Waikato also assists in identifying regional solutions which are likely to offer economic benefits in terms of economies of scale.

3.4.7 Behaviour Change and Waste Minimisation Education

Waste minimisation education has evolved in the last decade and has moved on from the often one-sided awareness-raising campaigns such as "Reduce Reuse Recycle" that were aimed at increasing recycling participation. Programmes are now focussed on community based social marketing programmes and tools aimed at specific behaviour change in the areas where changing behaviour has proved more difficult such as in the areas of home composting or 'smart shopping.' These social marketing programmes are generally more oriented toward specific action rather than relying on information-based 'education' campaigns.

A scan of council websites from across the country will reveal a wide variety of programmes and education campaigns. There are a great many programmes to draw on with some excellent programmes being spearheaded by Christchurch City, North Shore City and Waitakere City Councils to name a few.

The Auckland regional councils and the Canterbury regional councils have both formed regional waste officers' forums which include the support for regional waste reduction initiatives, such as the anti-litter initiative "Be a Tidy Kiwi" campaign[52], and in Auckland the "Create Your Own Eden" home composting campaign. The home composting campaign in Auckland involved 6 councils who offered a range of information and incentives to promote home composting including discounts on home composting bins, free composting courses run through community organisations, free trial garden waste collections and an awards scheme. This programme is also linked to the regional WasteWise Schools and Enviroschools programmes

Industry advocacy and behaviour change programmes such as the Resene Paintwise Scheme, EnviroSmart®[53] and REBRI were programmes that were first initiated by local government, which have now garnered regional and national support, with local government working directly with businesses to reduce C & D waste and to improve the overall efficiency of their operations through cleaner production methods.

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[52] Details regarding these programmes can be obtained via the Auckland regional council's websites.

[53] Details see: http://www.landcareresearch.co.nz/research/sustain_business/enviromark/envirosmart/

EnviroSmart is a council initiative that was launched in February 2006 to improve the environmental performance and resource use efficiency of over 500 businesses (nationwide). Support is provided to participating businesses through site visits by EnviroSmart consultants, as well as workshops. The programme is managed by Landcare Research with EnviroSmart consultants available to provide assistance to participating business. Some of the businesses involved are in the building related industries, such as concrete cutters, house painters and construction companies to name a few sectors involved.

EnviroSmart is a council initiative, managed by Landcare Research, to improve the environmental performance and resource use efficiency of over 500 businesses nationwide.

The Sustainable Households54 programme was formed by a coalition of local authorities in cooperation with central government, and aims to change behaviour of home owners in terms of actions they take in their homes to live more sustainably. The programme is based around holding courses for residents that include uses incentives, information and 'freebies' of sustainable products for participants to test. The programme is being operated by approximately 22 councils across the country.

3.4.8 Summary of Local and Regional Government Areas of Influence

Local and Regional Government, and Local Government in particular, have a high level of influence over waste management and minimisation services. This includes direct action, such as the provision of domestic kerbside collection systems, regulation, advocacy, community engagement and education programmes and provides waste measurement and a much more detailed level than what is available nationally.

Although they may not be directly providing landfill disposal / recycling of municipal wastes, local government represents the widest level of influence over waste services. Steps that are being taken by individual councils (demonstrated through the case studies above) show a strong drive towards increased recycling of domestic wastes in particular. There is also clear recognition by both local and regional government that regionalisation of waste services makes sense, both logistically and economically.

[54] ***See http://www.sustainablehouseholds.org.nz/index1.htm***

3.5 Solid Waste Industry

Within the context of this report, the solid waste industry is considered to encompass service providers within the following areas:

- Collection and transport of waste – including domestic wastes from kerbside and/or common collection points, commercial and industrial wastes from individual and collective sites, hazardous wastes etc.
- Waste treatment/transfer facilities – including waste transfer stations (resource recovery parks), facilities involved in any or all of the sorting/transfer/processing of recyclable wastes, and composting/biodigestion/co-generation facilities for the treatment and reuse of organic wastes.
- Waste disposal facilities – primarily landfills within New Zealand but in theory could also include alternative options such as incineration plants.

3.5.1 Mind Shift – from Disposal to Reuse and Recycling

The New Zealand solid waste industry has begun transforming over the past decade from a focus on final disposal to resource recovery. This is in small part[55] prompted by central government initiatives such as the NZWS but primarily influenced by market factors and international trends for reduced reliance on waste disposal and increased focus on resource recovery and reuse. Technological advancements in terms of landfill quality (improved liners, capping materials etc.) have also led to improvements within the industry and a significant reduction in the number of operating landfills within New Zealand. The potential for energy recovery from organic wastes (biogas recovery / methane extraction etc.) has also been an influencing factor in shifting mindsets and increasing the level of recognition held by the waste sector for potential benefits of reuse or recycling materials that were previously seen as items that had reached the end of the value chain.

Movements in the solid waste industry towards recycling and reuse ventures has of course been partially driven by competition and the recognition that, in order to be competitive in the future, reuse/recycling services will need to be provided, either as an alternative or complimentary to landfill disposal.

3.5.2 SBN Award for Solid Waste Industry Organisation

One example of this shift is that this year Hamilton's Perry Group won the Hamilton City Council Emerging Sustainable Business Award. The Perry Group has traditionally focused upon disposal of wastes rather than on reuse or recycling. However, in recent years, they have consciously made a shift away from solely disposal-focused and are now significant players within the beneficial reuse/recycling sector, in particular, through the conversion of organic

[55] ***The limited influence of the New Zealand Waste Strategy on the solid waste industry is due to the lack of legislative and/or fiscal controls to support the strategy, i.e. the strategy is based upon targets rather than requirements.***

wastes to compost and related soil conditioners. This also includes the sales and marketing of their own fertiliser brand, Revital.

3.5.3 Key Players

Table 5 describes some of the major players within the New Zealand solid waste industry. This list is provided to give an overview of the waste industry and the service provided, but is not an exhaustive review. There are also numerous small private operators including a number of local non-profit trust organisations that are providing direct solid waste services in some areas.

3.5.4 Interaction between the Solid Waste Industry and Local Government

The role of local government within the waste sector is discussed in greater detail in Section 3.3. However, it is important to note that in some locations, local government is also competitively involved in the solid waste industry, either as a sole owner/operator of a waste disposal facility or as part of a cooperative between numerous players including local councils and private waste facility / collection operators. These types of relationships can be very complex, particularly as the local government becomes both a customer and a provider of waste management and disposal services.

Table 5: Some Key Players within the NZ Waste Sector

Organisation Name	Ownership Structure	Location	Description of Services	Subsidiary / Associate Companies
Waste Management NZ Limited	Part of Australasian public company Transpacific Industries Group Ltd (amalgamated July 2006)	New Zealand and eastern Australia (headquarters in Auckland).	Waste Collection (including solid and liquid) Transfer Stations Landfills Site remediation and special waste handling Consultancy Landfill aftercare Waste minimisation Landfill gas utilisation Composting Recycling Rubbish bins	*New Zealand* Canterbury Waste Services Ltd Living Earth Ltd Recycle New Zealand Ltd; Allens United Septic Tank Cleaning Services (Whangarei) Limited; Budget Bins Limited; General Rubbish Collection Limited; Pacific Environmental Partners Limited; Waste Care Limited ; Sunshine Garden Bag and Bin Company Limited; Waste Disposal Services Limited; Waste Management Asia Limited; Midwest Disposals Ltd Otago Southland Waste Services Ltd Pikes Point Transfer Station Ltd Allbrite Industries Limited *Australia* Waste Management Pacific Pty Limited; Waste Management Pacific (SA) Pty Limited Mann Waste Management Pty Ltd

Organisation Name	Ownership Structure	Location	Description of Services	Subsidiary / Associate Companies
Envirowaste	currently owned by Fulton Hogan but being sold		Waste Collection Transfer Stations Landfills Site remediation and special waste handling Consultancy Landfill aftercare Waste minimisation Landfill gas utilisation Composting Recycling Rubbish bins	EnviroWay Limited (50% holding) Manawatu Waste Limited (50% holding) Mid West Disposals Limited (25% holding) Pikes Point Transfer Station Limited (50% holding) Canterbury Waste Services Limited (50% holding) Transwaste Canterbury (25% holding)
Perry Environmental;	Owned by the Perry Group (private New Zealand company)	25 locations throughout New Zealand, predominantly in the North Island	Land filling transfer station operation organic recycling centres site remediation composting and vermiculture (worm composting) sales and marketing of compost and vermiculture products, under the Revital Fertiliser brand.	

Organisation Name	Ownership Structure	Location	Description of Services	Subsidiary / Associate Companies
Full Circle	Owned by Carter Holt Harvey Limited	Recycling sorting stations in Wellington, Auckland and Hamilton and is currently building a fourth plant in Palmerston North (headquarters in Auckland)	Collection, sorting and exporting of used paper, glass, tin, plastic and aluminium Recycling of paper at Carter Holt Harvey's mills at Kinleith, Penrose and Whakatane. Consulting services (waste quantity analysis and recommendations for recycling)	The PaperChase is a brand of Full Circle CHH.
Living Earth	Jointly owned by Waste Management NZ and private shareholders	Auckland, Wellington and Christchurch	Composting of greenwaste and other 'biowaste' (biosolids, food waste and industrial waste such as abattoir waste)	N/A
Ward Demolition;		Auckland	Demolition services for residential, Commercial and Industrial projects Recycling of demolition debris, into products such as roading aggregate Reuse of demolition materials through the salvage sale yards	Ward Resource Recovery Limited Ward Salvage
Salters Cartage;- New Zealand	Privately owned	Auckland based but collects oil from various parts of the North Island.	Waste oil collection Tanker hire fleet Supply of oil drums Involved with HazMobile	
Streetsmart	Privately owned	Mainly Auckland council contracts	Refuse collection Recycling services	Not known

3.5.5 Summary of Solid Waste Industry Activity

Outside of their daily activities relating to solid waste management and 'business-as-usual', there is some wider involvement by industry within national and local waste management initiatives. Table 6summarises these points.

Table 6: Summary of Industry Solid Waste Activity

Key Action Category	Description
Direct Action	Business as usual – waste collection, transport, sorting, treatment, transfer and disposal.
Advocacy	NZWS contributors: Working Group on Waste Minimisation and Management included a number of individuals who are involved in the solid waste industry.
Measuring our progress	Recorded at waste transfer facilities, landfills etc. However there is limited feedback of this data to waste producers, and local or central government (the exception would be reporting requirements under some licensing agreements or where there is a local council involvement within the waste facility).
Research and Technology	Biogas extraction and power generation. Under the suite of air quality national environmental standards all major landfills are required to install landfill gas extraction systems, which for economic reasons (and marketing value) is typically converted to power for use at the facility, other local users or supplied back to the national grid. However, some members of the waste industry installed this technology on a voluntary basis prior to the national environmental standards being introduced. Due to the commercial and international focus of the waste industry, these players are sometimes responsible for the introduction of new technology, e.g. Envirowaste's introduction of the Gore Cover Composting system for the Timaru District Council's new composting facility.

3.6 Private Industry

This section discusses the involvement of the wider commercial/industrial sector within the area of waste management. This involvement is as consumers and waste producers, rather than being directly involved with the collection, treatment or disposal aspects.

A large number of private industry sectors are involved in research and development around products designed to minimise waste or to improve overall sustainability, such as the inclusion of recycled materials.

Discussed below are waste minimisation activities that private industry organisations are involved in. These include:

- research and development;
- product stewardship programmes;
- reduction of wastes through design;
- cleaner production;
- corporate memberships;
- facilitating waste minimisation by others.

3.6.1 Research and Development

Many of New Zealand's private sector organisations are involved in research and development, some of which are aimed at waste reduction, reuse or recycling. Specific examples are briefly discussed below.

3.6.1.1 Fulton Hogan

Fulton Hogan is a large construction company operating in New Zealand, Australia and parts of the pacific. Fulton Hogan's core services are earthworks, siteworks, road construction, drainage, concrete, metalling, soil stabilisation, kerb and channelling, surfacing and road marking. Fulton Hogan has also implemented research programmes to reduce the environmental effects of their activities and products, on topics including:

- construction of a 100% recycled road;
- in-situ pavement recycling;
- recycled glass in roading;
- Reclaimed Asphalt Pavement (RAP).[56]

56 Fulton Hogan company website : http://www.fh.co.nz

3.6.2 Product Stewardship

Product stewardship programmes are a key way in which private industry seeks to minimise wastes associated with their business and products. Product stewardship in New Zealand is currently on a voluntary, industry led basis but with some partnerships in place between industry and the Ministry for the Environment. Examples of existing product stewardship programmes potentially relevant to the RBE are briefly discussed in Table 7.

Table 7: Existing NZ Product Stewardship Programmes and Relevance to the RBE

Description	Administered By	Relevance to the RBE
Packaging Accord, 2004 Collective industry group with aim to reduce the disposal of packaging wastes. Divided into sector groups, who have individual targets, waste minimisation plans and annual reporting requirements. Sectors: Aluminium Brand Owners and Retailers Central government Glass Local Government Paper Plastics Recycling Operators Steel	Joint initiative between central government and the business sector, with signatories being the Packaging Council of New Zealand and the Minister for the Environment	The RBE has widespread relevance to the Packaging Accord initiatives, for both C & D and domestic wastes, and also applying to be new and renovation/refit. The Packaging Accord sector waste minimisation plans that would be most relevant to the RBE are aluminium (C & D – joinery etc.), brand owners and retailers of household appliances and construction materials, glass and steel. The recycling operators plan is also relevant in terms of current and future options for waste diversion.
Resene Paintwise programme take-back scheme for waste paint and containers reuse of left-over paint wherever possible (for community initiatives etc.). Any unused waste paint is disposed of to landfill in an appropriately controlled manner. Container disposal? Or reuse?	Established by Resene in 2004 with the assistance of North Shore City Council and the Auckland Regional Council. Continued operation is managed by Resene Funded by upfront levy on Resene paint and small disposal fee for other paint brands or Resene trade customers	Participating in take-back schemes for used paint applies to new and renovation/refit sites

Description	Administered By	Relevance to the RBE
Fisher & Paykel take-back scheme for used whiteware and packaging Takes back 25,000 old washers, dryers, cookers, refrigerators and freezers each year, majority being retail trade-ins. Returned packaging is either reused for packing other new appliances or sold into the second-hand carton market as packaging or for re-pulping. (All paper, scrap and off-cuts from the F & P production facilities are also collected and sold or reused.) In order to encourage the return of appliances and packaging material, F & P's take-back programme includes the following initiatives: encouraging service centres and dealer organisations to return scrap appliances to the Recycling Centre; free collection of old appliances upon purchase of a new model; free drop-off centre of appliances, available to the general public (Auckland only).[57]	Fisher & Paykel	

57 Source: http://www.mfe.govt.nz

Description	Administered By	Relevance to the RBE
AgRecovery voluntary waste levy –to collect, clean and reuse plastic containers for agricultural chemicals;	Managed by a contractor, 3R Group Ltd, who deliver the programme on behalf of the AgRecovery Foundation (joint initiative between industry and government). Funded by upfront levy applied to sale of agrichemical fertilizers	

3.6.3 Reducing Wastes through Design

Ways to reduce wastes through design are discussed elsewhere in this document, in terms of an advisory role that could be filled by Beacon. However, it is worth noting the increasing uptake of environmental design concepts within the private sector. With regard to the RBE, the most relevant example is the uptake of environmental guidelines by architectural firms.

3.6.3.1 Warren and Mahoney

A specific example is architectural firm Warren and Mahoney who introduced an Environmental Protocol in early 2005. This means that Warren and Mahoney encourage their clients to adopt more environmentally responsible designs, with more than $100 million worth of projects now being developed under this protocol. The Protocol addresses the environmental impacts originating from both the construction and the ongoing use of the buildings. At a minimum this means ensuring the efficient and effective use of energy, water, waste management and the re-use of building materials.

Warren and Mahoney have also noted the demand for environmentally sustainable commercial and community buildings to be steadily rising. Improved long-term returns on investments into these 'green buildings' is also being increasingly recognised. Warren and Mahoney have set themselves the goal of increasing work carried out under the Protocol to 75 percent of all activity within two years.[58]

3.6.4 Cleaner Production

Cleaner Production means the "continuous application of an integrated preventive environmental strategy to processes, products, and services to increase overall efficiency, and reduce risks to humans and the environment"[59]. In some cases this can involve the use of waste products in remanufacture, such as waste glass recycling within insulation material and the use of biomass in wood panel products. This is core business for some industries due to the high volumes of the waste materials available and cost savings over use of virgin materials.

One of Beacon's stakeholders, the Fletcher Group, provides a range of examples where cleaner production concepts have been incorporated into business ventures in this manner. Further details are provided below.

3.6.4.1 Fletcher Group Examples

Pacific Steel uses over 200,000 tonnes of scrap steel in the electric arc furnace, resulting in significantly reduced energy use and CO2 emissions compared with using iron ore as the raw material.

The Laminex Group uses 350,000 green tonnes per year of biomass waste within the manufacture of medium density fibreboard (MDF), making them the only composite wood

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58 Source : http://wwwlists.ccc.govt.nz/wa.exe?A2=ind0604&L=mrinfo-l&P=990
59 Excerpt from the UENP definition of cleaner production, weblink: http://www.uneptie.org/pc/cp/understanding_cp/home.htm#definition

panel manufacturer in New Zealand to utilise such volumes of biomass wood waste. This diversion of the biomass from landfill avoids the generation of CO_2 and methane emissions. Additional waste wood is also used to generate 0.5 PetaJoules of renewable energy.

Golden Bay Cement also uses waste wood as a (supplementary) fuel material, within the cement kiln, and uses thermal power station fly ash within the cement production process. Tasman Insulation derives 80 percent of the glass required for manufacture of glasswool insulation products from recycled glass[60].

3.6.5 Corporate Memberships

There are a number of non-profit organisations that are focused upon improved environmental performance, examples including the Sustainable Business Network (SBN) and the New Zealand Business Council for Sustainable Development (NZBCSD). Further details on these organisations are provided in Section 3.7.2. However, it is noted that their memberships include many private organisations. These member organisations represent various sectors, all with a shared aim to focus upon sustainable business practices. This of course includes reducing wastes from business activities.

3.6.6 Facilitating Waste Minimisation by Others

Minimising wastes is often a key focus when organisations embark upon improved environmental performance. This includes the introduction of measures such as plastics and glass recycling, paper recycling, reduced paper use through double-sided printing and photocopying and the collection of food wastes for composting on or off site (including worm composting bins set-up in some offices). Another example of waste reduction within office environments is a shift away from paper-based systems to electronic systems.

From a financial perspective, waste reduction is likely to be linked to improved systems and efficiency performance and therefore also to cost savings.

[60] ***Source: Kevin Golding, Winstone Wallboards from the Fletcher submission to the National Waste Minimisation (Solids) Bill 2006 .***

3.7 Other Organisations

There are a number of organisations that operate within New Zealand's waste sector, either in an advisory capacity or to provide industry representation and education. There groups tend to have a strong focus on waste minimisation and resource recovery. Organisations of note are described below, including examples of industry, not-for-profit and research groups.

3.7.1 Industry Organisations

3.7.1.1 WasteMINZ

The Waste Management Institute of New Zealand (WasteMINZ) was formed in 1989 with the aim of promoting sustainable waste management practices. Its primary function is "to provide a forum for presentation and dissemination of information and to act as a facilitator for the waste management industry in New Zealand"[61]. This goal is put into practice through hosting of the annual conference (New Zealand's largest waste related conference), workshops and seminars throughout the year, facilitation of sector discussion groups and publishing of a regular newsletter titled "Waste Awareness". WasteMINZ is linked to other international, similarly focused organisations including the International Solid Waste Association (ISWA).

Members of WasteMINZ include industry, local and central government and other non-profit organisations involved within the waste/resource recovery.

3.7.1.2 Plastics NZ

Plastics New Zealand (Plastics NZ) is an industry group representing over 180 companies involved in the manufacturer, raw material supply and recycling of plastic products (over 75 percent of the industry). The group's mission is to "maximise the growth and success of plastics-based technology in New Zealand in an economically, socially and environmentally responsible manner"[62] and seeks to achieve this through liaising with government, sponsoring the Plastics and Materials Processing Industry Training Organisation, co-ordinating industrial relations matters and undertaking environmental research, education and communication.

3.7.1.3 REBRI

Refer to Section 5.2 for details on REBRI.

3.7.1.4 RONZ

RONZ was established in 1992 to represent the Recycling Operators of New Zealand. The organisation's mission is "To gather, represent and support the diverse interests of members committed to minimising waste through resource efficiency and recycling initiatives" and members include recycling service providers, operators and educators in the recovered materials and recycling industry, local and regional councils and individuals, all of whom have an interest in and/or have made a commitment to achieving improved resource efficiency.

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61 Source: http://www.wasteminz.org.nz/about.htm

62 Source: http://www.plastics.org.nz/page.asp?section=about+us

3.7.2 Non-Profit Organisations

3.7.2.1 New Zealand Green Building Council

The New Zealand Green Building Council is a non-profit industry organisation that was established in 2005 (opened for membership in August 2006). New Zealand Green Building Council was formed to lead New Zealand's focus on green building and "is committed to developing market based solutions that help deliver efficient, healthier, innovative buildings for New Zealand."[63] This will be achieved through the development of New Zealand Building Rating tools, education and training for industry and the provision of other relevant information and resources.

3.7.2.2 New Zealand Business Council for Sustainable Development

The New Zealand Business Council for Sustainable Development is a member based organisation representing over 50 key New Zealand Businesses and with a vision to "contribute towards achieving a sustainable New Zealand and global sustainable development." Various sectors are represented by the membership, but with strong representation for the waste sector (members include Transpacific Industries/Waste Management, Living Earth and Perry Environmental). The New Zealand Business Council for Sustainable Development secretariat provides value to members through the distribution of information, provision of 'how to guides' and is increasingly taking on a lobbying and political advisory function. Current initiatives include a detailed submission for the proposed Waste Minimisation (Solids) Bill and for the current Building Act Review.

3.7.2.3 Sustainable Business Network

The Sustainable Business Network is a non-profit organisation that was developed to provide an information portal and discussion forum for businesses that are interested in sustainable development practices. This is achieved through the provision of regular networking events, an annual conference and regional and national awards for the demonstration of sustainable business practice. Sustainable Business Network also facilitates a number of initiatives that target specific topics such as sustainable transport (GreenFleet) and the Sustainable Business Challenge.

3.7.2.4 Zero Waste New Zealand Trust

The Zero Waste New Zealand Trust helps community organisations, businesses, councils, schools and individuals to implement waste minimisation and recycling projects. Through information exchange, research, advice, funding and direct involvement, the Trust is seeking to accelerate waste reduction. Its experiences in this area led to its early involvement in the Zero Waste International Alliance in 2003, which works to support the growing number of zero waste campaigns around the world.[64]

63 Source: http://www.nzgbc.org.nz/

64 Source : http://www.ledis.co.uk/abstract.php?id=E299

3.7.2.5 Environmental Choice

Environmental Choice is a New Zealand voluntary eco-labelling scheme that independently assesses and licenses manufacturers and their products. There are a number of products used in the building and construction trades that have received the Environmental Choice label, including a variety of floor coverings, paints, laminates and wood panels, thermal insulants and recycled plastic products. The labelling system has the potential to grow in New Zealand and to support improvements to the overall sustainability of homes through the use of eco-labelled products. For more details on the products currently licensed in New Zealand, see http://www.enviro-choice.org.nz/licensed_products.html.

3.7.2.6 Communities for Climate Change Protection (CCP-NZ)

CCP-NZ is a voluntary programme which aims to empower local councils to reduce greenhouse gas emissions from their own operations and from their communities.

CCP-NZ is a New Zealand Government initiative and funded by the Ministry for the Environment. The programme is delivered by the International Council for Local Environmental Initiatives – Australia/New Zealand (ICLEI-A/NZ). It is supported by the Energy Efficiency and Conservation Authority (EECA) and Local Government New Zealand (LGNZ) and is part of the international Cities for Climate Protection® (CCP®) campaign. There are currently 21 member councils representing 63 percent of the New Zealand population. The CCP-NZ Programme provides a strategic framework for councils to use to reduce greenhouse gas emissions, including through urban design. This programme is another example of local government efforts that may have some linkages with Beacon's aims. For more details see: http://www.climatechange.govt.nz/sectors/local-govt/ccp-nz.html.

3.7.3 Research Organisations

3.7.3.1 Universities

New Zealand universities carry out a range of research and up skilling of students within the area of recycling and reuse of wastes. This includes research projects to identify alternative uses for waste materials, such as those described within Table 8 (for Victoria University). Waste management/minimisation and other concepts such as cradle to grave, cradle to cradle, design for environment etc. crosses over a number of topics and is likely to be included within University programmes for architecture, engineering, environmental management, resource management law etc.

3.7.3.2 Manaaki Whenua - Landcare Research

Manaaki Whenua - Landcare Research is a Crown Research Institute and the self proclaimed "foremost environmental research organisation specialising in sustainable management of land

resources optimising primary production, enhancing biodiversity, increasing the resource efficiency of businesses, and conserving and restoring the natural assets of our communities".[65]

As mentioned previously, Landcare Research manages the EnviroSmart programme.

3.7.3.3 BRANZ

BRANZ Limited (BRANZ) is an independent research organisation that provides testing, consultancy and information services for the building and construction industry. BRANZ seeks to provide innovative and economically viable solutions that will improve the built environment. Information is provided through publications, seminar and training services, contract research, product appraisals and material and fire testing.[66]

3.7.3.4 Parliamentary Commissioner for the Environment

The Parliamentary Commissioner for the Environment is an independent Officer of Parliament with wide-ranging powers to investigate environmental concerns and reports through to the Speaker of the House and the Officers of Parliament Committee. The Parliamentary Commissioner for the Environment recently completed a report titled "Changing Behaviour: Economic Instruments in the management of waste" which offered a review of New Zealand's use of such instruments at a local and national level. The report finds that these instruments are underutilised in New Zealand and states that the NZWS 2002 has failed to address the core issues for waste minimisation. The report makes recommendations around implementation of national waste policy and support the use of economic instruments such as waste levies.

For details see: http://www.pce.govt.nz/reports/allreports/1_877274_42_9.pdf

3.7.3.5 Scion

Through their EcoTechnologies programme, Scion is involved in a number of research projects aimed at recycling wastes. Although the project topics are primarily focused on liquid waste-streams, there are some projects involving the beneficial reuse/recycling of solid wastes, specifically, "Environmental and economic performance optimisation of waste management processes" and "Redirection and up-valuing of recalcitrant materials from waste disposal environments".[67]

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65 Source: http://www.landcareresearch.co.nz/about/index.asp
66 Source: http://www.branz.co.nz
67 Source : Source: http://www.scionresearch.com/about+eco-smart+technologies.aspx?PageContentID=262

4 Waste Reduction – Knowledge and Technology

4.1 Overview

The first step in the waste hierarchy is to avoid waste before it is created. In terms of wastes from the RBE, this means the reduction of wastes from the construction, demolition or remodelling process and also the reduction in domestic wastes that are produced on an on-going basis. Beacon already has some understanding of ways in which to reduce the generation of C & D wastes from the front-end, through improved design and construction as targeted by programmes such as REBRI and the Sustainable Residential Building Manual, but the knowledge base is continually growing. The key focus of this report is upon the reuse and recycling of waste generation from the RBE (domestic and C & D wastes), yet this section will also look at the materials and design for the environment or waste avoidance.

The following is a brief overview of waste reduction methods and options for the beneficial reuse of both C & D wastes and domestic wastes. This includes examples of reuse/recycling technologies that are available either in New Zealand or overseas. Also provided is a discussion of emerging research and future directions for the reuse or recycling of these waste materials.

4.2 Reduction of Wastes from the RBE

Stated below are commonly recommended practices to reduce waste generation from the RBE, particularly at the construction stage. It is assumed that Beacon already follows many of these approaches within their educational and demonstration programmes.

4.2.1 Minimising Wastes through Supply and Construction Contracts

- Incorporate waste minimisation requirements into the tendering and selection process.
- Set contractual requirements such as waste separation on site and suppliers to remove all packing wastes associated with their products.
- Require all tenderers to submit waste management plans, which clearly identify methods and costs to reduce, reuse, or recycle wastes.
- Requiring and/or selecting suppliers that will take back materials for reuse or recycling – e.g. ceiling tiles, carpet (offcuts and/or used carpets), packaging materials etc.
- Consider leasing rather than purchasing materials. Examples include the leasing of carpets, which are then removed and taken away by the supplier at a later date. This type of approach is becoming more prominent for commercial buildings, however, applying this concept to the RBE should also be considered.

4.2.2 Minimising Wastes through Design

- Design to suit standard-sized building supplies, thereby reducing material wastage and improving overall efficiency of the construction process.
- Prefabricate structures off-site where practical, to reduce waste quantities on-site, improve efficiency of the construction process and to allow reuse/recycling options to be focused

upon at the factory rather than dispersed and potentially contaminated over a range of sites. (Examples are prefabricated timber framing and precast concrete panels.)

Design for disassembly, using materials and construction techniques that will allow for future changes to be made, including both external and internal renovations and extensions. Examples include movable wall-panel systems, spaces built to accommodate future cabling, cooling, and other technology demands and the use of screws or other removable fasteners rather than nails. These types of considerations would traditionally be more relevant to commercial and industrial buildings.

- However, the concept should not be discounted for residential design projects, particularly as the highest percentage of C & D waste is generated as a result of retrofit and renovations.
- Select 'environmentally friendly' construction materials, such as:
  - products that do not contain toxic chemicals;
  - products derived from renewable sources;
  - products that can be easily reused/recycled;
  - products that contain recycled content.

4.2.3 Minimising Wastes During Construction and Demolition and Remodelling

4.2.3.1 Demolition

- Identify the type and location of all toxic chemicals present in a building scheduled for demolition or deconstruction, and ensure that appropriate collection and handling procedures are in place.

4.2.3.2 Construction and Remodeling

- Reuse excess building materials on that same site or other developments in close proximity – particularly feasible for timber, bricks, concrete aggregate and other masonry materials. Leftover paint could also be reused, with small amounts potentially mixed for use in areas where the colour is less important.
- Encourage workers to use cut-offs wherever possible, rather than cutting fresh pieces of full-sized timber.
- Plan for efficient purchase and delivery of materials, to reduce packaging waste and fuel use and to help prevent material loss, theft, and damage.
- Educate workers about the proper handling and storage of materials, especially those containing hazardous substances. Store materials in an appropriate manner to reduce exposure and to protect against exposure to environmental factors that may affect product quality (such as moisture affecting cement or contamination of builder's mix through uncovered storage.
- Require suppliers and installers to participate in industry-sponsored product stewardship programs, particularly if there are any hazardous wastes associated with their product.

4.3 Reuse and Recycling of Wastes from the RBE

Wastes from the RBE include both C & D wastes that are produced during construction, demolition and renovation, and domestic wastes that are produced directly by householders and on an on-going basis. Options for reusing or recycling of these wastes have been considered in the following ways:

- Direct reuse of C & D wastes in its original form, such as using off-cuts of framing timber as framing timber. Direct reuse includes use on the site of origin or on another construction/renovation project;
- Recycling of C & D wastes, where the waste is used in a different way to its original purpose. An example of C & D waste recycling is the grinding of timber off-cuts into garden mulch. Indirect reuse includes use on the site of origin or elsewhere.
- Recycling of domestic wastes, where the waste is used in a different way to its original purpose. An example of domestic waste recycling is the conversion of food wastes into compost.

When researching methods to beneficially reuse wastes from the RBE, potential cross-overs between C & D and domestic activities have been considered. For example, there could be (future) potential for recycling domestic wastes into a product that could be used within the construction process. Due to this potential for cross-over, technology and research options are presented under general headings rather than being considered by waste stream.

4.3.1 Reuse and Recycling of C & D Wastes

Section 2 discussed the typical composition of domestic C & D wastes, whereby the main types of C & D wastes are:

- timber / wood waste;
- concrete / cleanfill / rubble;
- drywall / plasterboard / wall board.

Potential options for the reuse and recycling of these key waste streams are discussed below.

4.3.1.1 Timber

There are a number of options available for the beneficial reuse or recycling of timber off-cuts from RBE construction and demolition projects. These options are noted below. However, some options are limited if the waste timber has been chemically treated.

- recycled as construction timber (on site of origin or elsewhere);
- reused as Landscaping mulch (requires chipping / shredding, not a suitable use of treated timber);
- reused as a composting bulking agent (requires chipping / shredding and mixing with other putrescibles organic wastes, e.g. domestic food waste, not a suitable use of treated timber);

- reused as animal bedding (requires chipping / shredding, may not be a suitable use of treated timber);
- manufacture of fibreboard, particle board (potential issues associated with the purity and potential contamination of wood pulp if using C & D timber wastes);
- burnt to generate fuel or heat (potential issues associated with emissions and ash disposal);
- furniture making (limited specialty market).

A specific type of wood waste associated with construction and demolition projects is used wooden pallets. This form of waste can be recycled relatively easily within new pallets. Other options listed above, such as grinding for mulch or use as a fuel source (pelletised wood), are also available for the pallets.

A key factor influencing the extent to which these materials can be reused is whether or not the timber is treated (and the type of treatment used). Other issues that effect timber recycling and reuse include:

- level of care taken during demolition;
- market demand;
- economic viability of reuse / recycling processing (on a full life cycle basis).

4.3.1.2 Concrete / Cleanfill / Rubble

There is potential for this material to be crushed and used either on site or elsewhere, within applications such as aggregate, drainage material or inert fill material. However, the ability to do so depends upon the cost effectiveness and availability of a portable crusher and the reduction of contamination through on-site sorting of the wastes. As cleanfills are becoming increasingly available, it is recommended that the material is at least sorted to an extent that it will be accepted as cleanfill (although direct reuse is preferable).

4.3.1.3 Plasterboard

There are a number of issues that affect options and the complexity of plasterboard recycling, including:

- contamination of recovered plaster board (from paint, glues etc. or from commingling with other waste materials);
- different chemical compositions between locally manufactured and imported plasterboards; and
- sorting requirements for different plasterboard types (differing age, use, origin, composition etc.).

A common application for plasterboard is crushing / chipping and application to compost or other soil conditioners. The gypsum contained within the board offers beneficial properties for plant growth. However, this would not be a suitable use of older board covered in potentially toxic paints. There is also potential for recycling of waste board (factory offcuts) within new

sheets. However, the amount of recycled content is relatively low in proportion to virgin material.

Winstone Wallboards have worked with research students to identify a range of options for reuse or recycling of plasterboard. The trialed products are summarised in Table 8. It should be noted that this is 'blue skies' research and the recovered / recycled products may not yet be technically or economically viable for production on a commercial scale.[68]

Table 8: Plasterboard Recycling Trials for Winstone Wallboards

Reuse / Recycling Option	Researcher	Reuse / Recycling Option	Researcher
Seedling planters, made from earth, compost and crushed gypsum waste 	Rebekah Nancekivell	'Rap Board' Interior Partition 	Roger Hopkins
Collapsible composting system 	James Dinsdale	Thermal Heat Sink 	Karl Wakelin
Laminated Bricks 	Karina Madsen	Ceiling Tiles 	Patrick (Joseph) Hampton
Adobe Reinforcement 	Charlotte Bowie	Thermal Mass Blocks 	Stephanie Livick

68 Source: http://www.vuw.ac.nz/architecture/sustainability/plasterboard.aspx

Reuse / Recycling Option	Researcher	Reuse / Recycling Option	Researcher
'Eco-butt' Wall Cladding made from recycled wallboard and cigarette butts 	André Bishop	Bedding Compound 	Matthew Mitchell
Artificial Pumice Insulation 	Kuan Lu		

4.3.1.4 Other C & D Wastes

Below are some examples of recent research projects also undertaken by Victoria University and focussed on the recycling of C & D wastes for use within the construction industry (Source: http://www.vuw.ac.nz/architecture/sustainability/timber_metals.aspx).

Ross T Smith 'Sawment' building bricks, 2003

Coarse sawdust from untreated timber was combined with cement at a ratio of 15 percent cement to 85 percent sawdust to create a lightweight building brick with good compression and potential insulation properties."

Ben Mitchell-Anyon, Recycled structural beams, 2004

Timber, discarded corrugated iron roofing sheets, rivets and bolts were used to make reinforced structural timber beams. This alternative method and material choice for the construction of structural beams was shown to provide significant additional strength at minimal additional cost with the possibility to create a 'rustic industrial' look by exposing the structural beams."

4.3.2 Recycling of Domestic Wastes

Table 9 provides examples of domestic wastes being recycled into products that can be used within the construction or remodeling of homes. The range and economic viability of these types of products is expected to increase with time, due to technology innovation, increased landfill disposal costs and increased awareness and demand from the consumer. In order to facilitate the increased use of these types of products, there is an opportunity to specify minimum levels of recycled content within building materials. This is relevant for both recycled domestic wastes and for recycled C & D wastes (examples of which are provided in Table 8).

Table 9: Examples of Domestic Wastes as Building Resources

Domestic Waste Type	Recycled Products for the RBE
Old newspapers, reused gypsum	Fibre-reinforced wallboard
Crushed green glass	Drainage aggregate
Pulverised, recycled glass	Floor tiles (interior and exterior) Counter tops Insulation material (fibreglass)
Paper	Counter tops (stone appearance) Cellulose insulation
Tyres	Recycled rubber flooring (note: not suitable for use in fully enclosed spaces, due to risk of gas releases) Playground park equipment (relevant at the RBE neighbourhood level)
Rubber/Plastic wastes (commingled)	Roof shingles
Plastic Bottles	Plastic lumber (used for 'timber-look' decking, landscaping surrounds and furniture) Nylon carpet Erosion control matting Refuse and recycling bins

4.4 Technological Solutions

This section provides some discussion around technology and emerging approaches to reduce and recycle wastes generated from the RBE. A number of examples are included to demonstrate a range of technologies that could be applied at either the household or the neighbourhood level. However, the success of such applications would depend upon the ease with which the technology can be used, economic constraints, markets for the recycled product and the ongoing level of participation.

4.4.1 Factory Built Housing

The home itself is a consumer item, or a product, that is manufactured for use and eventually discarded. There is an international trend towards the concept of sustainable or green building, which involves making cost and eco-efficient choices for the design, material selection and construction process. This includes the use of modular and/or pre-fabrication building techniques, which increases the ability for future adaptation of the home or design and construction for final demolition and materials recycling.

Beacon is familiar with these design and construction approaches through the knowledge of its partner organisations and through research projects. A recent study highlighted a number of New Zealand and international examples of multi level sustainable housing initiatives, outlined within the report "TE 120, Sustainable Residential Structures, Draft" (May 2006). This study concluded that although modular and prefabrication techniques are used in New Zealand within specialist market niches, thereby optimising opportunities for sustainable building practices, there is significantly less acceptance of these techniques than in countries such as the United Kingdom and Canada.

The key advantages of this form of construction are opportunities for improved quality control, materials optimisation, optimised delivery times and trades specialisation, due to increased ease of application in a factory environment rather than on-site. There are also resulting opportunities for reduced wastage, improved building quality and reduced construction times. However, the review of overseas examples demonstrated that there are a number of technical issues to be addressed, including materials selection, design and the application of new technologies. A further important issue is the community relationship and urban setting. These later factors are particularly significant when applying modular housing techniques at the neighbourhood level. It should also be noted that while it is implied that modular housing will reduce waste from deconstruction, at some level this remains untested and some future-proofing may be required to determine actual waste reduction capability of these designs.

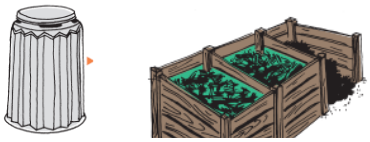
4.4.2 Composting

Composting is a natural, aerobic process whereby aerobic fungi and bacteria consume organic waste and producing humus ('compost'), carbon dioxide and water. The application of compost to soils improves soil structure, nutrient levels, organic content, water retention properties and plant growth. In this manner, the recycling of organic wastes into compost and other soil

amendment products (mulch etc.) is a clear example of 'closing the loop' and converting a waste into a valuable resource.

Issues associated with composting include the release of odour and leachate, which can create nuisance issues and the potential release of contaminants to ground, water and air. However, a wide range of in-vessel composting technologies are available to manage these issues and to allow organic wastes to be composted in high-density urban environments. A number of such technologies have been developed and/or supplied within New Zealand. These in-vessel composting systems are available within a range of sizes, to provide for composting at the regional, neighbourhood and individual household level. Table 10 provides an overview of some composting technologies that are available in New Zealand and suitable for use at a neighbourhood or household level.

Table 10: Examples of Composting Systems Relevant to the RBE

Composting Systems	Examples
Small-scale container systems	
Worm composting systems	 Bin-o-Worms Tat-G vermicomposting system
Commercial in-vessel composting systems	 HotRot horizontal system Rotocom horizontal system  VCU vertical system

LOWEST COST & CAPACITY, household level

HIGHEST COST & CAPACITY, neighbourhood (or regional) level

There are a number of issues and myths that are commonly raised when considering the impacts and logistics of composting domestic organic waste. These include the benefits and disadvantages of composting compared with biodigestion and landfilling and respective types and levels of greenhouse gas emissions, and the merits in collecting and composting domestic organic wastes within biodegradable plastic bags. These points are discussed below.

4.4.2.2 Composting, Biodigestion, Landfilling and Greenhouse Gases

Composting does produce greenhouse gases in the form of carbon dioxide. However, carbon dioxide is a significantly less harmful greenhouse gas than methane and sulphur and nitrogen compounds that are generated from organics under anaerobic conditions (e.g. within a landfill). Therefore, the diversion of organics from landfills to composting facilities can offer additional benefits in terms of reducing effects of harmful gas emissions. However, it should be noted that methane is also a resource if captured and utilised for power generation. Therefore, controlled anaerobic treatment of organics provides energy generation potential that composting does not. As most of New Zealand's larger landfills capture methane for energy use, the relative advantages and disadvantages between composting and landfilling depends upon whether the compost product or the generated energy has a higher value.

If composting systems become anaerobic, which is often the case with home composting systems, then methane and sulphur / nitrogen compounds may be produced rather than carbon dioxide. This would increase the release of more harmful greenhouse gases. However, it remains a natural process, similar to plant material degrading on the ground.

Biodigestion is a more direct alternative to composting than landfilling, as it is an anaerobic process also designed for separated organics. Compared with the extraction of methane from landfills, containing mixed organic and inorganic wastes, biodigestion plants offer improved methane utilisation rates and a more consistent power source.

There are some overseas examples of combined biodigestion and composting, whereby organic material is first digested to extract methane and is then composted. The key factor when combining these two approaches is to ensure that the digested material contains enough organic matter to still compost.

4.4.2.3 Composting and Biodegradable Plastic Bags

There are a number of biodegradable plastics available in New Zealand. Biodegradable plastic bags are often considered for use as kerbside organic waste collection bags, with the view that they could be composted with the organics. However, there are issues that would need to be addressed with the use of these bags within mechanical composting systems, as there may be a tendency for the bags to become caught around moving parts. The resulting impacts can be costly in terms of maintenance and machine downtime.

The conditions under which the bags break down should also be considered. Conditions within composting piles tend to offer temperatures and a high moisture content, which may assist with the biodegradation of the bags. However, this would need to be reviewed specifically for both the type of plastic and the composting technology.

This may be of interest to Beacon as the compostability of biodegradable plastic products is often cited as a potential end use of domestic plastic waste as an alternative to recycling. Both the type of biodegradable plastic material and composting method must be considered fully and tested before determining the end use for these products.

4.4.3 Biogas, Co-Generation and Waste-to-Energy Technology

Co-generation is a process whereby waste energy (potentially derived from waste products) is used to produce two forms of energy, usually being heat and electricity. There is increasing interest in the use of co-generation plants to convert biogas to energy and in the use of organic waste to generate the biogas fuel source. Technologies are being developed to options for a range of scales, including at the neighbourhood and household level.

The range of available technologies is extensive, with the appropriate options depending upon specific requirements such as raw material quantities and energy demand. Table 11 lists some of the co-generation technologies available internationally (predominantly within Europe), and specifies which technologies convert biogas to heat and electricity.

Co-generation using a fuel source derived from waste materials is a form of waste-to-energy technology. Waste to energy simply means just that, where waste is converted to energy through a range of methods, but typically involving some form of combustion.

Table 11: Overview of Co-Generation Technologies & Capabilities

Cogeneration technologies	Fuels (not exhaustive)	You need hot water?	You need steam?	You need hot air?
Gas turbine	Natural gas, biogas, heating oil	++	++	++
Gas Engine	Natural gas, biogas, heating oil, vegetable oil, wood	++	+	+
Heating oil Engine	Natural gas, biogas, heating oil, vegetable oil, wood	++	+	+
Steam turbine	Natural gas, biogas, heating oil, vegetable oil, wood, etc.	++	++	+
Stirling engine	Natural gas, biogas, heating oil, wood	++		
Fuel cell	Hydrogen or, via reforming, all others fuels	++		

Notes:

Source: http://www.cogen.org/cogen-challenge/Downloadables/Technology_Checklist_260706.pdf

"++" means the technology is very suitable to meet heat requirements and "+" means less suitable. Where no comment is provided, the technology is unable to meet that specific requirement.

4.4.3.1 Relevance to the RBE

Technologies that could be fuelled using household waste products are those that run on biogas or domestic waste in its solid form. Biogas turbines create potential opportunities for the reuse of organic wastes derived from the RBE, including wastes generated during the construction and demolition process (for both new and used homes) and potentially also for domestic organic wastes. However, due to the technology still being in its early stages, the provision of cost effective, smaller-scale plants is likely to be some way off.

Natural gas powered co-generation technologies may also be of interest for neighbourhood or household scale co-generation facilities. However, this is outside of the scope of this waste-related study.

5 Existing Tools / Rating Schemes and Waste

5.1 Overview

A number of rating tools exist for the assessment of the sustainability and efficiency of both commercial and residential buildings. Those that are most applicable to residential dwellings include the Green Home Scheme, NABERS, TUSC, BREEAM and LEED. Few of these specifically target waste but all are aimed at the promotion of sustainable, healthy and safe homes. There are also additional resources such as REBRI and the Sustainable Residential Building Manual available. All are described below.

5.2 REBRI

REBRI (Resource Efficiency in the Building and Related Industries) began in 1995 as a collaborative effort (called Project Construction + Demolition) between Auckland Regional Council, BRANZ and Auckland City Council, with some funding from the Ministry for the Environment. As part of this partnership, research, demonstration projects, trials, an industry advocacy group and a variety of other initiatives were carried out to promote, advocate, and assist resource efficiency measures in building and related industries.

Appropriate resources were supplied to achieve:

- reduction in waste disposal costs;
- reduction in money spent on raw materials;
- more effective use of materials;
- reduced environmental impact from landfill disposal;
- assistance to industry, councils and the community to meet the New Zealand Waste Strategy Target.

In 2003 the National Construction and Demolition Waste Reduction Project was set up to extend this initiative further. The resources resulting from this project were developed through close consultation with industry representatives, with the aim of developing tools to help industry, councils and the community to reduce C & D waste at landfills and clean fills. The project was completed in July 2005 and produced the following deliverables:

- a market assessment for recycled and reusable C & D waste materials and regional market development strategies for Auckland, Waikato and Canterbury;
- a review of current legislative tools to regulate C & D waste and guidance notes on regulating waste management under the Local Government Act (1974) and (2002);
- best practice guidelines for C & D recycling and reuse operators;
- a waste tracking system for C & D materials within the resource recovery industry;
- best practice guidelines for: design and planning, construction, home renovation, building products and demolition; and

- a website (www.rebri.org.nz) as a C & D waste reduction information portal for industry, local government and the community.

The REBRI organisation continues to operate as a consortium with the assistance of a governing board. North Shore City Council has applied these resources and tools within their own REBRI project initiative, and currently provides one-on-one assistance for C & D companies to reduce their wastes. Christchurch City Council has also set aside funding to pilot the REBRI guidelines in the Canterbury Region, and are currently seeking up to five pilot major construction projects with which to test the guidelines and to incorporate sustainable design depending on the project stage.

5.3 Sustainable Residential Building Manual

The Ministry for the Environment has recently contracted Beacon Pathway Ltd, in conjunction with Consumers' Institute, to produce an online information resource that promotes the design and construction of 'smarter' homes. The result will be a Sustainable Residential Building Manual, a fully integrated and comprehensive online information tool to advise consumers and industry members on how to build and renovate 'smart' homes, which are more affordable, more comfortable, healthier and with reduced environmental impacts.

Sustainable Residential Building Manual, which is expected to launch in 2007, will be a sister website to the ConsumerBuild site managed by Consumers' Institute and the Department of Building and Housing. The site will feature information for designers, builders and tradespeople as well as individual homeowners, and will draw on material from both Waitakere City Council's Sustainable Home Guidelines and the Australian Greenhouse Office's Your Home manual and website, but will be specific to New Zealand.

The Manual's consideration of waste focuses upon the REBRI Guidelines and covers design issues, as well as working with contractors, waste minimisation during construction and demolition phases and safe disposal options. It does not include a section around incorporation of space allocation for storage and collection of solid waste materials.

5.4 The Green Home Scheme

The Green Home Scheme is an independent method of assessing the environmental performance of residential buildings that are late in the design phase or recently completed. The tool was developed by BRANZ Ltd, and is largely based around the UK's BREEAM (homes) tool. The overriding purpose of the scheme is to recognise and measure the environmental impact that buildings have on their occupants and surroundings, thus promoting sustainable, healthy and safe homes.

The scheme is designed to be flexible and easy to use, with credits awarded for designs fulfilling set criteria and weighted according to environmental importance. A standard framework is used with specific criteria that are grouped by category:

- Household energy efficiency;
- Sustainable materials;
- Water economy;
- Site selection;
- Indoor air quality;
- Fire safety;
- Design excellence.

The Green Home Scheme's consideration of waste focuses on two areas. Specifically, the storage of recyclable materials (to encourage recycling of domestic waste on a larger scale and to support kerbside recycling schemes) and the establishment of composting bins for disposal of organic waste (to encourage the composting of biodegradable matter generated in the kitchen).

5.5 NABERS

The National Australian Built Environment Rating System (NABERS) is a voluntary tool introduced in 2005 that provides information on the sustainability of existing residential and commercial buildings in Australia. NABERS is different to most other tools in that it targets existing buildings only. It was the intention that NABERS would be used in conjunction with design stage rating systems to promote a shift in attitude towards the built environment.

NABERS Residential was intended for householders, councils and property portfolio managers. However, government agencies and councils, planning and housing authorities and utilities agencies may use the information provided to encourage environmental improvement, reward current performance levels and promote best practice. The system is performance based, and works by assessment of the previous 12 months against the prescribed categories listed below to give a final percentage mark.

- Energy use and greenhouse emissions;
- Refrigerant use;
- Water use;
- Stormwater runoff;
- Stormwater pollution;
- Sewage outfall volume;
- Transport;
- Landscape diversity;
- Toxic materials;
- Waste;
- Indoor air quality;
- Occupant satisfaction.

NABERS' consideration of waste requires weight of total waste and weight of total waste sent to landfill to be minimised.

5.6 TUSC

Tools for Urban Sustainability Code of Practice (TUSC) is a web-based analysis tool developed by Waitakere City Council. Its purpose is to develop an interactive code of practice to ensure sustainable urban planning and engineering, and to improve sustainable management practices by providing practitioners and decision-makers with the tools and guidelines needed to ensure cost-effective sustainable urban development.

The TUSC scheme focuses on residential buildings both in the design phase and retrofits. It is still in the development stages but there are plans to expand it as an urban planning tool. Plans are scored according to their effect on the environment and prompts suggest sustainability techniques and technologies that would reduce these impacts. With time and as new features are added/improved, TUSC is expected to become a powerful research and design tool.

The neighbourhood tool is provided as a user-friendly, web-based toolbox system that includes linkages to models and performance standards for all key areas including social, economic and cultural as well as environmental, and works at both neighbourhood and individual house level. It is intended as a planning tool rather than a rating tool, and as such will be useful for resource consent procedures and site specific planning.

The TUSC tool has very little consideration of waste and it is not specifically evaluated as part of the assessment process.

5.7 LCADesign

The LCADesign package was initiated to assess the status of life cycle assessment (LCA) tools in the building and construction sector and to develop strategies to improve the uptake and use of these tools, and thus the environmental performance of the building and construction sector, by promoting LCA as a tool for eco-efficient design and enhanced decision-making. Within the industry, impacts occur through the manufacture of building materials, as well as throughout the design, construction, operation and demolition phases of all buildings. LCA is a widely recognised tool which can be used to improve understanding of the environmental impacts of this sector.

The LCADesign package is intended primarily as a commercial design tool; however it is also able to be applied to medium to high density residential buildings. Behind the LCADesign tool is a software engine, which calculates the volume and cost of all construction materials, the environmental impact of those materials, and compliance with current industry standards, so that users may redesign the building based on its economic and environmental impact.

LCADesign does not specifically consider waste but its principles are written into a number of the other tools investigated.

5.8 BREEAM (UK)

The Building Research Establishment Environmental Assessment Method (BREEAM) was developed to assess the environmental performance of both new and existing buildings. Since its launch in 1990, BREEAM has been increasingly accepted in the UK construction and property sectors as offering best practice in environmental design and management, and is now the world's most widely used tool.

BREEAM covers a range of building types including offices, homes (EcoHomes) and industrial units, and assesses their performance in the following areas:

- Management;
- Energy use;
- Health and well-being;
- Pollution;
- Transport;
- Land use;
- Ecology;
- Materials;

Credits are awarded in each area and environmental weightings applied to produce an overall score.

BREEAM's consideration of waste also focuses on recycling facilities in the form of internal bins, external bins, or a household collection scheme. The purpose of this is to encourage developers to provide homeowners with the opportunity and facilities to recycle household waste.

5.9 LEED (US)

LEED (Leadership in Energy and Environmental Design) is a rapidly growing green building system developed by the US Green Building Council and released in December 2004. The system has been developed as a voluntary, consensus-based national standard for developing high-performance, sustainable buildings. The tool aims to encourage and accelerate the global adoption of sustainable green building and development practices through "the creation and implementation of universally understood and accepted standards, tools and performance criteria" (LEED website).

The LEED rating system can be applied to almost any building project. Variations include LEED-H (for homes) and LEED-ND (neighbourhood development). Implemented in March 2000, it has achieved widespread market acceptance, having been adopted by almost 1,000 projects.

The applicant project must satisfy all of the prerequisites and obtain a minimum number of credits, ideally during the early stages of project design, to attain a LEED rating level. Specific aspects are assessed under the following categories:

- sustainable sites;
- water efficiency;
- energy and atmosphere;
- materials and resources;
- indoor environmental quality;
- innovation and design process.

LEED's consideration of waste requires that a maximum of 2.5lbs per square foot of construction waste may be sent to landfill, with 0.5 points awarded for each additional 0.5lbs per square foot reduction.

5.10 Summary of Existing Tools / Rating Schemes

A summary of the types of tools available is provided in Table 12.

Table 12: Summary of Residential Assessment Tools Available Internationally

Tool	Country of Origin	Date est.	In use	Market Penetration	Residential/ commercial	New /existing building	C & D Waste ?	Domestic Waste?
REBRI	NZ	1995	Yes	Low	Residential/ commercial	New	✓	x
Sustainable Residential Building Manual	NZ	2007	No	Low	Residential	New and existing	✓	x
Green Home Scheme	NZ	Late 1997	Yes	Medium	Residential	New and existing	x	✓provision for recycling and composting
NABERS	Aus	2005	Yes	Low	Residential/ commercial	Existing	x	✓total waste volume measured
TUSC	NZ	Under development	No	Under development	Residential/ neighbourhood	New and existing	x	x
BREEAM	UK	1990	Yes	High	Residential/ commercial	New and existing	x	✓provision for recycling
LEED	US	1995	Yes	High	Residential/ commercial	New and existing	✓max. waste to landfill	x
LCA Design	Aus	Under development	No	Under development	Commercial/ some residential	New	x	x

6 Key Findings and Opportunities

6.1 Key Findings

Below is a summary of key findings that have been established from this study. They relate to the background information that has been compiled as part of the scoping exercise. Key findings are presented in topic areas related to the report section headings. It is from these conclusions that opportunities and recommended next steps have been developed.

This section includes comments labelled as 'authors' reflections'. These discussion points are based on the authors' practical experience within the waste sector and are presented for Beacon's consideration. These views are considered 'opinion' that also draws upon the findings of this research study.

It is noted that Beacon will be best able to note further synergies and opportunities that would arise for them from this research as our knowledge of Beacon's current strategy and interests is somewhat limited. However, some key opportunities are presented as prompts for discussion and to engage Beacon around the topic of waste minimisation. It is noted that Beacon is likely to be in a position to identify other opportunities more directly and these can be developed further in the next stage for the solid waste target areas.

We recommend that Beacon consider a workshop around this research, to aid in developing a sound and directed process for determining next steps in the waste minimisation target area. This goes above and beyond the presentation of the study results, as next steps for Beacon also depend on organisational interests, capability and levels of resourcing available for future projects and research. Further discussion of this workshop concept is provided in Section 7.

6.1.1 General

There is limited baseline information on the level and composition of solid waste in New Zealand. However, the existing data indicates that, despite the introduction of numerous waste minimisation initiatives over the last decade, solid waste disposal to landfill appears to be continuing to increase (on a per capita basis). Estimates also indicate that the majority of all solid waste to landfills (and cleanfills) has its origins in the RBE, including both construction and demolition activities (including new homes and renovation/refit projects) and household domestic activity.

6.1.1.1 Authors' Reflection

This continuing increasing trend in waste generation is a startling fact, especially considering the introduction of kerbside recycling across New Zealand since the mid 1990s. Conventional wisdom would indicate that a step-change is needed to make an impact on waste reduction per capita, however recycling represented a major step-change but has seemingly made little difference to quantities and composition of waste to landfill. This points to the need for a shift away from end of life solutions, such as recycling, composting and awareness-raising programmes of the last decade, towards improved design for sustainability, waste reduction at

the front-end, and improved extended producer responsibility and product stewardship. This would imply a focus for Beacon on materials and housing design as methods to prevent solid waste production.

6.1.2 Waste Facilities and Disposal

Landfills are the key method of end of life disposal in New Zealand. The number of landfills is decreasing with time while environmental performance is improving.

Despite its isolation and size, New Zealand has a well-developed recycling and commercial composting industry, both in local and international markets. There is a considerable amount of innovation and potential for further resource recovery in New Zealand and abroad, driven primarily by increasing costs for final disposal. These increases in landfill costs will continue either as a result of market forces or through the implementation of economic instruments such as solid waste levies, further driving resource recovery industries.

6.1.3 C & D Wastes

C & D wastes are "any product or material resulting from the construction and demolition process that is surplus to, or not included in, the final building". Almost all types of C & D wastes will originate from the RBE and they are the predominant type of wastes associated with activities influenced by Beacon.

On a weight basis, the key components of C & D wastes are:

- wood waste – around 40 percent, by weight;
- concrete / cleanfill – around 13 – 25 percent, by weight;
- drywall / wallboard / plasterboard – around 18 – 26 percent, by weight.

If the aim is to reduce waste quantities to landfill then opportunities for reuse/recycling of C & D wastes should firstly focus upon these waste types.

Due to the nature of the material, cardboard and paper is relatively high in terms of volume (around 40 percent) but only a small contributor in terms of tonnages to landfill (3 – 4 percent). There are already existing markets for paper and cardboard, therefore the key to maximising the amount of packing wastes recycled from construction and demolition projects is to make adequate provision for source separation of these materials on the site. In practice this would generally involve the requirement for separate waste containers for paper and cardboard and engaging appropriate collection and recycling contractors.

Other types of packaging materials are also likely to contribute to C & D site wastes, such as plastic wrap, straps, polystyrene etc. These wastes are not significant contributors in terms of wastes to landfill by weight. However, they are highly visible and can be costly to dispose of, particularly polystyrene. The emergence of some polystyrene recycling facilities and the use of plastic materials not suitable for recycling in fuel production may improve the options for diverting these materials from landfill.

C & D quantities generated from residential construction projects varies, however, industry waste reduction programmes appear to be successful, in the order of 30 to 40 percent reduction of waste to landfill being possible if long-term waste reduction programmes and incentives are in place.

The severity and likelihood of hazardous materials being contained within C & D wastes should be considered at an early stage of the construction process, as it could result in additional sorting requirements and reduced options for the reuse and recycling of waste materials.

There are currently gaps in the data for waste generation from New Zealand major renovations and/or minor and retrofitting. These waste quantities are difficult to quantity as the scale of renovation and refit varies on a case by case basis. However, there is potential to carry out research in this area by focussing upon data that could be provided with the help of the waste industry, such as from skip bin providers or from existing retrofitting projects such as the MfE-supported Warmer Homes programme.

There are also information gaps on the ability of modular and/or factory built homes to reduce waste generation over the life of the home, through the application of 'design for deconstruction' concepts. This gap is due to both the limited use of these techniques within New Zealand and, to a greater extent, the fact that this is a relatively new technique and the resulting buildings have not yet been in place long enough to know if they have resulted in reduced waste.

6.1.4 Domestic Wastes

Organic waste is a key waste stream generated from the home. Generally waste reduction, reuse and/or recycling at source is the preferred option, however, home composting is no longer seen as the only answer for reducing organic waste to landfill. This view is based on the consistently low uptake of home composting for Auckland cities, including in areas where home composting has been heavily pushed for the last five years (e.g. through the "Create your own Eden" campaign).

In response, New Zealand is doing well in the progression towards the separation of organics at source especially considering low cost of landfill relative to areas such as Europe and Canada. A number of organic waste kerbside collection schemes are emerging around the country. However, barriers remain around siting of organics facilities, market use of compost, collection costs, and interest by some in keeping organics in landfill to maximise methane gas capture.

One solution will not be suitable for all household size and types, with recycling and reuse options for single households being quite different for that which would suit multi-unit dwellings.

6.1.4.1 Authors' Reflections

The potential for composting domestic organic wastes at the neighbourhood scale is recognised. However, issues for this scale are similar to those for home composting, with regard to the ongoing management of composting systems, control of contamination issues (within both raw wastes and composted product) and potentially for significantly higher capital and operating costs compared with Council collection and disposal services. Neighbourhood scale facilities may also require resource consents, which add to both the complexity of environmental control requirements and ongoing monitoring, as well as to up-front costs. These issues all point towards the benefits of working with larger scale, regionally focused commercial operations in preference to multiple smaller facilities. Due to the types of issues associated with the processing of organic wastes (odour, leachate generation etc.) it is likely that regionalised facilities outside of intensified city centres would also be more manageable. Larger facilities also offer considerable economies of scale for costs, expertise and technical performance.

There is a potential market for the application of improved technology at a smaller-scale, such as micro-biogenerators, small-scale waste to energy and composting plants etc. However, currently, technology gaps exist and the technologies available still require a high level of ongoing commitment and expertise to ensure that the natural processes involved are properly harnessed and maintained. Therefore, as with the example of on-site wastewater treatment systems, research into appropriate technology at this smaller scale requires the maintenance element to be carefully considered. (The example of on-site wastewater treatment systems demonstrates the need for ongoing maintenance and potential failure if the homeowner does not follow guidelines correctly). In other words, a 'fool-proof' approach is required to ensure the ongoing success of household or neighbourhood level technologies for organic wastes.

Packaging is a relatively small portion of the domestic waste stream, contributing only 15 percent of household waste. Councils are already working in this arena through the provision of kerbside collection services and private industry in terms of the Packaging Accord and other similarly focussed initiatives. Therefore, in the author's opinion targeting of packaging waste attracts more attention than is justified for the level of harm and quantity of wastes going to landfill. On the basis of these points, it is recommended that Beacon does not focus on this area, with the exception of incorporating product stewardship criteria within supplier selection processes (i.e. to require suppliers to reduce and/or dispose of packaging wastes associated with their products).

6.1.5 Central Government

The central government New Zealand Waste Strategy (NZWS) has been successful in providing a vision for reducing waste and establishes key areas and targets. Generally however, the NZWS is considered insufficient due to the lack of baseline data and measurability and the lack of support through legislation. The NZWS has been picked up largely by local government but less so by industry. The recent actions by the Green party has required the MfE to further progress targeted but non-completed work to review the use of legislative and economic instruments to assist in meeting NZWS targets.

6.1.6 Local Government

Under current legislation (Local Government Act), local government has the key responsibility for managing solid waste collection, disposal and other options such as beneficial reuse and diversion from landfill. Therefore local government agencies, for the most part, are actively involved in waste management and minimisation ranging from direct service provisions through to advocacy and behaviour change programmes. Beacon has no need to repeat this work but should work to support Council shareholders (e.g. WCC and ACC). Information from, and the experiences of, these shareholders should also be applied to help draft revised HSS waste targets.

6.1.6.1 Authors' Reflection

There is a considerable amount of waste minimisation activity being carried out by local government, although the work is not coordinated. Therefore Beacon should aim to stay informed of developments within this area through their existing networks and local government shareholders.

6.1.7 Industry

Product stewardship and/or extended producer responsibility is the key to improved product design to reduce wastes throughout the product's lifecycle. We are unsure at what level Beacon should be aiming to influence these actions. However, at a minimum, Beacon should work with industry to promote these concepts through the work of shareholders activities and through product selection.

6.1.8 Other Organisations

Beacon has knowledge of a wide variety of organisations currently operating in this space and is already actively involved with the Sustainable Business Network, the New Zealand Business Council for Sustainable Development and the New Zealand Green Business Council. To maintain the full benefits of these affiliations and relationships Beacon now has to ensure that they participate in the relevant projects and tools promoted by those organisations, particularly to ensure that waste minimisation at the RBE level is included and focussed appropriately.

6.1.9 Knowledge and Technology

There are many emerging products that can be created from recycled materials in the building industry, providing a 'closed loop' approach for C & D or domestic wastes and even between domestic and C & D waste streams (e.g. recycled products such as carpets from plastic bottles). Beacon is well positioned to be able to demonstrate and educate others on these options (both internally, through partnerships, and externally through demonstration sites and education tools).

There are technologies such as modular/factory built housing methods that offer potential to reduce wastes, both at the construction stage and through possible renovation, refit and demonstration later in the buildings life cycle.

Composting and other technologies such as waste to energy applications are available internationally and further development is underway to provide for small-scale, easy-to-use applications. However, the balance and relative advantages and disadvantages between providing options at the home/neighbourhood or regional level require further consideration. The best option is likely to vary between regions and with other factors such as housing type. The key is to clearly identify the intended outcome and to consider options on a case-by-case basis.

6.1.10 Decision-Making Tools

The tools and rating schemes reviewed in this study do not generally apply to individual homes and provisions for managing and reducing domestic wastes. Beacon needs to identify the key tools they want to focus on and to promote and ensure that these tools adequately cover both C & D waste and domestic waste. Domestic waste provisions in the tools should include the allocation of space for the storage and collection of a variety of recoverable materials.

6.2 Opportunities

Table 13 provides a comprehensive list of opportunities that URS have identified for Beacon, with regard to minimising solid waste from the residential built environment. Opportunities are presented by action category, as previously used within this report.

These opportunities are not prioritised or ranked in terms of the potential level of impact and influence that they may provide for Beacon. Refer to Section 7 for discussion of linkages between these potential opportunities and Beacon's wider aims and objectives and business models and recommended "next steps".

Table 13: Waste Minimisation Opportunities Identified for Beacon

Key Action Category	Description
Direct Action – internally focused actions, to be undertaken within Beacon, including with stakeholders	Consider allocating a role within Beacon to identify and promote opportunities for shareholders to minimise wastes, through the use of measures promoted by Beacon (such as REBRI). It is noted that this could be difficult for a small, virtual organisation and more dedicated attention may be required to stay focussed on this outcome. To overcome these challenges a process could be developed to ensure that a successful information feedback loop is in place between Beacon and its shareholders as well as other stakeholders. Some level of external support may also be required. Ensure that the Sustainable Residential Building Manual includes a section on incorporating access to refuse and recycling storage and collection space, including options for dealing with waste streams both in the home/garden and for kerbside collection. Revise Beacon targets and the HSS document to recognise the value of providing options to householders for both home composting and for the collection of source separated materials, such as the provision of space for a compost bin and/or a 3-bin waste collection system for recyclables, organics and refuse. Beacon should also support their Council shareholders and work with them on promoting these types of initiatives, particularly for multi-unit dwellings and/or at a neighbourhood level. Revise Beacon targets and the HSS to recognise the differences for waste reduction at the single household and the multi-unit dwelling levels. Currently the HSS document focuses just on the single family home. However, this should be revised to consider the implications on waste generation from urbanisation and intensification or multi-unit developments.
Direct Action – externally focused actions, to be undertaken within the public arena, potentially alongside stakeholders	Consider becoming a member of WasteMINZ, to keep up with industry developments and to raise Beacon's profile within this space. If Beacon does any more construction projects they should ensure that they consult with the relevant local government waste representatives to discuss current and future options, such as collection and recycling services, waste exchanges in the local area and adaptation and use of the REBRI guidelines.
Economic Instruments	*Refer to 'Regulation and Policy' for actions linked to the potential introduction of waste levy legislation – an example of an economic instrument intended to drive the diversion of wastes from landfill.*

Key Action Category	Description
Regulation and Policy	Waste Minimisation (Solids) Bill – the opportunity for submissions to the Select Committee on consideration of the proposed Bill have closed. However, Beacon should aim to maximise opportunities that may be available for future submission rounds, most likely to be focussed upon the manner in which Waste Levy and Product Stewardship legislation would operate. These two types of instruments are likely to offer benefits for increased funds for resource recovery and further incentive to divert wastes from landfill. However, Beacon needs to work with their shareholders and partners to understand their individual issues should this legislation be implemented. There could be a future opportunity for Beacon to work with the MfE on the method for allocating funds collected through a waste levy. Beacon should keep in mind that there could be resulting opportunities to seek out a share of contestable funding when and if it becomes available. Beacon may want to consider approaching Government and MfE separately or potentially through becoming involved in the NZBCSD project for this topic. Any lobbying Beacon is involved in for waste minimisation should also highlight the work that shareholders and partners are doing in this area. Continue working on submissions for the Building Code Review (should further submission opportunities be available).
Advocacy	Continue to promote the use of waste minimisation practices during construction and demolition (as per the REBRI guidelines). These practices need to be demonstrated on a wide scale, both for new home construction and for renovation / refit projects. Look to reduce materials packaging associated with C&D materials, through applying REBRI guidelines and by working with suppliers on improving the recyclability or reuse of the packaging used for their products. The NOW Home is indicative and has provided Beacon with first hand experience on the practical application of REBRI guidelines. This experience and knowledge should be shared through working more directly with Beacon's stakeholders, particularly the councils and Fletcher Building, with the ultimate aim of ensuring that the REBRI guidelines become standard practice for all construction and deconstruction projects.

7 Beacon's Strategy

7.1 Overview

This section is dedicated to the linkages between the learnings of this research and Beacon's strategic documents, action plans and targets.

The purpose of this section is to give Beacon a starting point for potential modifications to its existing strategic planning documents, in particular the High Standard of Sustainability indicators for waste and the current Waste Targets as provided to URS by Beacon Pathway.

It should be understood that the modifications to these documents and strategies are suggestions only, as the development of the waste targets will continue to evolve as learning develops. The ideas presented are intended to stimulate discussion and act as a catalyst for further development of these documents.

7.1.1 Prioritising RBE Waste Streams

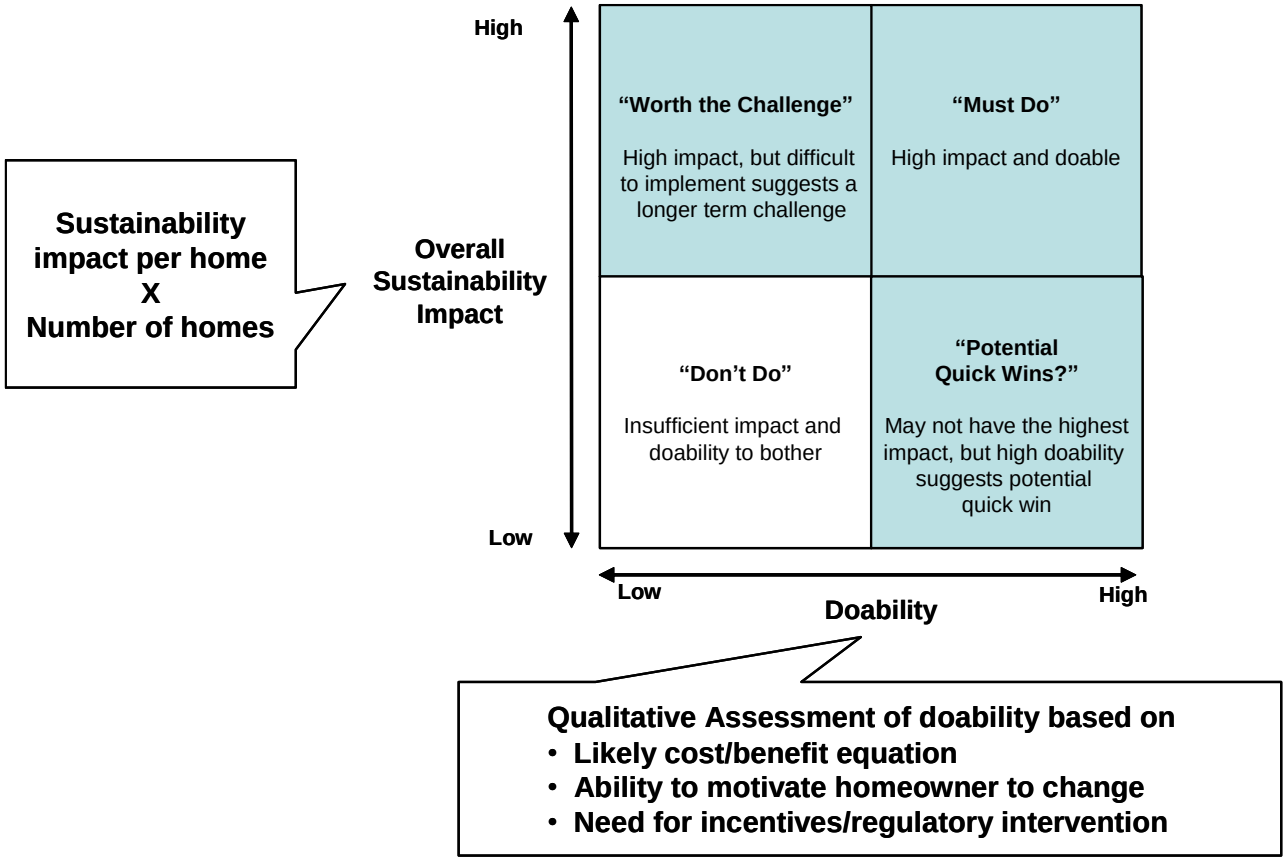
There are a number of different approaches Beacon can take in terms of prioritising the opportunities arising from this research. Beacon may want to consider using criteria focused on the waste stream as part of its 4-quadrant prioritisation process. It is expected that Beacon will need to undertake the prioritisation exercise again in light of this report as a method of revising the indicators and waste targets.

The NZWS 2002 suggests prioritising actions in waste management plans according to the following criteria:

- Volume and harm;
- Achievability;
- Public concern;
- Cost-effectiveness.

There are obvious synergies between the prioritisation methods, as the volume and harm criteria fit well with the "overall sustainability aspect" of the Beacon prioritisation model (shown in Figure 7).

Figure 7: Beacon Prioritisation Model



7.1.2 Beacon's Existing Waste Targets

Targets have been established for each of Beacon's main sustainability indicator areas. Solid waste falls into both the materials and waste areas.

Each target has been developed to be specific and measurable. The measures or 'indicators' are to be selected in accordance with a benchmark or baseline. The following is a review of the existing targets for waste as understood from the Pathways Portfolio Management presentation and the HSS document provided to URS in the course of this research. Suggestions for revisions are included as comments for Beacon's consideration.

It is noted that Beacon uses the terms 'materials waste' and 'household waste' to refer to C & D waste and domestic waste respectively. Beacon may wish to consider adopting these terms for use in all strategies in plans and/or ensure that Beacon terminology is adequately defined.

7.1.3 Materials Targets

This target deals with the minimisation of construction, demolition and renovation waste going to landfill with focus on 2012. This target applies to both new homes and renovations.

Beacon Materials Target 3:

- Minimise construction, renovation and demolition waste going to landfill in the most cost effective manner from design to build to alteration to deconstruction by 40 percent by 2012.

Current Target Details:

2006	2008	2010	2012
~4 MT of new materials to landfill per home	Key industry stakeholders engaged in process		~2.6 MT of new materials to landfill per home
Negligible use of recycled material in new & retrofit	Key industry stakeholders engaged in process		Established industry provision for recycled materials

There are no revisions recommended for Target 3 at this time, although some additional research may arise from the opportunities presented in this report, which may have an impact on the target in terms of use of recycled materials.

Beacon Domestic Waste Target 1:

- Homes are designed, built and renovated with features for minimising and recycling waste while improving cost effectiveness to the inhabitants and not contributing to public health issues.

Current Target Details with Revisions:

2006	2009	2012	2016
Levels of organic and recyclable matter from homes to landfill unknown. Authors Note: 65% of domestic refuse can be recycled and or composted. Target could be around capturing a % of this waste.		National waste strategy review	No organic waste or recyclable material to landfill from 90% homes
Suggested Target: Reduction of waste from renovation and retrofit. Data required to establish baseline for New Zealand homes.			

It was noted that there is no target in either the Materials Target #3 or the Domestic Waste targets regarding solid waste from renovation and retrofit. It is uncertain whether an additional target detail is required, but it is suggested that this material comes as a result of C & D operations but is generally regarded by the homeowner as domestic inorganic refuse. This potential target requires further discussion in terms of its fit and details, but is presented for comment.

7.1.4 Waste Indicators

Beacon's HSS High Standard of Sustainability defines a number of key features to achieve a high standard of sustainability. The key features for waste have been revised as follows to facilitate collection of materials from kerbside, including both kitchen and garden organics:

- "Space provision for compost bin and/or worm farm, to enable home composting for kitchen and garden waste and adequate storage/device in the kitchen for putrescibles storage.
- Dedicated space both within the home or garden and at kerbside for the collection of separated refuse, recyclables and organics wastes. "

Beacon may also wish to consider potential clarifications in the HSS document regarding objectives as used in the Beacon national scorecard development. In particular garden waste may need to be added to the goal definition under resource use. Suggested revisions are shown in Table 14 below.

Table 14: National Scorecard Goal Definitions

Objective	Goal definition	
Resource Use (CO_2 emissions, waste)	To reduce the amount of green house gas emissions from the RBE sector caused by operating energy demand and kitchen (putrescible) and garden organic waste, minimise construction waste and increase the use of recycled materials in design and construction.	
National scorecard recommended indicator	Made up of:	HSS performance measure
Resource use	Greenhouse gases	Partially captured by energy and materials measures, also included within the Neighbourhood Sustainability measures
	Manufacturing energy intensity	Materials choice
	House floor area	Not included
	Kitchen and garden waste	Waste
	Recycling and organics storage and collection areas where kerbside collection available.	Waste

As Beacon has not identified baseline data, a checklist method was incorporated into the HSS. Table 15 contains a revised version of the HSS based on this report. The revisions include the addition of the term 'garden waste', and allocation of space for 'storage' in the home as well as space for kerbside collection, which is frequently overlooked during new home development. The benchmark indicator regarding in-sink systems has been deleted until this topic has been further researched.

Due to the high value of the REBRI Guidelines and their relevance to the Beacon aims and opportunities arising from this research as highlighted in Section 6, it is further recommended that Beacon develop a more formalised strategy or action plan around the use and incorporation of the REBRI Guidelines. This strategy could be spearheaded by the Beacon representative nominated to manage the solid waste targets.

Table 15: Revised Checklist for Waste for Beacon's HSS High Standard of Sustainability

Key Indicator of Performance	New / Existing	Measurable Indicator		Benchmark (checklist requirements)
Waste	NEW homes	*Provision for solid waste minimisation*	*HSS*	Provision for kitchen and garden waste composting and/or storage of organic waste for collection Space for recyclables storage and collection Building construction in accordance with REBRI construction guidelines
			Building Code	
	EXISTING homes	*Provision for solid waste minimisation*	*HSS*	Provision for kitchen and garden waste composting and/or storage for organic waste collection Space for recyclables and organics storage and kerbside collection Renovation in accordance with REBRI construction and demolition guidelines

7.2 Next Steps

On finalisation of the Final Report, URS recommends a process involving internal review and feedback on the content of this report, particularly opportunities for Beacon. In considering the amount of detail in this report, there is a large amount of information to digest. Beacon may find more benefit in a facilitated workshop rather than an overview presentation of this Report and its findings. A workshop format will allow for discussion of more detailed questions and in depth consideration of future opportunities as well as targets and pathways.

8 Limitations

URS New Zealand Pty Ltd (URS) has prepared this report for the use of Beacon Pathway Ltd. in accordance with the usual care and thoroughness of the consulting profession. It is based on generally accepted practices and standards at the time it was prepared. No other warranty, expressed or implied, is made as to the professional advice included in this report. It is prepared in accordance with the scope of work and for the purpose outlined in the Proposal dated 13 September (revised) 2006 "Work Plan" document.

The methodology adopted and sources of information used by URS are outlined in this report. URS has made no independent verification of this information beyond the agreed scope of works and URS assumes no responsibility for any inaccuracies or omissions. No indications were found during our investigations that information contained in this report as provided to URS was false.

This report was prepared between September 2006 and January 2007 and is based on the information and data available at the time of preparation. URS disclaims responsibility for any changes that may have occurred after this time.

This report should be read in full. No responsibility is accepted for use of any part of this report in any other context or for any other purpose or by third parties. This report does not purport to give legal advice. Legal advice can only be given by qualified legal practitioners.

9 References

Ministry for the Environment National Landfill Audit 2002. Web address: http://www.mfe.govt.nz/issues/waste/landfills/audit.html

[8] Web address : http://www.marlborough.govt.nz/content/docs/waste/Waste_Strategy_&_Plan_2005-2010.pdf#search=%22construction%20demolition%20wastes%20definition%22

[9] Web address: http://www.mfe.govt.nz/issues/waste/construction-demo/index.html

[10] Definition sourced from the Guide for Construction Waste Audits (REBRI, May 1999), footnote No. Web address: http://www.rebri.org.nz/links/WasteAuditGuide.pdf#search=%22definition%20construction%20waste%20rebri%22

[11] Web address: http://www.mfe.govt.nz/issues/waste/landfills/cleanfill/definitions.html

[12] Oikos is a website that has been developed to provide information on sustainable design and construction.

[13] The Partners in Clean Construction Study and findings are described within the report titled "Sustainability in Practice: Reducing Construction Waste in the Ontario Residential Construction Industry (1997), Web address: http://www3.gov.ab.ca/env/waste/aow/crd/publications/OHBA-Sustainability_In_Practice.pdf#search=%22residential%20construction%20waste%20pro.

[14] The study was commissioned by the Tauranga City Council and Environment Bay of Plenty and was conducted by the Environmental Education for Re Web address: Sustainability Trust (EERST). Web address: Article produced on the Business Care website, http://www.businesscare.org.nz/bookshelf/articles/index.htm.

[15] Maddren Homes is an Auckland-based house building company who constructs a variety of house types and sizes, ranging from economy kitsets to large completed homes.

[16] Published by the US NAHB Research Center.

[17] By personal communication with David Mansel and William Carter of Generation Developments, September, November 2006.

[18] Conversions adapted from the Ministry for the Environment, as used in the National Waste Data Pilot.

[19] Published by the US NAHB Research Center.

[20] Based on the assumption that C & D waste included debris from residential and non-residential buildings, roads, and bridges.

[21] Web address : http://www.harc.edu/Projects/CultivateGreen/Events/20050518 (imperial units converted to metric).

[22] Web address : http://www.mfe.govt.nz/issues/waste/construction-demo/faq.html

[23] A series of reports on C & D wastes and related issues were prepared by SKM Limited during 2004. Report topics included market development strategies for selected regions, sector group's issues and options, market assessment, review of regulatory tools, guides for reducing C & D wastes and a wastes auditing guide. Copies of these reports are available through the REBRI Web address: http://www.rebri.org.nz/

[24] Web address : http://www.mfe.govt.nz/publications/waste/review-targets-waste-strategy-feb04/html/index.html

[25] Web address : REBRI case study, http://www.rebri.org.nz./case-studies/domestic.html

[26] Adapted from 2005 SWAP data for waste management plans of North Shore City and Rodney District Councils' waste management plans.

[27] The New Zealand Waste Strategy- Towards Zero Waste and A Sustainable New Zealand 2002. Ministry for the Environment.

[28] Web address: Auckland Regional Council website: http://www.aucklandcity.govt.nz/auckland/introduction/people/population.asp

[29] Auckland Region Waste Data Report 2003. Waste Not Consultants, for the Auckland Regional Council. Solid waste (from both domestic and commercial Web address: s) arising data for the Auckland Region: 968,000 estimated tonnes per annum (2001) . Auckland Regional Population census statistic for 2001 is 1,231,500 people.

[30] Adapted from the *OECD Environmental Outlook 2002*, published by the Organisation for Economic Development and Cooperation.

[31] North Shore City research on uptake of waste minimisation behaviours conducted in 2004. No national data regarding uptake of composting is available.

[32] By personal communication with Dave Perkins, Director of Living Earth Limited.

[33] Web address: : http://www.mfe.govt.nz/publications/waste/waste-levy-discussion-nov06/html/page6.html

[34] Based on NSCC and Rodney District data for 2003 as the National SWAP baseline did not contain this level of detail.

[35] Refers to Recycling Participation Studies conducted by local authorities including North Shore City Council where recycling participation is defined as putting out recyclable materials for collection a minimum of once per month.

[36] High Density Polyethylene

[37] Low Density Polyethylene

[38] Polyethylene Terephthalate

[39] Via NZ Packaging Council and by personal communication with Dave Perkins, General Manager, Recycle NZ (a division of Transpacific / Waste Management) and a member of the NZ Packaging Accord Governing Board.

[40] Adapted from Keep New America Beautiful, see

Web address: http://www.ccc.govt.nz/Publications/ReWeb address: CatalogueForSchools/WasteLitter/LitterAbatement.pdf

[41] Based on the North Shore City Council study "Refuse and Recycling in Multiple Unit Dwellings", 2000 and through personal communication with the Auckland City Council waste management business unit.

[42] Data on the residential dwelling sector and new building consents via Statistics New Zealand.

[43] By personal communication with Kevin Golding of Winstone Wallboards in November 2006.

[44] it is proposed that the levy would be charged at the point of disposal, at $25/tonne and split 50/50 between the local and national waste authorities

[45] By personal communication, Nandor Tanzcos, Green Party MP, at the WasteMINZ conference in November 2006.

[46] Adapted from Wikipedia.

[47] Web address : http://www.zerowaste.co.nz/default,councils.sm

[48] Web address : http://www.scoop.co.nz/stories/AK0611/S00102.htm

[49] Web address : http://www.beehive.govt.nz/ViewDocument.aspx?DocumentID=27619

[50] From the MfE's report titled Review of the New Zealand Waste Strategy- a decade of progress. (Oct 2005)

[51] North Shore and Waitakere City Councils also have actions in their Long-Term Community Council Plans (LTCCP) stating their intent to introduce a household kerbside kitchen waste/organics collection in

the future, although it is understood that a combination of funding and the availability of compost processing facilities are limiting factors at this time.

[52] Details regarding these programmes can be obtained via the Auckland regional council's websites.

[53] Details see Web address: http://www.landcareresearch.co.nz/research/sustain_business/enviromark/envirosmart/

[54] See Web address http://www.sustainablehouseholds.org.nz/index1.htm

[55] The limited influence of the New Zealand Waste Strategy on the solid waste industry is due to the lack of legislative and/or fiscal controls to support the strategy, i.e. the strategy is based upon targets rather than requirements.

[56] Fulton Hogan company Web address : http://www.fh.co.nz

[57] Web address: : http://www.mfe.govt.nz

[58] Web address: : http://wwwlists.ccc.govt.nz/wa.exe?A2=ind0604&L=mrinfo-l&P=990

[59] Excerpt from the UENP definition of cleaner production, Web address: http://www.uneptie.org/pc/cp/understanding_cp/home.htm#definition

[60] Web address: : http://www.wasteminz.org.nz/about.htm

[61] Web address : http://www.plastics.org.nz/page.asp?section=about+us

[62] Web address : http://www.nzgbc.org.nz/

[63] Web address : http://www.ledis.co.uk/abstract.php?id=E299

[64] Web address : http://www.landcareresearch.co.nz/about/index.asp

[65] Web address : http://www.branz.co.nz

[66] Web address : Web address: : http://www.scionresearch.com/about+eco-smart+technologies.aspx?PageContentID=262

[67] Web address: : http://www.vuw.ac.nz/architecture/sustainability/plasterboard.aspx

[68] Adopted from the REBRI definition for Construction Site Waste, as described within footnote No. 1 of the Guide for Construction Waste Audits (Rebri, May 1999). Web address: http://www.rebri.org.nz/links/WasteAuditGuide.pdf#search=%22definition%20construction%20waste%20rebri%22

[69] From the *OECD Environmental Outlook 2002*, published by the Organisation for Economic Development and Cooperation.

[70] The New Zealand Waste Strategy- Towards Zero Waste and A Sustainable New Zealand 2002. Ministry for the Environment.

[71] Estimates as taken from NZWS, the Auckland Regional SWAP 1997, and North Shore City Council Waste Minimisation Plan 2005.

[72] Data as taken from the NSCC Waste Minimisation Plan 2005 and the Rodney Waste Minimisation Plan 2005.

10 Appendix One: Glossary

Cleaner Production	Producing environmentally sound products or services that use energy and resources efficiently and avoid or reduce the amount of waste produced, resulting in fewer overall costs.
Cleanfill and Cleanfill Material	A cleanfill is a depository of cleanfill material. Cleanfill material is inert material that does not undergo physical, chemical, or biological transformation or adverse effects when placed in a cleanfill. (examples: rubble, rocks, bricks, soil)
Commercial Refuse	The portion of the waste stream from commercial activities and sources that is discarded for landfilling.
Commercial Waste	The portion of the waste stream arising from commercial activities such as production, wholesaling or retailing of goods or services. Includes material that is landfilled, recycled or otherwise treated for final disposal.
Compost	The decomposed organic material resulting from the composting process.
Composting	The controlled biological decomposition of organic waste (such as garden, food, wood, paper and wool) under aerobic conditions (in the presence of oxygen).
Construction and Demolition Waste (C&D)	Any product or material resulting from the construction and demolition process that is surplus to, or not included in the final building.[69] (Materials in the waste stream that arise from C&D activities, including civil engineering, roadworks, earthworks and demolition. NSCC def 2005).
Diversion of Waste	The process of diverting waste from landfill as final disposal.
Domestic Waste	The part of the waste stream originating from households or domestic housekeeping activities. Generally it refers to the refuse and recycling collected for disposal using a kerbside collection scheme and it excludes commercial and tradewastes.
Garden waste	The organic waste from gardening such as leaves, grass, plant clippings, prunings or branches.
Hazardous Waste	Solid or liquid wastes that pose dangers to human health and the environment if not treated, stored, transported and disposed of properly. These wastes often require special handling and treatment prior to disposal.
High Standard of	A term devolped by Beacon Pathways to guide initiatives to

[69] Adopted from the REBRI definition for Construction Site Waste, as described within footnote No. 1 of the Guide for Construction Waste Audits (Rebri, May 1999). Source: http://www.rebri.org.nz/links/WasteAuditGuide.pdf#search=%22definition%20construction%20waste%20rebri%22

Sustainability (HSS)	improve the standard of New Zealand homes, considering the five key performance indicators: energy, water, indoor air quality, materials and waste. At present, the performance indicators and benchmarks for Beacon's high standard of sustainability for waste are defined as a checklist (see Table 1 included within this report).
Household Hazardous Waste	Hazardous waste in generally small quantities that arises from domestic activities from households.
Kerbside Recycling	The practice of roadside collection of materials separated for recycling.
Kitchen Food Waste	Any fruit, vegetable, meat or other food scraps arising from domestic or commercial kitchens.

11 Appendix Two: New Zealand Waste List – Construction and Demolition Wastes

Table 16: NZ Waste List - Construction and Demolition Wastes[1]

Code	Waste
17 01	**Concrete, bricks, tiles and ceramics**
17 01 01	concrete
17 01 02	bricks
17 01 03	tiles and ceramics
17 01 06*	mixtures of, or separate fractions of concrete, bricks, tiles and ceramics containing hazardous substances
17 01 07	mixtures of concrete, bricks, tiles and ceramics other than those mentioned in 17 01 06
17 02	**Wood, glass and plastic**
17 02 01	wood
17 02 02	glass
17 02 03	plastic
17 02 04*	glass, plastic and wood containing or contaminated with hazardous substances
17 03	**Bituminous mixtures, coal tar and tarred products**
17 03 01*	bituminous mixtures containing coal tar
17 03 02	bituminous mixtures other than those mentioned in 17 03 01
17 03 03*	coal tar and tarred products
17 04	**Metals (including their alloys)**
17 04 01	copper, bronze, brass
17 04 02	aluminium
17 04 03	lead
17 04 04	zinc
17 04 05	iron and steel
17 04 06	tin
17 04 07	mixed metals
17 04 09*	metal waste contaminated with hazardous substances
17 04 10*	cables containing oil or coal tar
17 04 11	cables other than those mentioned in 17 04 10 and 17 09 02

Code	Waste
17 05	**Soil (including excavated soil from contaminated sites), stones and dredging spoil**
17 05 03*	soil and stones containing hazardous substances
17 05 04	soil and stones other than those mentioned in 17 05 03
17 05 05*	dredging spoil containing hazardous substances
17 05 06	dredging spoil other than those mentioned in 17 05 05
17 05 07*	track ballast containing hazardous substances
17 05 08	track ballast other than those mentioned in 17 05 07
17 06	**Insulation materials and asbestos-containing construction materials**
17 06 01*	insulation materials containing asbestos
17 06 03*	other insulation materials consisting of or containing hazardous substances
17 06 04	insulation materials other than those mentioned in 17 06 01 and 17 06 03
17 06 05*	construction materials containing asbestos
17 08	**Gypsum-based construction material**
17 08 01*	gypsum-based construction materials contaminated with hazardous substances
17 08 02	gypsum-based construction materials other than those mentioned in 17 08 01
17 09	**Other construction and demolition wastes**
17 09 01*	construction and demolition wastes containing mercury
17 09 02*	construction and demolition wastes containing PCB (e.g. PCB-containing sealants, PCB-containing resin-based floorings, PCB-containing sealed glazing units, PCB-containing capacitors, PCB-containing cables)
17 09 03*	other construction and demolition wastes (including mixed wastes) containing hazardous substances
17 09 04	mixed construction and demolition wastes other than those mentioned in 17 09 01, 17 09 02 and 17 09 03

12 Appendix Three: Zero Waste Councils

Source:
http://www.zerowaste.co.nz/assets/img/ZWNetwork/Councils/Apr06ZWmap.pdf