

# THE NEW ZEALAND WASTE DISPOSAL LEVY

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Potential Impacts of Adjustments to the Current  
Levy Rate and Structure  
Final Report

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#### *Disclaimer*

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## Glossary of Terms

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**AD (Anaerobic Digestion)** – a technology for treating organic waste in which it is broken down by micro-organisms in the absence of oxygen. This process produces a methane-rich gas that can be combusted as a fuel source and a digestate material that can be used as a source of nutrients in fertiliser.

**Collection system** – the manner in which waste is collected, including types of waste receptacles, degree of source separation and collection frequency.

**Dry recycling** – dry materials including paper, card, plastics, glass and metals, and free of contamination by organics such as food or garden waste.

**Energy recovery/EfW (Energy from Waste)** – one of a range of treatment options which use waste as a fuel for the production of energy (of which the most common is incineration with energy recovery).

**ETS** New Zealand Emissions Trading Scheme.

**Gate fee** – the fee paid to waste management sites for the acceptance of waste.

**GVA (Gross Value Added)** - the measure of the value of goods and services produced in an area, industry or sector of an economy, in economics. In national accounts GVA is the value of output less the value of intermediate consumption.

**HWRC (Household Waste Recovery Centre)** – a site which collects a variety of different waste types, run by a local authority or its waste contractor.

**Incineration** – a waste treatment technology whereby waste is heated at very high temperatures, causing its organic components to combust. In incineration, energy from the waste may or may not be recovered.

**IVC (In Vessel Composting)** - a technology for treating organic waste in which it is broken down by micro-organisms in the absence of oxygen. Composting takes place in an enclosed environment, with accurate temperature control and monitoring

**Landfill** – a means of waste disposal whereby waste is buried in the ground. In the UK, landfills must meet environmental standards, and lined ‘cells’ are used to hold the waste with systems to manage the liquids (‘leachate’) and gases produced by the decomposition of waste.

**Landfill diversion** – reducing the amount of waste going to landfill and instead redirecting this waste to other waste management options.

**MBT (Mechanical Biological Treatment)** – a type of waste treatment facility that uses a number of different technologies to extract dry recyclable materials and organic waste from mixed residual waste.

**MRF (Materials Recovery Facility)** – a type of waste treatment facility that separates out different types of recyclable materials from loads of mixed recycling (e.g. by using magnets to extract ferrous metals).

**OAW (Open Air Windrow)** - a technology for treating garden waste in which it is broken down by micro-organisms in an aerobic environment

**Preparation for re-use** – activities such as a repair and refurbishment which allow items that have been discarded as waste to be re-used.

**Recovery** - any operation the principal result of which is waste serving a useful purpose by replacing other materials which would otherwise have been used to fulfil a particular function, or waste being prepared to fulfil that function, in the plant or in the wider economy.

**Recovery rate** – the proportion of waste recovered out of the total amount of waste generated, commonly expressed as a percentage.

**Recycling** – the reprocessing of waste materials into new products or materials, whether for their original or another purpose.

**Residual waste** – mixed waste that is not collected separately for recycling, but rather which is sent for recovery or disposal.

**Waste hierarchy** – an order of preference of management options for waste materials, with preventing waste as the most preferred option followed by (in descending order of preference) preparation for re-use, recycling, other recovery (e.g. energy recovery through incineration) and finally disposal.

**WMA** Waste Minimisation Act 2008.

**Waste prevention** – reducing the amount of waste which arises in the first instance through policies such as designing out waste at the product design stage, improving systems and processes and reducing consumption.



# 1.0 Introduction

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## 1.1 Project Background

A consortium of public and private sector organisations has commissioned Eunomia Research & Consulting to undertake research aimed at improving understanding of the impacts of potential changes to the structure and rate of the Waste Disposal Levy (the Levy).

The Waste Minimisation Act 2008 (WMA) enables a levy to be imposed on waste disposed of in order to “raise revenue for promoting and achieving waste minimisation; and, increase the cost of waste disposal to recognise that disposal imposes costs on the environment, society and the economy”.

Section 39 of the WMA requires that the Minister must review the effectiveness of the Levy every three years, with the next review required to be completed by 1 July 2017.

The effectiveness of the Levy is assumed to be defined in relation to the purpose of the Levy under Section 25, which is to raise revenue for supporting waste minimisation, and to increase the cost of waste disposal. The effectiveness of the Levy is also assumed to ultimately be determined in relation to the purpose of the WMA under section 3, which is to “encourage waste minimisation and a decrease in waste disposal”.

International experience suggests that the rate of landfill levies or taxes is negatively correlated to the quantity of waste landfilled – in other words the higher the levy rate the less material is landfilled.<sup>1</sup> This would support the aim of the Levy to “encourage waste minimisation and a decrease in waste disposal”.

Section 27 makes provision for there to be a ‘prescribed rate’ for the Levy and, where no rate is prescribed, it mandates a default rate of \$10. As no rate has been prescribed, the Levy has, since its inception, been applied to disposal facilities as defined under the WMA at the default rate of \$10 per tonne.

There is provision under Section 41(1) of the WMA to extend the Levy to different classes of disposal facility, types of waste, and to adjust the ‘prescribed rate’ of the Levy across these different classes of disposal facility and types of waste.

In previous reviews of the Levy, the provisions to prescribe different rates of the levy and to apply the Levy across different classes of facility and types of material have not received detailed consideration.

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<sup>1</sup> European Topic Centre on Sustainable Consumption and Production (2012) *Overview of the use of landfill taxes in Europe* ETC/SCP working paper 1/2012;  
Ministry for the Environment (2014) *Review of the effectiveness of the waste disposal levy*, 2014

In order for there to be informed policy decision making, there is a need to understand how implementation of the provisions in Section 41 could impact the effectiveness of the Levy. This research seeks to address this knowledge gap, and to begin to build an evidence base for a rational approach to improving the effectiveness of the Levy.

## 1.2 Project Scope

In order to deliver on these intentions, the research covers the following:

- Consider options for changes to prescribed rate, and applications to different classes of facility/types of material;
- Assess potential impacts of options on diversion from disposal and on the economy;
- Identify how the use of Levy funds could support changes to a Levy regime (for example supporting infrastructure provision, or improved monitoring and compliance);
- Identify a broad preferred option that, if possible, enhances the effectiveness of the Levy, while optimising economic impacts, and minimising unintended consequences; and
- Develop an outline implementation plan that would suggest how any changes could be phased in over time to ensure support structures are in place and provide certainty to the sector for planning purposes.

For the purposes of clarity, this report does not cover the following:

- An analysis of environmental and social externalities associated with disposal;
- Options for Levy structures, rates, or the use of revenue, that are not provided for in the WMA;
- Analysis of the impacts of changes to the Levy at a local or regional level; or
- Analysis of the impacts of changes to the Levy on individual industries or social groupings;
- Consideration of the political and/or public response to the potential recommendations.

## 2.0 Waste Disposal and Recycling in New Zealand

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### 2.1 Current Situation

#### 2.1.1 Legislative Provisions

This section provides a brief review of the key features of the levy that are enabled in current legislation.

Part 3 of the WMA sets out the provisions for a waste disposal levy. Section 26 enables a levy to be imposed on waste deposited at a disposal facility.

A disposal facility under the act is defined in Section 7(1) as:

- (a) a facility, including a landfill, —*
  - (i) at which waste is disposed of; and*
  - (ii) at which the waste disposed of includes household waste; and*
  - (iii) that operates, at least in part, as a business to dispose of waste; and*
- (b) any other facility or class of facility at which waste is disposed of that is prescribed as a disposal facility.*

This definition means that, in practice, not all facilities that accept waste are currently subject to the levy. Those that are subject to the levy essentially align with what are termed ‘Class 1 facilities’ under the Land Disposal Guidelines.<sup>2</sup> However, Section 7(1) (b) does provide for different types of facility to be prescribed as disposal facilities. This means that there is scope to extend the application of the levy to any type of facility.

Section 27 makes provision for the levy to be set at a prescribed rate or, if the rate is not prescribed, then it defaults to \$10 per tonne. The legislation therefore enables the rate of the levy to be adjusted without constraints (beyond that it must be officially prescribed by regulation as provided for in Section 41). There is no maximum rate prescribed and no constraints on the magnitude or timing of any changes in the rate.

The income from the levy must be distributed in accordance with Section 30. In essence this provides for the following:

- Territorial Authorities (TAs) get half of the gross levy that is collected, distributed on a per capita basis (As provided for in Section 31). TAs must spend their allocated portion on waste minimisation in accordance with their Waste Management and Minimisation Plans (Section 32);

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<sup>2</sup> Waste Management Institute New Zealand (WasteMINZ). 2016. Technical Guidelines for Disposal to Land

- The Government can retain funds to cover administration costs associated with the levy; and
- The remainder is directed towards funding of projects that promote or achieve waste minimisation (As provided for under Section 38).

The WMA therefore ‘ring-fences’ income from the levy so that it must be used for waste minimisation. There is no provision for income from the levy to go into the consolidated fund or to be used to offset other forms of government revenue.

Section 39 requires that the ‘effectiveness’ of the levy must be reviewed initially after two years then at 3 yearly intervals. ‘Effectiveness’ is not directly defined in the clause, this is therefore interpreted to be defined in relation to the purpose of the Levy under Section 25, which is to raise revenue for supporting waste minimisation, and to increase the cost of waste disposal. The effectiveness of the Levy can also be assumed to ultimately be determined in relation to the purpose of the WMA under section 3, which is to “encourage waste minimisation and a decrease in waste disposal”.<sup>3</sup>

Section 39 also requires that the Minister considers the advice of the Waste Advisory Board, whether waste disposal has decreased, and whether waste that is reused, recycled, or recovered has increased.

Section 41 provides for regulations to be made by the Minister in relation to the levy. This is a key section in relation to the potential for changes to the rate and application of the levy. Section 41 (1)(a) allows for the type of facilities to which the levy can be applied to be prescribed, while 42 (1)(d) and (e) enable different rates to be applied to different disposal facilities, classes of disposal facility or types of waste. Together these clauses provide the potential to adjust the rate and structure of the levy so that it can more effectively deliver on the purpose of the levy and of the WMA. It is noted, however, that any such changes would require new regulation. Section 41 (2) specifically requires that, in making any regulations, adequate consultation must be undertaken, and that the costs and benefits of changes must be considered.

### 2.1.2 Current Rate and Structure

No rate for the levy has been prescribed by regulation, therefore the levy has, since its inception, been applied to disposal facilities as defined under the WMA at the default rate of \$10 per tonne.

Given the definition of disposal facilities under the WMA, the levy has effectively been only applied to ‘Class 1’ landfills.

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<sup>3</sup> This interpretation is supported by the evaluation framework adopted by the Ministry for the Environment in their 2014 review: Ministry for the Environment. 2014. *Review of the effectiveness of the waste disposal levy, 2014 in accordance with section 39 of the Waste Minimisation Act 2008*. Wellington: Ministry for the Environment.

### 2.1.3 Key Waste Issues and Trends

This section highlights a number of key issues and trends that are particularly relevant to consideration of potential changes to the levy regime.

#### 2.1.3.1 Waste Data

One of the difficulties in establishing the true impact of the levy is the lack of a comprehensive, reliable dataset, particularly over time. Since the introduction of the levy there has been good quality data available on the quantity of material that is going to levied disposal sites. However, prior to this report, there have been no attempts to calculate the magnitude of waste generated and treated in New Zealand by material.

There is limited data on the quantities of material going to non-levied disposal sites including on-farm disposal and illegal dumping. The studies that have been conducted have relied on extrapolation of information from snapshots of small study areas to derive national data.<sup>4</sup>

Similarly, there is only patchy information on the quantities of material that are recovered. TAs generally have good information about the quantity of materials recovered through their services and facilities, although this information is not consistent, and has not been collated into a set of national figures. Outside of this, some information is gathered by industry bodies, but there is little consistency across sectors and in how readily available the information is.

This situation was recognised in the last Levy review which noted:

*“Nationally aggregated waste data is very limited, and a comprehensive data-gathering exercise has not been carried out to establish a baseline from which to assess progress against policy objectives. As a result it is not possible to construct a comprehensive picture of the current situation, the situation before the introduction of the levy, or how this has changed. As a consequence, it is impossible to determine whether these outcomes have been achieved, and it will not be possible to do so until these gaps in data are addressed.”<sup>5</sup>*

This means that, while quantities to levied sites can be tracked, it is not possible to know whether any changes are a result of changes in the total quantities of material generated (e.g. as a result of changes in population or GDP), changes in the quantities of material

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<sup>4</sup>.For example: Ministry for the Environment. 2011. *Consented Non-levied Cleanfills and Landfills in New Zealand: Project Report*. Wellington: Ministry for the Environment; Tonkin & Taylor 2014 *New Zealand Non-Municipal Landfill Database*. Prepared for Ministry for the Environment; GHD 2014. *Rural waste surveys data analysis Waikato & Bay of Plenty*, Waikato Regional Council Technical Report 2014/55; GHD 2013. *Non-natural rural wastes Site survey data analysis*, prepared for Environment Canterbury

<sup>5</sup> Ministry for the Environment. 2014. *Review of the effectiveness of the waste disposal levy, 2014 in accordance with section 39 of the Waste Minimisation Act 2008*. Wellington: Ministry for the Environment. P 80.

recovered, or material changing disposal destination (e.g. from levied sites to non-levied sites).

### 2.1.3.2 Total Waste Generation

Historic waste generation figures to be used in the study were compiled from a variety of sources and are presented in Table 2-1 and Figure 2-1. Further detail is provided in Appendix A.3.1.

**Table 2-1: Waste Generation and Treatment Destinations (2015)**

Waste Destination	Tonnes	Notes
Class 1 Landfill	3,220,888 <sup>1</sup>	2015 data
Class 2 Landfill	2,575,771 <sup>2</sup>	Estimated from 2013 data with waste growth equivalent to change in real GDP applied
Class 3 Landfill	64,394 <sup>2</sup>	
Class 4 Landfill	3,799,262 <sup>2</sup>	
Farm Dumps	1,362,666 <sup>2</sup>	
Recovery	4,288,743	Estimate based on data from various sources <sup>6</sup>
<b>Total Waste Generated</b>	<b>15,311,725</b>	

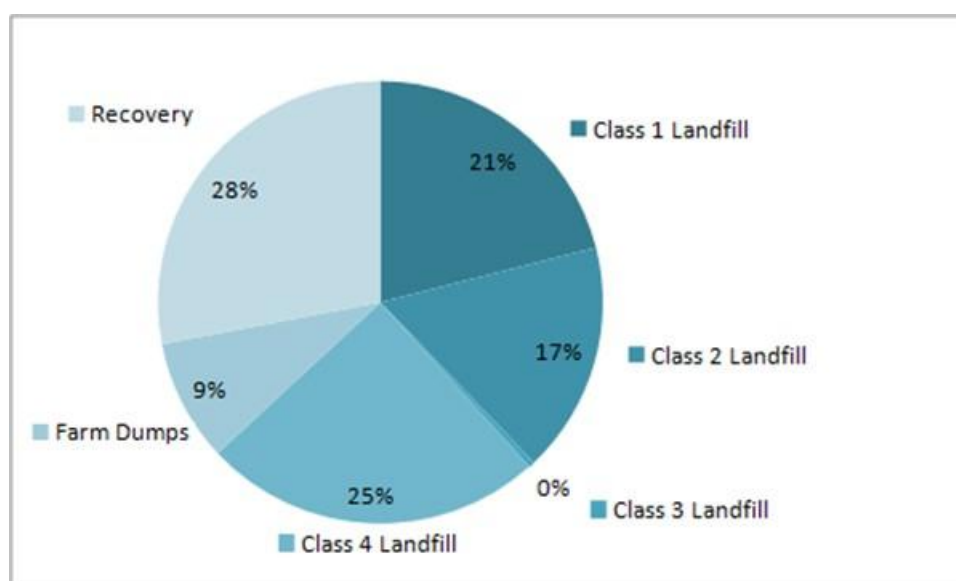
Sources:

1. Ministry for the Environment (2016) Monthly Levy Graph (background data), 2016, <http://www.mfe.govt.nz/waste/waste-disposal-levy/monthly-levy-graph>
2. Ministry for the Environment (2014) New Zealand Non-Municipal Landfill Database, October 2014, <http://www.mfe.govt.nz/publications/waste/new-zealand-non-municipal-landfill-database-report>

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<sup>6</sup> Refer to Appendix A.3.1 for further detail on the sources and methodology used to calculate recovered quantities.

**Figure 2-1: Proportion of Waste Generation by Destination**



The available data suggests that waste that is sent to levied (Class 1) disposal facilities accounts for approximately 21% of all waste generated. About 28% of material is estimated to be recovered, while the remaining 51% goes to some form of non-levied disposal.

### Waste to Non-levied Sites

The quantity of material going to non-levied sites has been a topic of concern in the industry and with the Ministry for some time. The 2014 review notes:

*“... data collected as part of this review suggests that currently the levy is only applied to an estimated 30 per cent of all waste disposed of to land. Not only does this relatively narrow application of the levy allow the potential for operators to minimise or avoid levy obligations, it also means the incentive effect of the levy is limited.”<sup>7</sup>*

One of the key issues is there is little national consistency in how non-levied sites are regulated and monitored. Regulation of fill sites is mandated under the Resource Management Act 1991 (RMA). There are no national standards for regulation of fill sites and so rules are set at a regional level. All regional authorities require resource consents for solid waste disposal. However disposal of ‘cleanfill’ material is either a permitted activity or is permitted below certain threshold quantities.<sup>8</sup> Cleanfill definitions can vary at the regional level although most have adopted or referenced the 2002 Cleanfill

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<sup>7</sup> Ministry for the Environment. 2014. *Review of the effectiveness of the waste disposal levy, 2014 in accordance with section 39 of the Waste Minimisation Act 2008*. Wellington: Ministry for the Environment. P 12.

<sup>8</sup> SKM 2008. *Waste Facilities Survey - Methodology and Summary of Results*. Prepared for Ministry for the Environment

Guidelines definitions<sup>9</sup>. Adding to the inconsistency is the fact that, because consents are issued on an individual facility basis, the conditions that are applied and the requirements for reporting and monitoring on compliance with those conditions can vary by facility. In general, older consents have fewer consent conditions and varying definitions of cleanfill.<sup>10</sup> This lack of consistency makes it virtually impossible to know at a national level the quantities of material going to these types of sites, the composition of the material, and to track trends over time. There is anecdotal evidence to suggest that there are issues with material being disposed of into non-levied sites that does not comply with consent conditions or permitted activity rules. However, there is no data on the extent to which this is an issue.

## Rural Waste

Rural waste that is disposed of on farms is another similar issue that has seen increasing focus in recent years. Work by the Canterbury, Waikato, and Bay of Plenty regional councils has attempted to quantify the issue and identify the risks associated with on-farm disposal. The Canterbury study concluded:

*“...92% of the sites surveyed used the ‘3B’ (burn, bury and bulk store indefinitely) disposal strategy. Simply speaking this means the NNRW [Non-Natural Rural Wastes] could eventually be detected in the streams, rivers, and groundwater of Canterbury. It also means that a legacy is being created in and on the land for future generations to deal with as well as a legacy for the ecosystems...”<sup>11</sup>*

Although there are available solutions which operate in different parts of the country to collect rural waste and recover or dispose of it within the formal waste management system, extending these solutions so that they are widely and economically available and are used by all farms is a more difficult proposition. The New Zealand Rural Waste Minimisation Project run by Environment Canterbury is undertaking detailed consideration of the key options to determine which ones are most feasible for wider application.<sup>12</sup>

## Food Waste

Food waste is identified as a specific issue in this context because it remains the largest single fraction of household waste (40%)<sup>13</sup> and one of the largest sources of waste to Class 1 disposal. In the UK and Europe, separate collection of household food waste is

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<sup>9</sup> Ministry for the Environment. 2002. *A Guide to the Management of Cleanfills*

<sup>10</sup> SKM 2008. *Waste Facilities Survey - Methodology and Summary of Results*. Prepared for Ministry for the Environment

<sup>11</sup> Environment Canterbury (2013) *Non-natural rural wastes - Site survey data analysis*. August 2013 prepared by GHD

<sup>12</sup> Environment Canterbury (2017) *New Zealand Rural Waste Minimisation Project: Milestone 4 Phase II: Detailed Business Cases*, prepared by True North Consulting

<sup>13</sup> Data from: Waste Not Consulting (2009) *Household sector waste to landfill in New Zealand*. Prepared for Ministry for the Environment



widespread and well established<sup>14</sup> but, despite the existence of proven systems to collect and process the material, take up of such systems in New Zealand has been slow and they are yet to be widely implemented<sup>15</sup>. Although there are some technical barriers, the principal reason is cost: simply put, the cost of processing (allowing for revenue) collected food waste usually exceeds the cost of landfill disposal. It would be expected therefore that increased collection of this waste stream would be sensitive to changes in the cost of disposal.

### Construction and Demolition Waste

We estimate that construction and demolition type waste accounts for over half of material that is sent to disposal (Refer to Appendix A.3.1). Most of this is inert material such as rubble and concrete, the majority of which is disposed of at Class 4 facilities (cleanfills). However there are also large quantities of timber waste, plasterboard, and metal (for more detail on estimates of the quantities and activities sources of material in the waste stream refer to Appendix A.3.1). Much of the construction and demolition waste could be recovered, including concrete and rubble, which can be processed and sold as aggregate.<sup>16</sup> However, the low cost of disposal for this material – particularly to non-levied sites – does not incentivise its recovery. If further progress is to be made in respect of this waste stream then a well-structured Levy regime that takes account of all fill sites is likely to be important.

### Illegal Dumping

One of the concerns in respect of increasing the cost of disposal through increases to the Levy is the potential for material to be disposed of illegally. This question was specifically addressed in the 2011 Levy review through a survey of TAs. The survey found the following:

*Of the 66 councils that responded to the WasteMINZ and Ministry for the Environment survey, 56 reported incidences of illegal dumping. For those responses comparing the 2008/09 and 2009/10 reporting periods, 20 out of 26 (77%) indicated a decline in the number of incidents of illegal dumping. Forty-four of the 48 councils (92%) that reported annual tonnages collected from illegal dumping indicated that they collect less than 1000 tonnes annually.<sup>17</sup>*

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<sup>14</sup> The drivers for collection of organic waste are different in these markets including restrictions on the quantities of biodegradable municipal waste allowed to be landfilled under the European Landfill Directive, incentives such as Renewable Obligations Credits for low carbon energy generation, and effective local authority monopoly on household waste collections.

<sup>15</sup> At the time of writing, Christchurch and Timaru collect food comingled with garden waste, a food waste collection has been announced for Auckland and systems are being considered for roll out in, Hamilton and the Wairarapa.

<sup>16</sup> There are successful enterprises such as Green Gorilla, Green Vision, and Ward Demolition currently operating that process and sell this material.

<sup>17</sup> Ministry for the Environment. 2011. *Review of the effectiveness of the waste disposal levy*

There have been numerous changes over the years in respect of the cost of waste disposal in NZ, and there remain large regional differences in the costs of waste disposal. However there is no evidence to suggest that there has been a significant change in the incidence of illegal dumping over time, or that regions with higher disposal costs necessarily have higher incidence of illegal dumping. It should be noted that a part of the reason for the lack of evidence may simply be a lack of reliable data – both before and after changes are introduced.

A review of international illegal dumping literature similarly showed no firm conclusions about the relationship between illegal dumping and other waste management practices<sup>18</sup>.

In general the literature suggests that the factors that lead to illegal dumping are relatively complex and inter-related, and that it is likely to take a convergence of factors before illegal dumping becomes a significant issue.<sup>19</sup> Therefore while the cost of disposal is a risk factor, it is not sufficient in itself to drive increases in illegal dumping and it is possible to mitigate against illegal disposal through adequate education, monitoring and enforcement, and provision of convenient and cost effective waste management options<sup>20</sup>

Illegal disposal sites impose a number of costs on the community including the cost of cleanup, loss of amenity and potentially loss of levy revenue. Enhanced enforcement of illegal disposal is likely to have benefits in terms of reducing these costs to the community.

The issue of illegal dumping is discussed further in A.1.7.2

### **2.1.3.3 Waste to Disposal over Time**

As noted above, reliable time series data is only available for waste that has been disposed of at levied disposal sites since the introduction of the levy. This is shown in the chart below.

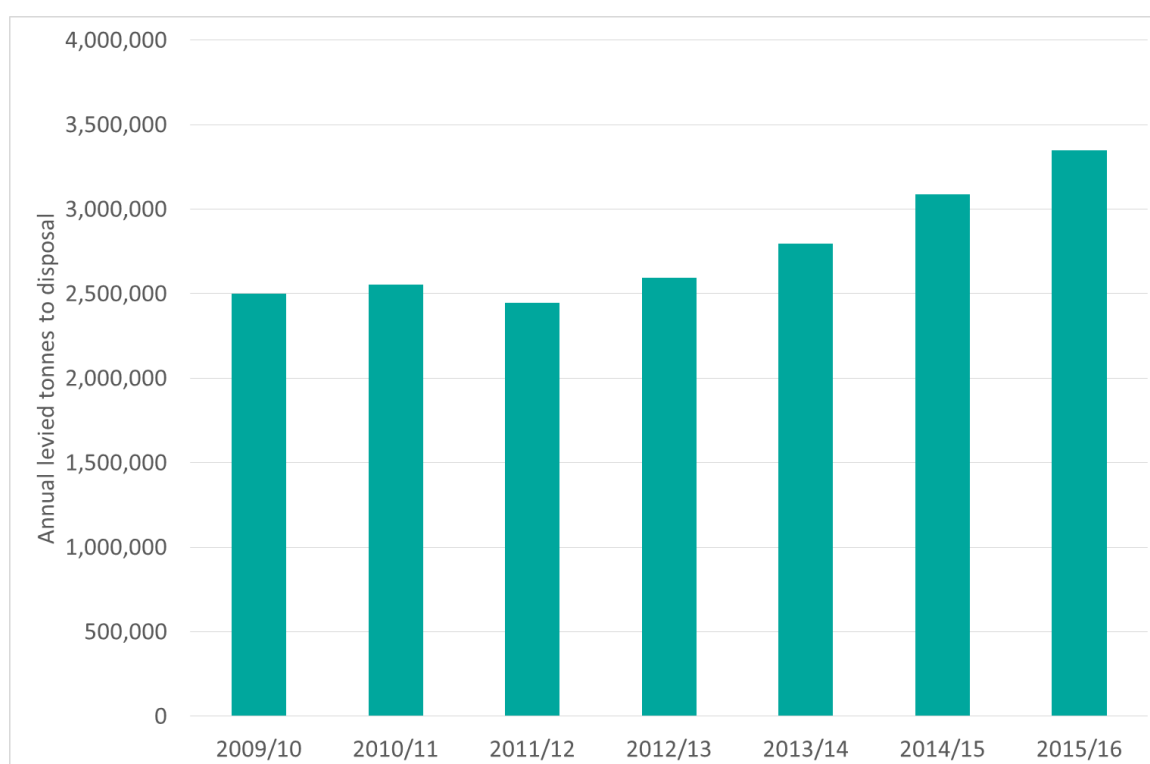
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<sup>18</sup> As referenced in: Eunomia, 2014 *Service Review: Review of Illegal Dumping*. Prepared for Hamilton City Council)

<sup>19</sup> Based on: UCL Jill Dando Institute of Crime Science (2006) “Fly-tipping: Causes, Incentives and Solutions” available at [www.defra.gov.uk](http://www.defra.gov.uk)

<sup>20</sup> NSW Govt. NSW Illegal Dumping Strategy 2017–20

**Figure 2-2: Waste to Levied Disposal Sites by Year**



Source: <http://www.mfe.govt.nz/waste/waste-disposal-levy/monthly-levy-graph>

Figure 2-2 indicates that while the quantities of material to landfill remained relatively constant from 2009 to 2012/13, they have climbed steadily since resulting in a 29% increase in disposal from 2012/12 to 2015/16.

It is likely that some of this increase may be due to how material that is diverted after entering the landfill is accounted for. The last Levy review in 2014 noted that 24 per cent of waste material entering disposal facilities is being classified as ‘diverted material’. Of this, only 3 per cent is being removed from site, while 21 per cent is being classified as diverted and used on site, and that the use of material on site “..contradicts the policy intent for the levy, which was that the levy would apply to all waste material disposed of at a disposal facility..”<sup>21</sup>. It is our understanding that the Ministry has clarified the application of the diverted material provisions, and this may have led to a change in the quantity of material classified as disposed of at levied sites.

However, while this could account for a large proportion of the change since 2014, it does not account for the change prior to that time. It is likely that changes in population

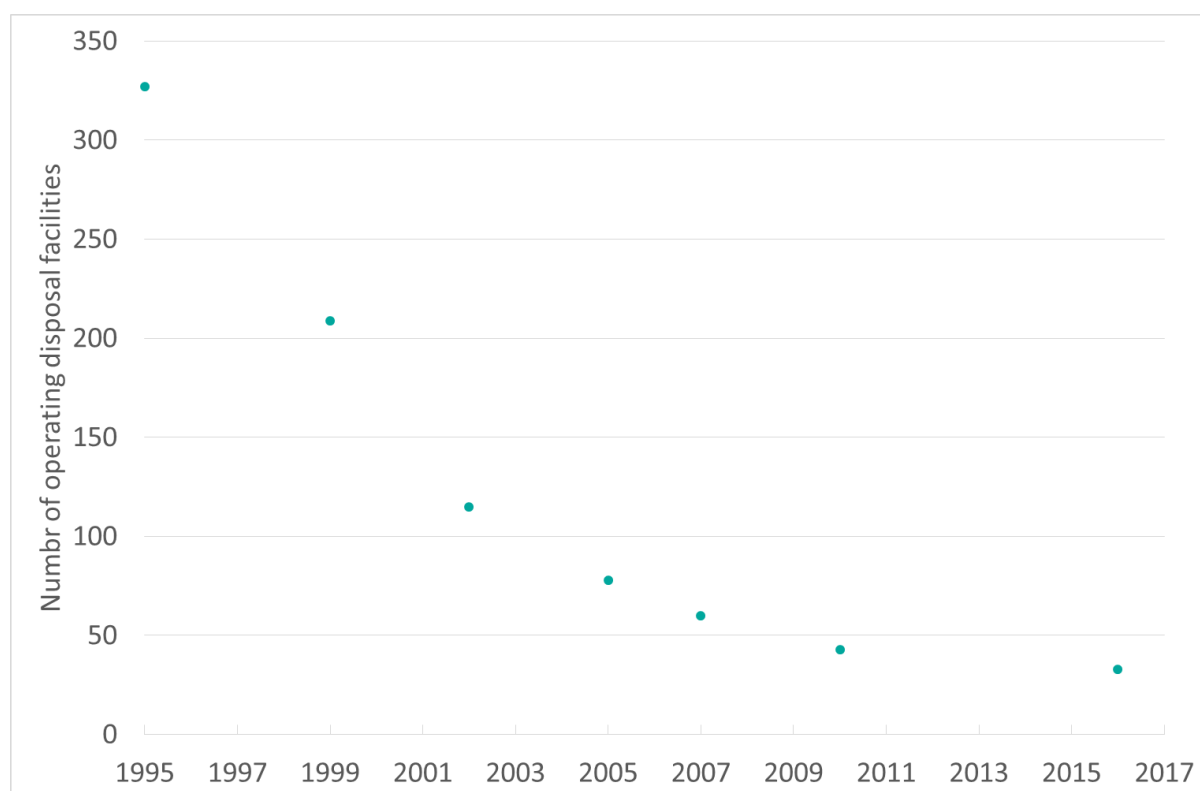
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<sup>21</sup> Ministry for the Environment. 2014. *Review of the effectiveness of the waste disposal levy, 2014 in accordance with section 39 of the Waste Minimisation Act 2008*. Wellington: Ministry for the Environment. P 32.

and GDP are also a factor, as these indicators show a strong correlation to waste generation and disposal over time.<sup>22</sup>

Another observable trend in waste management in New Zealand has been the consolidation of material sent to disposal from small, local (usually council owned), landfills to large regional facilities (usually private sector, or public/privately owned). This is shown in Figure 2-3. The latest available data (2016) indicates that 33 Class 1 landfills were in operation.

**Figure 2-3: Number of Class 1 Disposal Facilities in Operation**



Sources: Ministry for the Environment (2007) *The 2006/07 National Landfill Census*, Ministry for the Environment (2014) *New Zealand Non-Municipal Landfill, October 2014*, 2016 data compiled from TA Waste Assessments.

This flow of material from numerous small to fewer larger facilities has been driven primarily by an increased focus on environmental performance. This has resulted in the closure of many smaller (often remote) landfills and an increase in the design, construction and operation costs for remaining landfills. The cost of compliance with the RMA has meant that smaller facilities have higher fixed costs, which necessitates higher pricing to ensure cost recovery. Conversely, the larger facilities are able to have relatively low fixed costs in relation to their capacity. This price differential has meant regional facilities are able to attract waste from a large catchment and be competitive

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<sup>22</sup> These changes are discussed further in Appendix A.3.3

even taking account of transport costs. As tonnage moves from the smaller facilities to the larger ones, this results in less tonnage across which the small facilities can spread fixed costs, leading to price pressure which has further fuelled the flow of material to the large facilities.

#### 2.1.3.4 Impact of the NZ Emissions Trading Scheme (ETS)

The NZ ETS was introduced in 2010 and, from 2013, landfills have been required to surrender New Zealand Emissions Units (NZUs) for each tonne of CO<sub>2</sub> (equivalent) that they produce. Up until recently, however, the impact of the NZETS on disposal prices has been very small. There are a number of reasons for this:

- The global price of carbon crashed during the Global Financial Crisis in 2007-8 and been slow to recover. Prior to the crash it was trading at around \$20 per tonne. The price has been as low as \$2, but since in June 2015 the Government moved to no longer accept international units in NZETS the NZU price has increased markedly (currently sitting at around \$17 per tonne).<sup>23</sup>
- The transitional provisions of the Climate Change Response Act meant that landfills only had to surrender half the number of units they would be required to otherwise. These transitional provisions however are now being phased out and, between 1 January 2017 and 1 January 2019, landfills will move towards surrendering their full NZU liabilities.<sup>24</sup>
- Landfills are allowed to apply for 'a methane capture and destruction Unique Emissions Factor (UEF)'. This means that if landfills have a gas collection system in place and flare or otherwise use the gas (and turn it from Methane into CO<sub>2</sub>) they can reduce their liabilities in proportion to how much gas they capture. Up to 90% capture and destruction is allowed to be claimed under the regulations, with large facilities applying for UEF's at the upper end of the range.

Taken together (a low price of carbon, two for one surrender only required, and methane destruction of 80-90%) these mean that the actual cost of compliance with the NZETS has until recently been negligible, particularly for larger facilities claiming high gas capture.

However, the removal of the transitional provisions and the increase in the price of NZUs has meant that those landfills without gas capture, or with lower levels of claimed gas capture, are now faced with increasing costs of compliance.

While it is early days in the removal of the transitional provisions, it might be expected that the increased cost of compliance would lead to increased diversion of material from landfill. However, based on the fact that the current ETS policy settings are likely to

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<sup>23</sup> <https://carbonmatch.co.nz/> accessed 11 May 2017

<sup>24</sup> <http://www.mfe.govt.nz/sites/default/files/media/Climate%20Change/one-for-two%20factsheet-final%20%282%29.pdf>

disproportionately impact small facilities with no (or low levels of) gas capture, our expectation is that the main impact from increases in the price of NZUs and the attendant liabilities will be to increase the flow of material from small facilities to large facilities with high gas capture, rather than to incentivise higher levels of recovery (although this may occur, we expect the impact to be small and relatively localised). In other words, we expect the ETS will push prices up (to reflect increased landfill and transport costs) but not by the amount that is implied by the prevailing carbon price. The price increase will affect areas serviced by smaller landfills, which means the majority of the tonnage (roughly two-thirds) that goes to landfills with high gas capture will be only marginally affected by increased ETS costs.

Allowing for the flow of materials to high capture facilities we calculate that if the cost of NZUs were to reach \$45 by 2025<sup>25</sup> the net impact of the NZETS would be an average increase in the cost of disposal in the order of \$12 - \$13 per tonne (refer to Appendix A.3.3.3).

The way the scheme has been structured to date also results in some inconsistencies in the way it is applied – for example Class 2-4 landfills and closed landfills do not have any liabilities under the scheme. Further, the default waste composition (rather than a SWAP) can be used to calculate the theoretical gas production, which means landfill owners have an incentive to import biodegradable waste, which then increases gas production and which can then be captured and offset against ETS liabilities.

In brief, based on the above analysis, although the ETS may result in some increase in disposal costs over time, we do not expect this to be at a level that will drive significant diversion from landfill. The ETS cannot therefore be relied on to achieve the same aims as the Levy.

## 2.1.4 Revenue and Use of Levy Funds

The total revenue closely tracks the total tonnages to landfill – as would be expected. The main difference between Levy revenue and tonnes disposed of at levied sites is due to situations where a waiver of the Levy has been applied. This is enabled in the legislation and can be applied in circumstances such as waste from natural disasters.

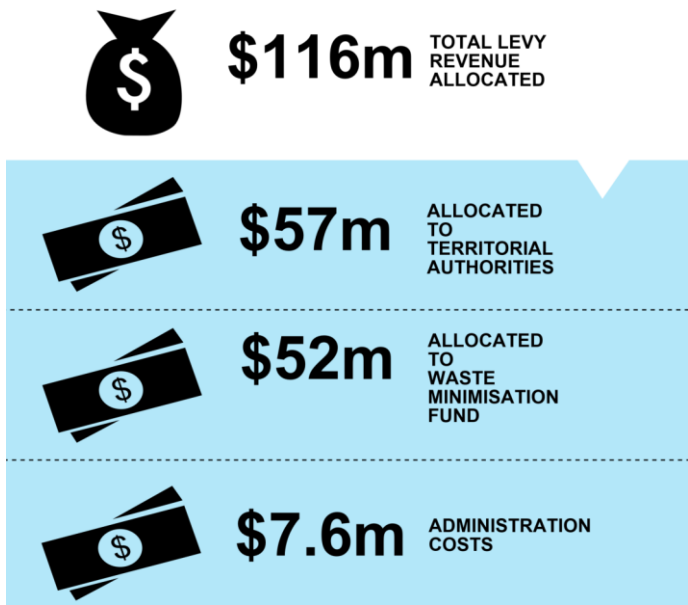
As of the last Levy review in 2014 the Ministry reported that \$114,781,966 of Levy revenue had been raised since its introduction, equivalent to the Levy being paid on approximately 98% of the tonnage to levied sites. If this is applied to the most recently available tonnage figures (May 2016) this would suggest that in the order of \$190 million has been raised by the Levy to that point.

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<sup>25</sup> Mid range scenario used by central Government in: Ministry of Business Innovation and Employment (2016) *Electricity Demand and Supply Generation Scenarios 2016*, November 2016, <http://www.mbie.govt.nz/info-services/sectors-industries/energy/energy-data-modelling/modelling/electricity-demand-and-generation-scenarios/edgs-2016#assumptions>

The distribution of Levy funds as of the last review is shown in the graphic below:

**Figure 2-4: Allocation of Levy Revenue (to 2014)**



Source: Ministry for the Environment. 2014. *Review of the effectiveness of the waste disposal levy, 2014 in accordance with section 39 of the Waste Minimisation Act 2008*. Wellington: Ministry for the Environment.

The data provided suggests that 49% of levy funds have gone to TAs, 45% to Waste Minimisation Fund projects and 7% to administration.

**TA Spending**

Data from the 2014 review suggests that nationally, Levy revenue has resulted in an increase in spending by TAs on waste minimisation. However, it also noted that about 30% of the allocated funds were unspent, and that nearly half of the revenue allocated to TAs is spent on existing services. While spending on existing services is not expressly prohibited under the WMA, it is considered inconsistent with the policy intent. The review concluded that spending on existing services “..indicates that some councils may be using levy money to offset the cost of running existing waste minimisation services (such as kerbside recycling), with no additional net waste minimisation benefit resulting from the additional levy funding.”<sup>26</sup>

While there is provision in the WMA for the Minister to set performance standards for TAs (Section 49), this provision has not been utilised to date. Reporting on Levy spending is currently voluntary, and the quality of data available makes it difficult to

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<sup>26</sup> Ministry for the Environment. 2014. *Review of the effectiveness of the waste disposal levy, 2014 in accordance with section 39 of the Waste Minimisation Act 2008*. Wellington: Ministry for the Environment. P. 47

judge whether Levy spending by councils has been effective in promoting and achieving waste minimisation.

Under the WMA half of the levy revenue must be allocated to TAs, therefore, how that money is spent will be critical to determining the overall impacts from Levy expenditure. There could be some concern therefore that, if the revenue increases substantially (as it could under a higher rate of Levy), the money allocated to TAs may not be spent effectively. Thus, there may be an argument to suggest that, if substantially higher revenues are received, performance standards should be put in place that align spending with national strategic objectives.

### Waste Minimisation Fund

The Waste Minimisation Fund allocates approximately 45% of the Levy through a contestable process. The criteria for the fund are set by the Minister. To date the allocation of funds has not been well aligned with strong strategic waste minimisation goals. The 2014 review noted that:

*“WMF funding appears to have been predominantly applicant-driven, with funding decisions based on general assessment criteria and without targeted priorities. This has resulted in an ad hoc range of funded projects. While it was always intended that WMF funding should be available as a catalyst for new and innovative waste minimisation initiatives, there is scope to operate the fund in a more strategic way, ensuring funding is also available for projects that support the New Zealand’s waste minimisation priorities.”<sup>27</sup>*

The Ministry has more recently made efforts to put a stronger strategic focus on the WMF. In 2013, the Ministry developed a framework for assessing waste streams by priority. Under the framework waste types are assessed against three criteria – risk of harm, quantity of waste, and benefits from minimisation. The WMF then prioritises applications that deal with the highest ranking waste streams. In addition, in previous rounds, the WMF has targeted funding at particular types of projects. For example, in 2015 it opened a second round of funding for projects specifically focussed on securing markets for end-of life tyres and, in 2016 sought projects that address litter.

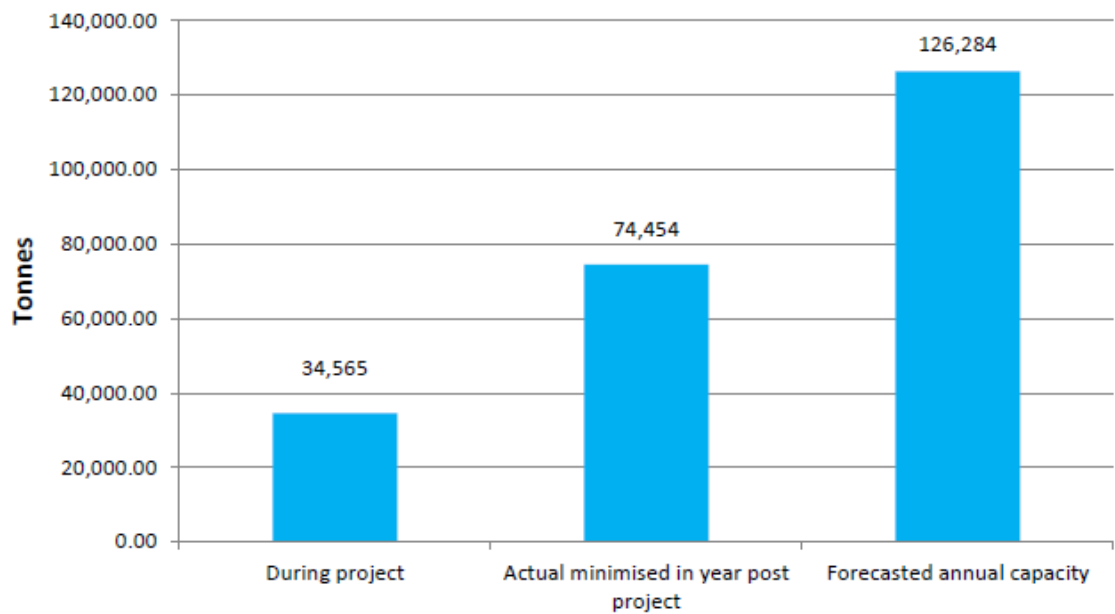
The tonnages reported as diverted through WMF funded projects are shown in the figure below:

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<sup>27</sup> Ministry for the Environment. 2014. *Review of the effectiveness of the waste disposal levy, 2014 in accordance with section 39 of the Waste Minimisation Act 2008*. Wellington: Ministry for the Environment. P.58



Figure 2-5: Tonnes of Waste Minimisation Reported from WMF Projects



Source: Ministry for the Environment. 2014. Review of the effectiveness of the waste disposal levy, 2014 in accordance with section 39 of the Waste Minimisation Act 2008. Wellington: Ministry for the Environment.

The Ministry notes that “Data on long-term processing tonnages from WMF projects is limited due to the fact that there is currently no established system for capturing information about projects after their funding deeds expire.”

Conclusions

There is an overall lack of a clear strategic focus for the both the WMF and TA spending of levy revenue. However, this is perhaps attributable to the lack of clear actions that arise from the New Zealand Waste Strategy 2010 (NZWS). The NZWS sets two high level goals: to reduce the harmful effects of waste, and; to improve the efficiency of resource use. However, it does not provide a road map for how action is to be taken to achieve these goals. There is no identification of key issues, gaps, and of the roles of the central and local government and the private and community sectors in addressing these. If Levy income is to be spent effectively in the future, then a clear strategic framework will be important to enable this.<sup>28</sup>

2.1.5 Outcomes of Previous Reviews

There have been two reviews of the effectiveness of the Levy, an initial review in 2011 and the last review in 2014. It is noted that the current review of the Levy is in process, and conclusions from this review are not reflected here.

<sup>28</sup> It is worth noting that in other jurisdictions spending is directed and assessed against targets (for example EU Directive targets, State or Federal Targets in Australia).

### 2.1.5.1 2011 Review

This review took place two years after the introduction of the Levy and was substantially focused on whether the administrative structures were in place and functioning correctly. The review concluded that it was too early to determine whether WMF funded projects were successful, or whether the cost of waste disposal had been increased to recognise that disposal imposes costs on the environment, society and the economy.<sup>29</sup>

### 2.1.5.2 2014 Review

The 2014 review was more comprehensive and provided a range of recommendations.

The review noted that there were a number of issues with respect to the structure of the Levy, in particular that it only applied to facilities that accept household waste (disposal facilities under the WMA), and that there has been inconsistent application of the Levy to 'diverted materials'. It concluded that *"The priority is to ensure the levy is being applied in a fair and effective way before any consideration is given to increasing the rate of the levy"*<sup>30</sup>.

The recommendations from the review were:

- 1) Investigate options to clarify the legislation so that the levy is consistently applied at disposal facilities.
- 2) Investigate making additional waste disposal sites subject to the levy obligations.
- 3) Investigate options for setting rules on how territorial authorities spend levy funds.
- 4) Investigate options to require reporting from territorial authorities on levy spending and outcomes in relation to their broader responsibilities to encourage effective and efficient waste minimisation under the Act.
- 5) Continue investigating options to operate the Waste Minimisation Fund in a more strategic way, ensuring funding is available for projects that support New Zealand's waste minimisation priorities.
- 6) Undertake targeted data collection of key waste minimisation infrastructure and services in New Zealand to establish a baseline against which improvements can be measured.
- 7) Develop a framework and agreed metrics to evaluate the medium- and long-term outcomes of levy funding, including considering the wider environmental, social, economic and cultural benefits of waste minimisation funding.
- 8) Investigate options to require Waste Minimisation Fund recipients to report on the ongoing outcomes of projects after funding ceases.

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<sup>29</sup> Ministry for the Environment. 2011. *Review of the effectiveness of the waste disposal levy*

<sup>30</sup> Ministry for the Environment. 2014. *Review of the effectiveness of the waste disposal levy, 2014 in accordance with section 39 of the Waste Minimisation Act 2008*. Wellington: Ministry for the Environment. p.14

- 9) Undertake further work to better understand how factors such as cost and convenience are influencing disposal patterns and consider options to make alternatives to disposal more attractive than landfill.
- 10) Consider ways to support user-pays pricing systems for waste disposal that would allow waste disposers to better respond to price signals.
- 11) Investigate options to establish the ongoing data collection required to evaluate long-term waste minimisation outcomes.

Most of the above recommendations appear very sensible, although there is a preference for ‘investigating’ rather than taking action. While investigation is a necessary precursor to action, there does not appear to have been a consistent work programme in place to address the above recommendations. The recommendation that we would consider is missing from the above list is essentially the subject of this report: to investigate the potential impacts of changes to the rate and structure of the Levy and to identify an appropriate rate and structure that will most effectively deliver on its aims.

The Ministry has rightly identified that, if the structure of the Levy is not correct, and that if there is inadequate monitoring and enforcement, raising the rate of the Levy could lead to unintended consequences such as more material going to non-levied sites or illegal disposal. However, we do not subscribe to the view that this means that consideration cannot be given to the rate of the Levy in advance of having the right structures in place.

Our view is that it is necessary to first understand what an effective Levy regime should look like, which includes consideration of the rate of the Levy as well as appropriate enforcement, and then to map a sensible pathway to implementation of that regime.

## 2.2 Problems with the Current Situation

Setting aside issues regarding the lack of good quality data, which makes the impact of the Levy hard to evaluate, there are a number of key issues with the current Levy regime. These are discussed briefly below:

### 2.2.1 Levy Set Too Low to Influence Levels of Disposal

There is no evidence to suggest that the introduction of the Levy at its current rate of \$10 per tonne has led to a decrease in waste to disposal. As noted from the most recently available data, quantities of waste sent to landfill have actually increased in the last few years (although the drivers for this are uncertain). This finding is consistent with our knowledge of similar instruments introduced elsewhere which indicate that there is usually a ‘threshold’ level at which significant diversion from landfill starts to occur.<sup>31</sup>

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<sup>31</sup> For example: *Review of Solid Waste Levy, Zero Waste SA*. Report prepared by Hyder Consulting, 2 February 2007. The threshold can be expected to relate to the net effect of different thresholds for key materials. In this regard, the thresholds for the largest components of the waste stream that can be readily diverted (e.g. organic waste, C&D type waste) would be expected to drive the overall threshold.

With the rate set at its current level it is apparent that it is too low to influence key strategic waste management decisions in respect of recovery. This is particularly the case for key waste streams such as food waste and C&D waste. Until the Levy is set at a higher level it is likely that its main impact will continue to be to simply accumulate funds that can be applied to waste minimisation activities.

### **2.2.2 Application of the Levy Only to Class 1 facilities**

One of the key constraints on the effectiveness of the Levy is that it is only applied to sites that handle an estimated 30% of waste sent for disposal. This narrow application of the Levy means that there will be an incentive for waste to migrate from levied sites to non-levied sites. Not only does this avoid the Levy and any associated incentive for waste minimisation, but the material is generally going to sites that have lower levels of monitoring and environmental controls, and hence there is potential for negative environmental outcomes. Thus, at lower levels the levy would appear to incentivise waste to seek cheaper forms of disposal but, because recovery still appears relatively expensive, significant recovery is not incentivised.

### **2.2.3 Inconsistent Monitoring and Enforcement of Non-levied Sites**

There is substantial inconsistency in the monitoring and enforcement of disposal at non-levied sites, including on farms. Not only does this mean a paucity of reliable data on the actual quantities and composition of material being disposed of, but it means that there is limited ability to ensure that material is going to the most appropriate form of disposal. Without improvements in how sites other than Class 1 disposal facilities are regulated, any changes to the rate of the Levy could potentially result in unintended consequences.

### **2.2.4 Use of Levy Funds**

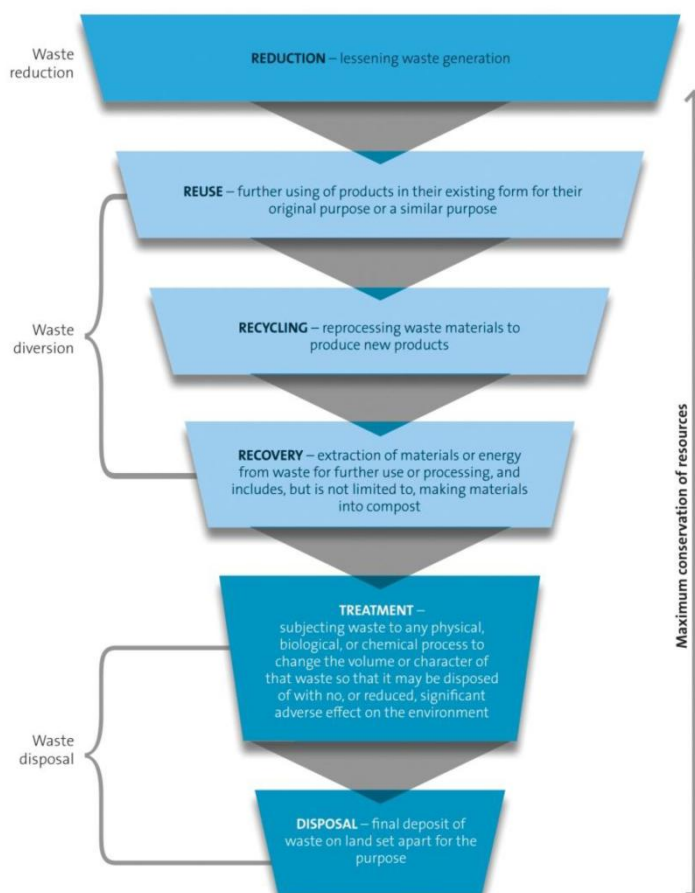
Although there have been some recent improvements in the strategic focus of the Waste Minimisation Fund, over all there is a lack of a clear strategic approach around how the Levy funds can best be applied to achieve outcomes consistent with its intent. This applies not just to WMF projects but also to the spending of Levy income by TAs. Ideally there would be a clear strategic plan of action set at a national level, with the Levy funds providing resource to carry out the plan of action, and clear roles for central and local government as well as the private and community sectors. For example, funding could be directed towards some of the areas identified here as necessary to improve the functioning of the Levy, such as enhanced monitoring and enforcement, addressing data gaps, providing infrastructure and services in rural areas, or investing in recovery services and infrastructure to ensure there is sufficient alternative capacity (that is cost competitive with disposal) to process recovered materials.<sup>32</sup>

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<sup>32</sup> Alternatively, although it is outside of current legislative provisions and outside the scope of this report to consider, a longer term option for revenues from the Levy that are not spent within the sector is for

## 2.3 Cost of Disposal and the Waste Hierarchy

The internationally recognised waste hierarchy is shown in the following chart.



The intention of the hierarchy is that actions at the top of the hierarchy should have preference over those at the lower levels. While there is widespread agreement that this is a useful guide for action from an environmental perspective, the reality is that waste management decisions are influenced by considerations of cost, and the costs do not always support implementation of the hierarchy. Fundamentally, if disposal costs are low, then the activities in upper tiers of the hierarchy, whose financial/commercial rationale rests on the avoided costs of disposal, are less likely to be taken.<sup>33</sup>

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them to be transferred to the Treasury for use in financing expenditures within the national budget. For example, reducing labour taxes as part of a strategic 'tax shift' programme. This would require a change to the WMA.

<sup>33</sup> A goal of the New Zealand Waste Strategy is the 'efficient use of resources'. Resource use is more efficient at the higher levels of the hierarchy.

Thus, in order to divert waste from a lower level of hierarchy (e.g. disposal at landfills) to a higher level (e.g. recycling), it is necessary to provide regulatory measures (e.g. landfill ban) or economic instruments (e.g. landfill levy or subsidies). However, economic instruments are often preferred over regulatory measures, as the former is generally more efficient than the latter. Regulatory measures such as landfill ban could divert waste from landfill to incineration instead of recycling if cost of incineration is lower than recycling. On the other hand, a carefully designed economic instrument, for example, the combination of landfill levy and incineration levy, could make recycling more cost-effective than disposal to landfill or incineration.

The OECD makes the following comment about efficiency of economic instruments:<sup>34</sup>

*“There are good theoretical reasons to believe that economic instruments offer the potential for substantial static and dynamic efficiency gains, compared to traditional command and control regulation. Economic incentives offer two important advantages over traditional “command and control” regulation. First, they allow business and others to achieve regulatory goals in the least costly manner. Second, market incentives reward the use of innovation and technical change to achieve these goals.”*

In addition, subsidy schemes are difficult to ensure the money is spent in the most efficient way and in the right places, and market support activities (e.g. renewable energy, recycled content) would not necessarily ensure high diversion from landfill. Perversely, supporting renewable energy may support continued landfilling as landfill gas can be used to generate renewable energy.

### 2.3.1.1 Waste Disposal and Recovery

Waste disposal costs (i.e. bulk rates at the landfill) can vary significantly (\$20- \$190), but the average in New Zealand is determined to be in the order of \$75 per tonne for active waste, and \$10 per tonne for inert (cleanfill) waste (refer to Appendix A.4.4.2).

In comparison, recovery of putrescible material (e.g. food waste) can cost between \$80- \$160 per tonne, and processing of construction and demolition materials can cost between \$5-40 per tonne (refer to Appendix A.4.4.2). Recycling of some materials can be cheaper than disposal due to the value of the materials, however, when recycling markets are low material may not have sufficient value to make their recovery economically viable. Other materials can be more expensive to recycle due to the low material values, or the most complex collection and/or sorting operations that are required to ensure high capture rates. The collection costs are also a major part of the overall costs of waste management. This is important in New Zealand where transportation can be costly due to the nature of the geography. These costs are also included in the model.

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<sup>34</sup> <https://www.oecd.org/gov/regulatory-policy/35260489.pdf>

### 2.3.1.2 Incineration

There is no large scale incineration or other forms of energy from waste (EfW) in New Zealand at present, although historically there were a number of ‘destructors’ that burned municipal waste<sup>35</sup>. Although the option of incineration has been considered from time to time, no modern EfW facilities have been established.<sup>36</sup> The principal reason appears to be the relatively high cost compared to large scale landfill. In 2012 Auckland Council commissioned a report into Energy from Waste as a possible option for the City. The report concluded that “..there is no clear indication at this stage that economic drivers are in place to ensure viability of WTE [Waste to Energy] in the Auckland waste market.”<sup>37</sup>.

The study identified that combined capex and opex costs for a 200,000 tonne per annum incinerator would range between \$140 and \$210 per tonne. Taking account of income from electricity generation this would indicate gate fees of between \$100 - \$170 per tonne (average \$135) would be required.<sup>38</sup> A facility of this size or larger is likely to be necessary to be economic viable, and as such it would need to be located near to a large population centre to be able to ensure sufficient feedstock (i.e. Auckland). We have assumed in this study that the average cost of landfill disposal in NZ are around \$75 per tonne, however the costs for the large facilities serving Auckland can be as low as \$35-\$40. Assuming a cost for incineration of around \$135, this would suggest that if levy rates were to increase to around \$90 - \$100 per tonne then incineration could become an economically viable disposal option as a replacement for existing disposal facilities.

### 2.3.1.3 Costs of Collection

Estimated average costs of collection are shown in Appendix A.4.4.3. The average costs of collection (together with the average costs identified for processing and disposal) were used as the basis for a cost modelling exercise<sup>39</sup>. The aim of the exercise was to determine the impact of increasing levy on status quo diversion versus high diversion (increased recycling plus organic waste collection) collection scenarios. The exercise

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<sup>35</sup> For example Auckland (closed 1960s), Otahuhu (closed 1965) Wellington (closed 1946) and Christchurch (closed 1947) all had facilities for burning municipal waste. From: Ministry for the Environment (2014) Incorporating Waste Minimisation Act Data into New Zealand Greenhouse Gas Emissions Estimates. Prepared by Eunomia Research & Consulting and Waste Not Consulting

<sup>36</sup> For example Olivine had a proposal to build an incinerator at Meremere, Waikato District in the late 1990s.. The ex-Holcim cement works site in Westport is under consideration as a location for establishing a large scale EfW facility that would import waste, post-sorting, for treatment. However, the project is not yet confirmed, and whilst some financial figures have been quoted publicly, given that the facility is some way from being financed or constructed, the figures quoted are not considered reliable at present.

<sup>37</sup> Campbell MacPherson (2011) Waste to Energy for Auckland Discussion Paper. Prepared for Auckland Council

<sup>38</sup> <https://www.transpower.co.nz/system-operator/security-supply/wholesale-pricing>. A wholesale price of \$0.05 - \$0.06/kwh is assumed

<sup>39</sup> The cost modelling exercise was conducted using Eunomia’s proprietary collection cost model ‘Hermes’. Further explanation of the cost modelling is provided in Appendix A.4.4.6

indicated that with the current cost of landfill (assumed to be an average of \$75 per tonne), high diversion collection systems are more expensive than the status quo systems. High diversion is therefore unlikely until the levy reaches around \$80 - \$90 per tonne at which point it starts to become cheaper to collect food waste, and dry recyclables from more challenging areas, for recovery than to dispose of it. This rate represents a threshold level where more significant diversion would occur, which is a different concept from elasticities of demand which represent a smoother relationship between price and demand.



## 3.0 Options for Changes to the Levy

### 3.1 Expectations based on International Experience

As discussed in Appendix A.1.0, the landfill levy is being used as an economic instrument for stimulating waste reduction, and increase reuse and recycling in many European countries as well as in Australia. A properly designed landfill levy could be used to achieve and/or create incentives for the following:

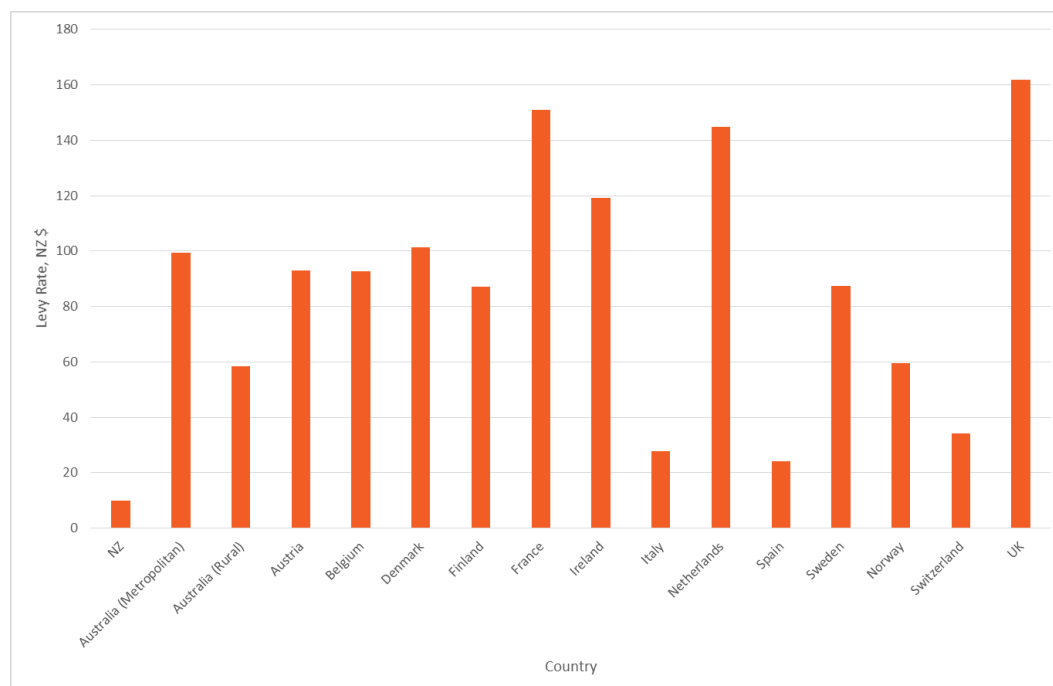
- Waste disposal to landfills is minimised to the extent possible;
- Resources are recycled bringing them back in to the circular economy, waste is minimised;
- The waste sector provides additional jobs; and
- Economic growth and gross value added (GVA) is maximised.

However, it is important to recognise the potential perverse effect of the levy (see Appendix A.1.7), and ensure that:

- Waste is not diverted to EfW instead of recycling;
- Waste is managed appropriately in the formal sector;
- Unregulated disposal of waste is minimised; and
- A proper monitoring and enforcement system is in place.

Different countries adopt different levy rates, structures, and supporting policies to when designing and implementing a landfill levy. Figure 3-1 depicts the current levy rates for different countries (in NZ \$). It can be observed that most countries have a significantly higher rate than NZ, with UK having the highest levy rate of \$162.

**Figure 3-1: Levy Rates for Active Waste in Different Countries, NZ \$**



Review of levy structures in other countries shows the following main variants:

- High rate for active waste and low rate for inert waste;
- High rate for hazardous waste and low rate for non-hazardous waste; and
- High rate for metropolitan areas and low rate for rural areas, as well as other regional variations in the levy rate.

Setting different rates for active and inert waste is most common in the EU countries, where the levy rate for inert wastes are set at a much lower level than the rate for active wastes. This is because the environmental damages from landfilling inert waste are much lower than landfilling active wastes. Moreover the large quantities and low disposal costs result in significant marginal changes, even at low levy rates.

Some of the countries in EU also implement different rates for hazardous wastes and non-hazardous wastes. However, it might not be ideal to regulate hazardous wastes using economic incentives as this can lead to illegal disposal with major environmental consequences.

Setting different rates for metropolitan areas and rural areas, and/or other regional variations in rates are usually observed in large countries, such as Australia, where the transport cost is usually higher than the rate differentials due to lengthy distances. However, this type of variation, especially for small countries, will lead to 'waste tourism' if the rate differentials are higher than the costs of transporting waste from high rate areas to low rate areas, limiting the overall impact of the tax.

### 3.2 Possible Changes under NZ Legislation

The following changes are possible under Section 41 of the WMA:

- Changes to the class of facilities that the Levy is applied to
- The ability to apply the Levy to different classes of waste
- Changes to the rate of the Levy and their application to different disposal facilities, classes of disposal facility or types of waste.

It should be noted that under Section 30 the WMA 'ring-fences' income from the Levy so that it must be used for waste minimisation. There is no provision for income from the Levy to go into the consolidated fund or to be used to offset other forms of government revenue.

### 3.3 Modelling the Options for Changes to the NZ Levy

Reflecting on the above discussion, our proposed waste disposal levy structure for NZ incorporates two distinct levy rates based on type of waste, rather than destination landfill class. These are:

- **Standard rate** – any waste not specified below; and
- **Lower rate** – this includes inert manufactured materials (concrete, brick, tiles) and natural materials soils, clays, gravel and rocks. Material that is not chemically

inert but is an aggregate-type material, e.g slag from the steel industry and ash, is also included here. This category effectively includes all waste categorised as rubble. This category excludes material from the VENM wastes from mining activities, for which it is assumed that no levy will be applied.

It should be noted that the modelled levy rate differential based on materials disposed to landfill will have some additional monitoring and enforcement cost, which can be funded by the increase in levy revenue from higher levy rates. Detailed discussion on this can be found on Section 5.0.

To capture the impacts of changes in the levy rate by different magnitudes, we have modelled 4 scenarios with the aforementioned levy structure covering all 4 classes of landfills. These are:

- **Scenario 1: Low improvement scenario** – The levy is set at a low rate with an aim to generate enough revenue for supporting enhanced inspection and enforcement requirements under the new levy structure;
- **Scenario 2: Enhanced recycling scenario** – The levy is set in the region where the business case to invest in quality recycling services is made, including biowaste collections;
- **Scenario 3: Minimal waste disposal scenario** – The levy is set to a very high rate which drives majority of waste from landfill, but also stimulates diversion to EfW; and
- **Scenario 4: Maximum recycling scenario** – The levy rate is same as scenario 3 with an additional levy of \$40 per tonne on EfW, which is driving a high level of recycling performance.

The potential impacts under each scenario on waste disposal, recycling, employment, GVA, etc. are discussed in Section 4.0.

## 4.0 Impacts from Changes to the Levy

### 4.1 Modelling the Impacts

To evaluate the impacts of potential changes to the levy, we have developed a New Zealand specific landfill levy model in Excel® from first principles. A detailed description of the model can be found in Appendix A.2.0. The primary aim of the model was to ascertain the effectiveness of any of the proposed landfill levy rises against a baseline scenario in which the levy remains at its current rate. For this, we have modelled 4 scenarios, which include different rates of the levy. These are presented in Table 4-1. Further details on various assumptions related to the modelled scenarios are discussed in Appendix A.4.0.

It should be noted that the changes modelled are at the national level only. It is recognised that there may be differences at the local and regional level which may be different in magnitude and even direction of impact from what is modelled here.<sup>40</sup>

However, while assuming an 'average' national rate as we have done will almost certainly underestimate the impact in some areas and overestimate it in others, it is outside the scope of this report to model the local and regional impacts.

The structure and the levy rates were rationalised in the previous section.

**Table 4-1: Modelled Scenarios**

#	Scenario	Maximum levy rate (\$ per tonne)		Incineration Levy
		Standard	Inert	
1	Low improvement scenario	\$20	\$2	-
2	Enhanced recycling scenario	\$90	\$10	-
3	Minimal waste disposal scenario	\$140	\$15	-
4	Maximum recycling scenario	\$140	\$15	\$40

Changes in levy rate under each scenario were modelled using a tax escalator over a 7 year period because it takes around 5-8 years to make infrastructural changes to the collection system to support increased recycling rates as a result of the levy increase. For each scenario, the Levy increases at a slow rate for the first three years, and then increases at a faster rate for the next four years to the proposed level to make the

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<sup>40</sup> Refer to Appendix A.4.4.2 for further detail on gates fees and assumed ranges.

adjustment easier for the industry. The Levy rates for each year based on this escalator structure are provided in Table 4-2.

**Table 4-2: Modelled Levy Rates (\$ per tonne)**

#	Tax band	2017 <sup>1</sup>	2018	2019	2020	2021	2022	2023	2024 <sup>2</sup>
<b>1</b>	Standard	\$10	\$11.67	\$13.33	\$15.00	\$16.25	\$17.50	\$18.75	\$20.00
	Inert	\$0	\$0.33	\$0.67	\$1.00	\$1.25	\$1.50	\$1.75	\$2.00
<b>2</b>	Standard	\$10	\$13.33	\$16.67	\$20.00	\$37.50	\$55.00	\$72.50	\$90.00
	Inert	\$0	\$0.67	\$1.33	\$2.00	\$4.00	\$6.00	\$8.00	\$10.00
<b>3 &amp; 4</b>	Standard	\$10	\$15.42	\$20.83	\$26.25	\$54.69	\$83.13	\$111.56	\$140.00
	Inert	\$0	\$1.00	\$2.00	\$3.00	\$6.00	\$9.00	\$12.00	\$15.00
<b>Notes:</b> 1. Current levy rates 2. This rate is applied for all future years									

The model estimates the following impacts of changes to the Levy under different scenarios:

- Change in the waste flows;
- Change in revenue from the landfill levy;
- Change in employment (i.e. the number of jobs associated with waste management activities);
- Change in Gross Value Added (GVA); and
- Change in material revenue from increased recovery.

These are presented and discussed in the following sections. Impacts are presented by both a single year and over time (from 2015 to 2030). 2025 was chosen as the single year, as this represents a future year by which time the changes in the Levy considered under each scenario could realistically be expected to have taken effect, assuming they are announced in the near future. In addition, an estimated timeline of the impacts based on the modelled rate of changes in the levy is presented for each of the above impacts.

## 4.2 Change in Waste Flows

The change in waste flows are shown in Figure 4-1. Under scenario 1 the change is significantly smaller than under the other scenarios, due to the low rate of the Levy and the less cost effective alternatives available at this rate. Scenario 3 shows some diversion to EfW as the levy tipping point for this treatment type to become cost effective is

considered by the project team to be around \$100 per tonne. So when the levy is \$140 per tonne some diversion to EfW could be expected. Under scenario 4 a levy of \$40 per tonne on incineration is also included, which is assumed to price out EfW. Some of this waste will now be diverted to recycling under this scenario, as recycling is more cost-effective option for these materials with increasing cost of incineration. Thus, the highest recycling rate will be achieved under scenario 4.

**Figure 4-1: Change in Waste Flows, thousand tonnes (2025)**

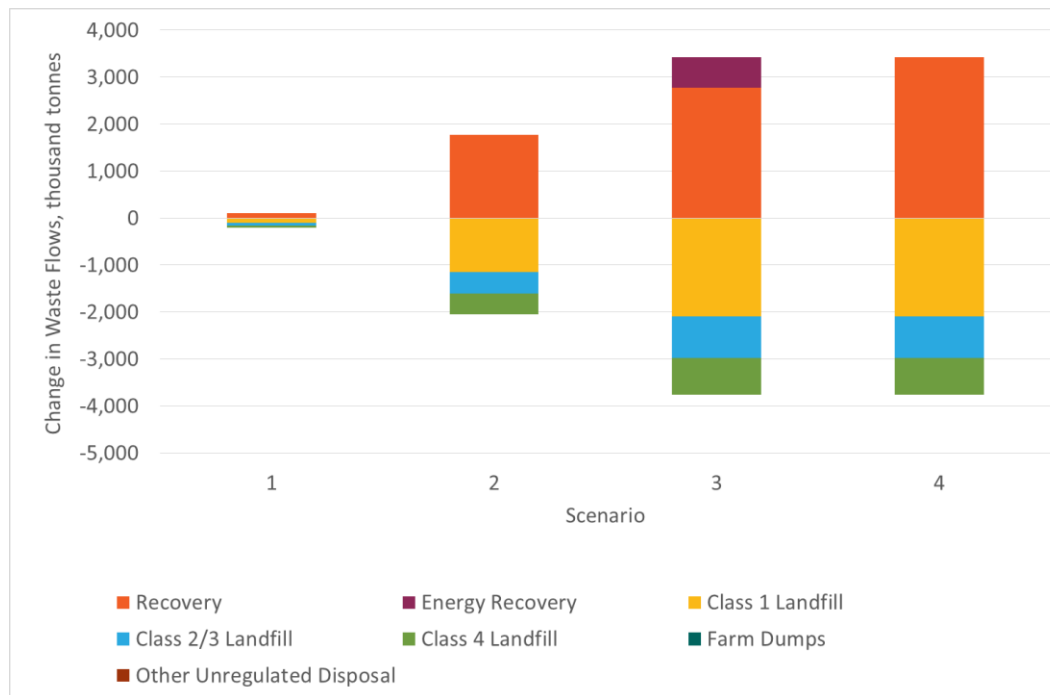


Figure 4-2 shows the changes in recovery rates under the modelled scenarios along with the baseline recovery rate between 2015 and 2030.<sup>41</sup> The baseline rate is assumed to be constant at 35% throughout the entire period. The highest recovery rate of 60% is achieved under scenario 4.

<sup>41</sup> Recovery rates have been calculated after excluding the VENM wastes from the total waste generation, as the VENM waste cannot not be recycled due to their composition, and therefor skew the rates.

**Figure 4-2: Recovery Rates over Time (2015 – 2030)**

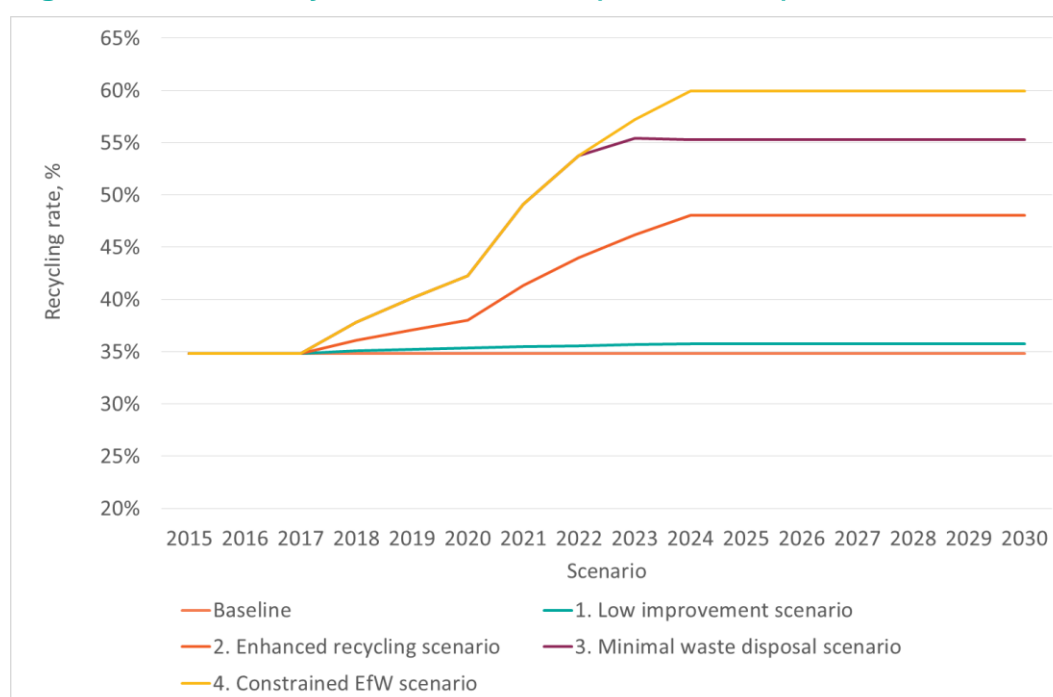


Table 4-3 shows the recycling rates by activity source for the four scenarios. The highest rates are for ICI and residential, as these are already at higher levels. The most significant relative changes are for waste streams with higher proportions of standard rate wastes, as the increase in price for these waste streams are much more significant than for inert wastes.

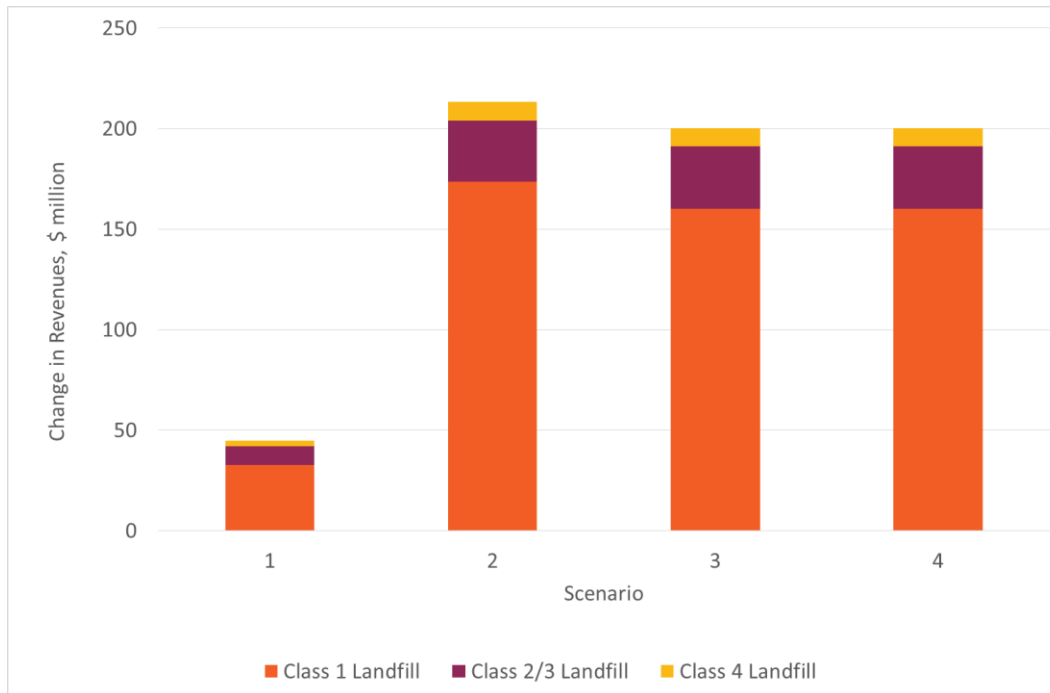
**Table 4-3: Recycling Rate by Activity Source in 2025, %**

Activity Source	1	2	3	4
Domestic Kerbside	26%	48%	56%	69%
Residential	56%	69%	73%	80%
ICI	63%	73%	77%	82%
Landscape	36%	48%	56%	61%
C&D	30%	44%	55%	57%
Special	4%	28%	43%	50%
Rural	2%	4%	5%	6%

### 4.3 Change in Revenue from the Levy

Additional revenue is expected to be obtained from increasing the levy, which is depicted in Figure 4-3. It can be observed that the significant increase in revenue occurs when switching from scenario 1 to scenario 2 (from about \$50 million to over \$200 million), due to the large change in the levy rate (from \$20 to \$90 for the mixed active waste and \$2 - \$10 for the inert waste). Also scenario 3 and scenario 4 shows a decrease in levy revenue from scenario 2, which suggests that impact of reduction in waste landfilled on levy revenue outweighs the impact of increase in the levy rate.

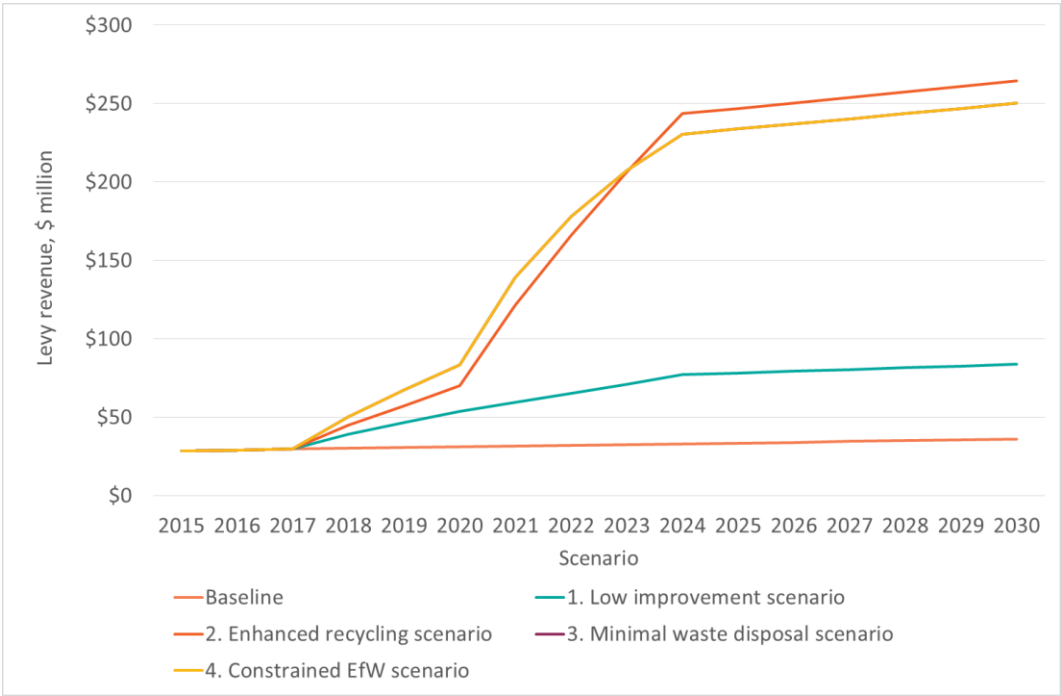
**Figure 4-3: Change in Revenue, \$ million (2025)**



The change in levy revenue under baseline and the modelled scenarios from 2015 to 2030 are depicted in Figure 4-3. It can be observed that the increase in revenue is moderate under all scenarios for the first three years, which is consistent with the levy escalator structure. After that the levy revenues increase rapidly for scenario 2, scenario 3 and scenario 4.



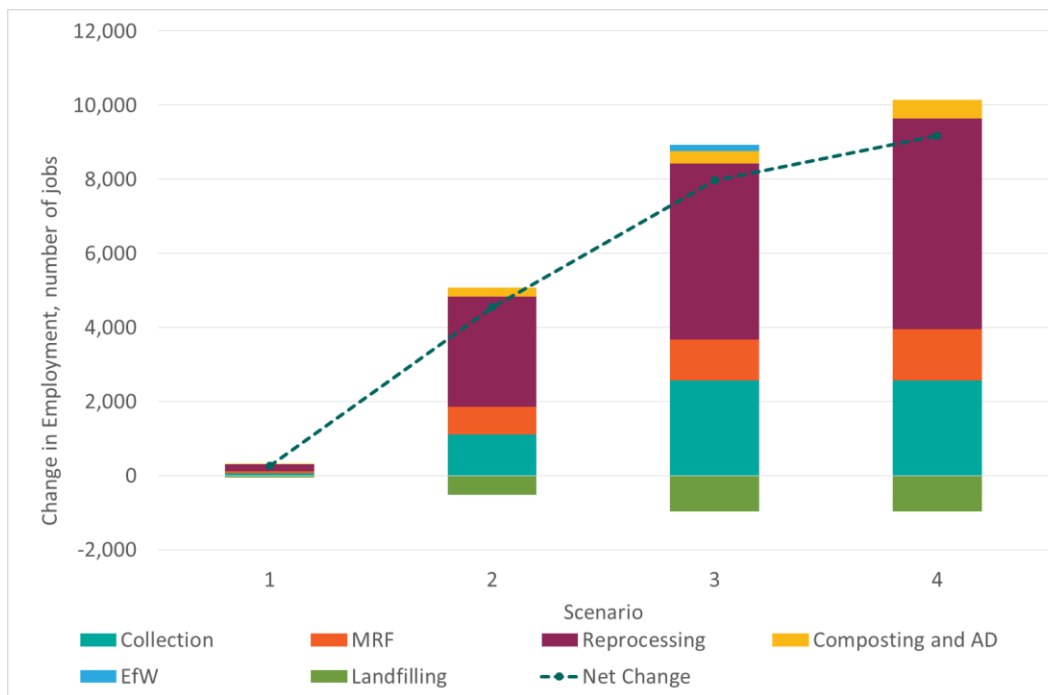
Figure 4-4: Annual Levy Revenue over Time (2015 – 2030), \$ million



#### 4.4 Change in Employment

The total change in employment under each scenario is shown in Figure 4-5. Significant numbers of jobs are created once levy rates drive significant levels of change, most of which can be attributed to higher collection and reprocessing. Employment could increase by about 9,000 jobs per annum under Scenario 4. It should be noted that the reported figures include direct, indirect and induced effects on employment, estimated using an employment multiplier. Further details on the multipliers used are provided in Appendix A.5.0.

**Figure 4-5: Change in Employment, number of jobs (2025)**



Employment could increase further if increases in the amount of material collected for recycling stimulated the development of national reprocessing infrastructure (where materials are currently being exported), for example, for plastics, metals and textiles. Figure 4-6 shows the additional employment that could have been generated by reprocessing all materials in NZ.

Figure 4-6: Lost Employment from Export, number of jobs (2025)

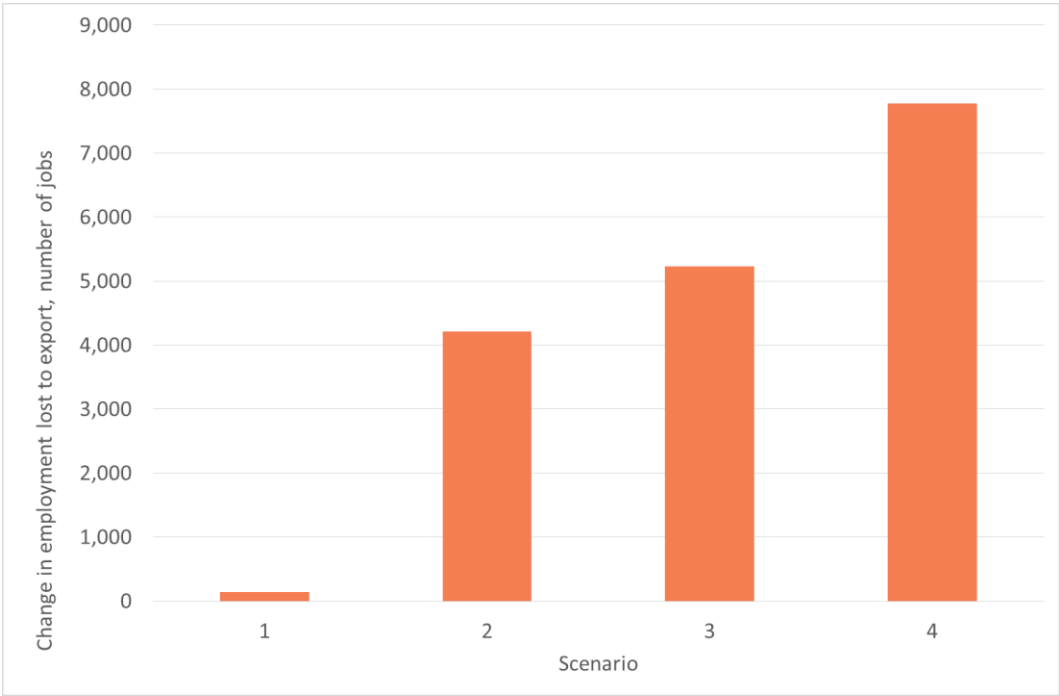
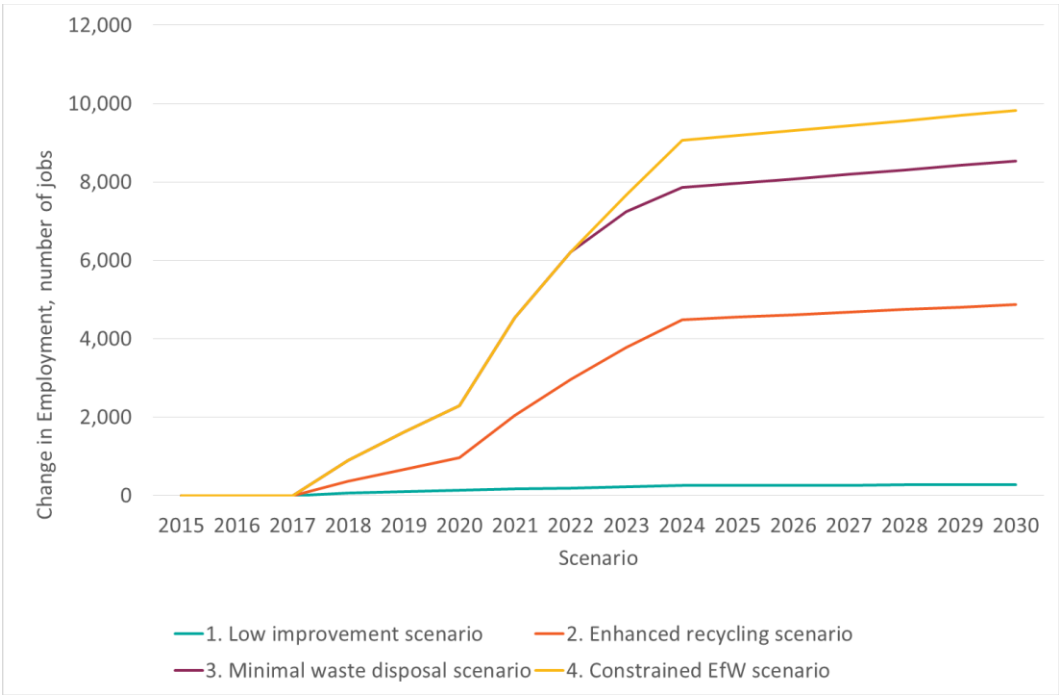


Figure 4-7 shows the change in employment over time under each modelled scenario. Highest growth in employment can be observed under scenario 3 and scenario 4, while the growth of employment under scenario 1 is close to zero.

Figure 4-7: Change in Employment over Time (2015 – 2030), number of jobs



## 4.5 Change in Gross Value Added (GVA)

Figure 4-8 shows the increase in gross value added (direct, indirect and induced combined) under all 4 scenarios.<sup>42</sup> The most significant contributing factor for the increase in GVA under all scenarios is waste prevention, which is closely followed by contribution from reprocessing (under scenarios 2, 3 and 4). When switching from scenario 3 to scenario 4, lost GVA from eliminating incineration is offset by increase in GVA from sorting, reprocessing and organics treatment.

**Figure 4-8: Change in GVA, \$ million (2025)**

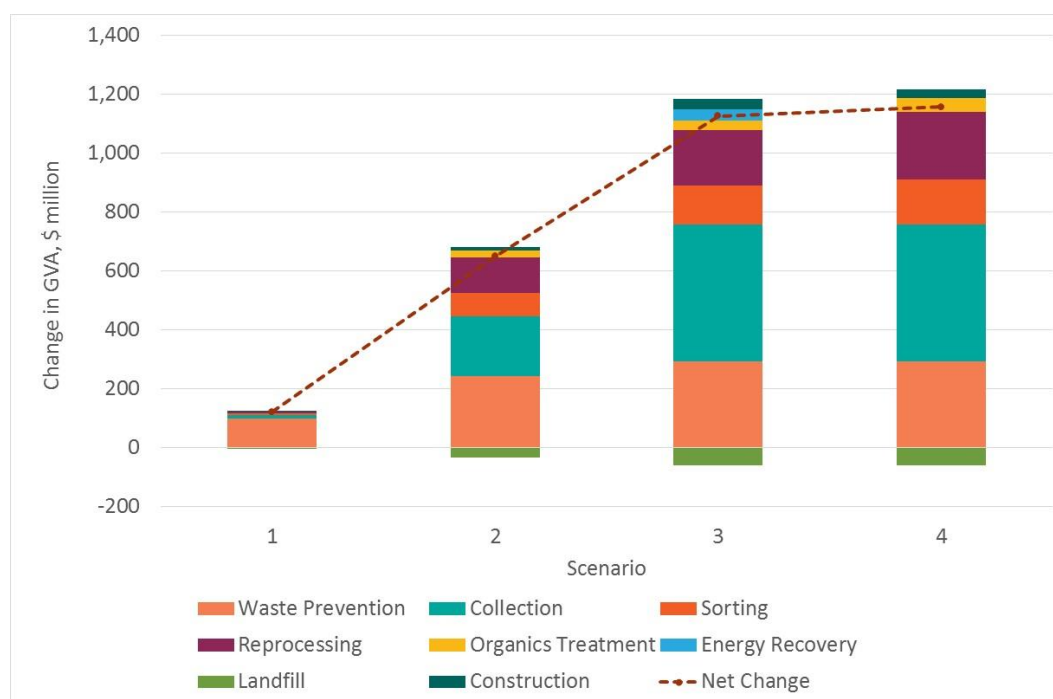
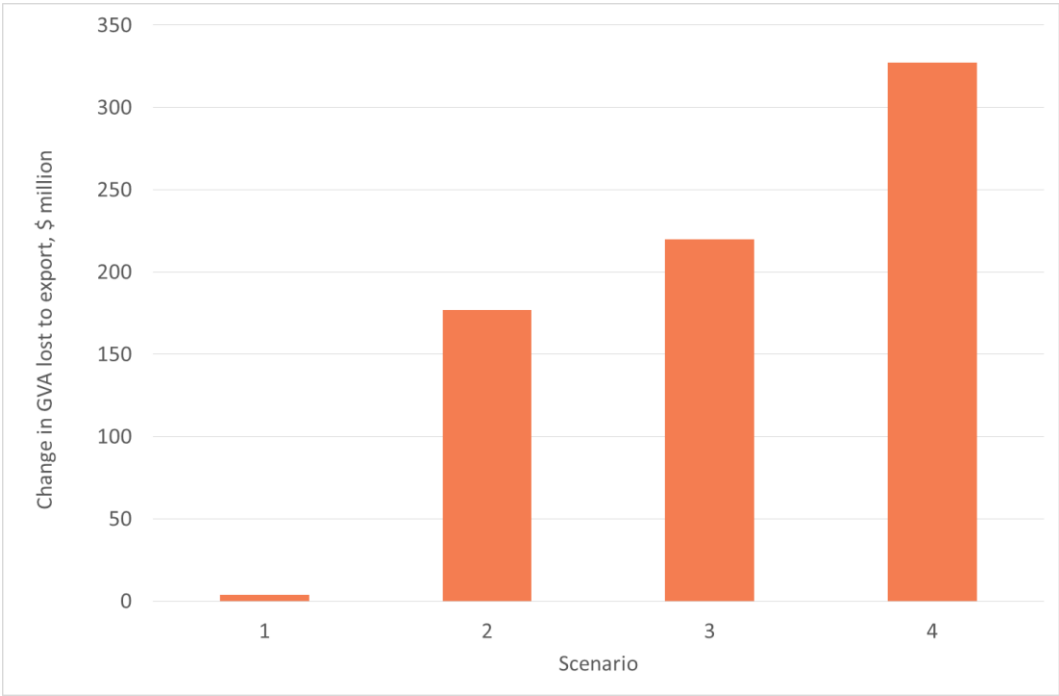


Figure 4-9 depicts the additional GVA (direct, indirect and induced combined) that could be generated from domestic reprocessing of materials that are currently being exported. It can be observed that NZ GVA could be increased by over \$350 million under scenario 4 by reprocessing all material in NZ.

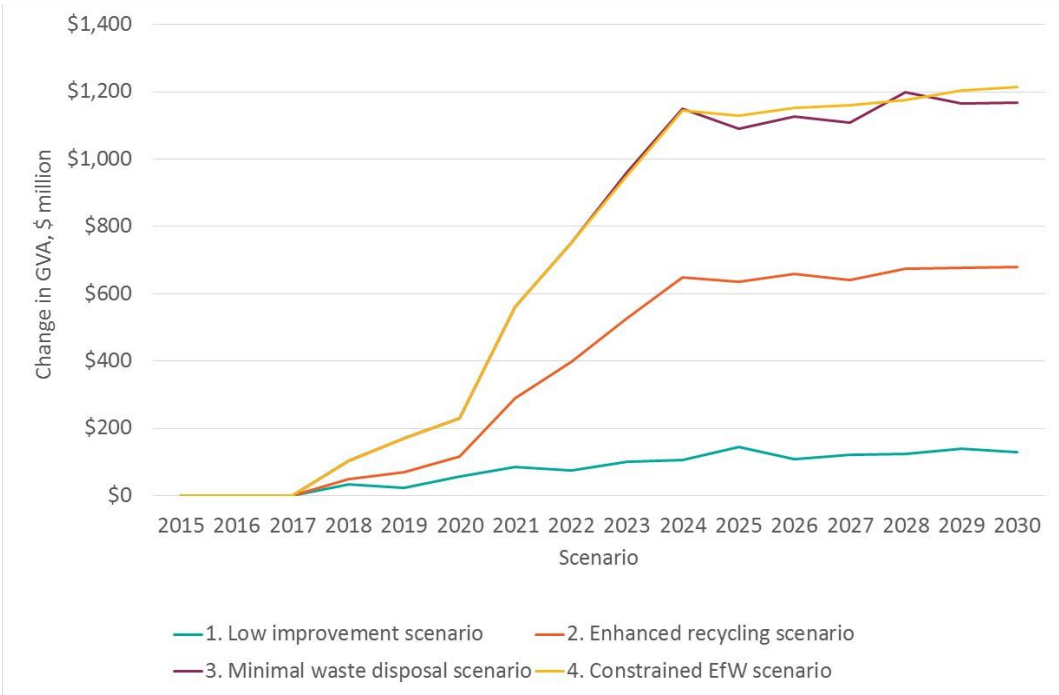
<sup>42</sup> Contribution to GVA from construction of sorting, treatment and disposal facilities is shown as average contribution to GVA because GVA from construction can fluctuate from one year to the next depending upon whether a facility was needed to be constructed.

Figure 4-9: GVA Lost from Export, \$ million (2025)



The change in GVA over time under different scenarios are presented in Figure 4-10. The observed cyclical fluctuations in GVA figures are caused by fluctuations in GVA associated with the modelled construction of sorting, treatment and disposal facilities.

Figure 4-10: Change in GVA over Time (2015 – 2030), \$ million



## 4.6 Change in Material Revenues

Increasing the waste disposal levy will result in higher revenues from sale of recyclable materials. This is presented in Figure 4-11. It can be observed that highest revenue will be generated from textile, followed by plastics and timber.

**Figure 4-11: Change in Material Revenues, \$ million (2025)**

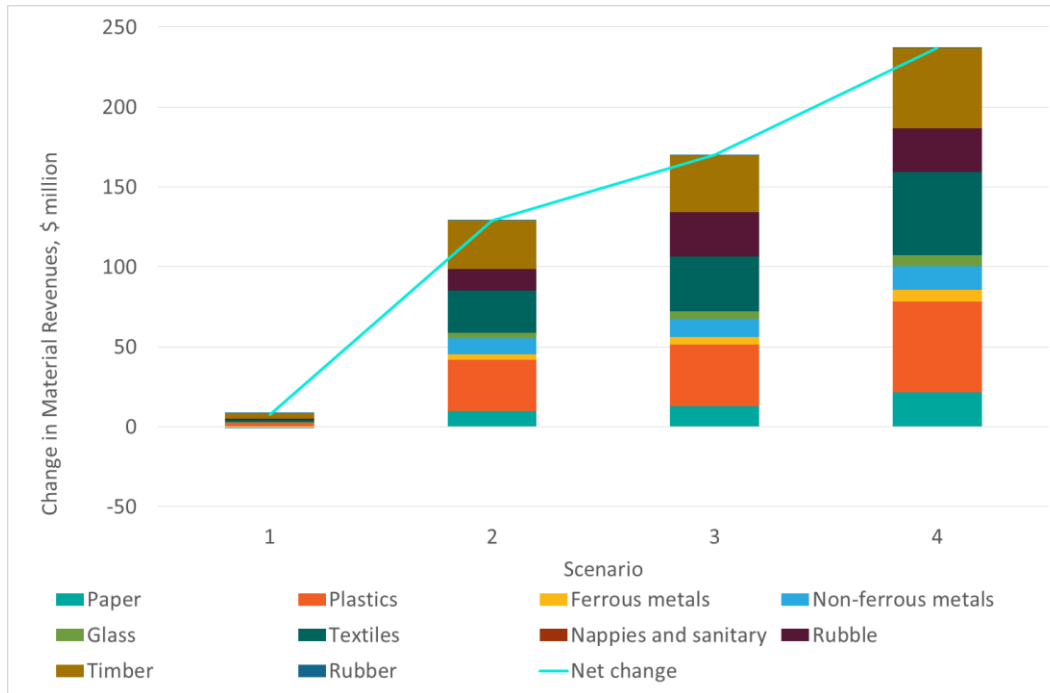
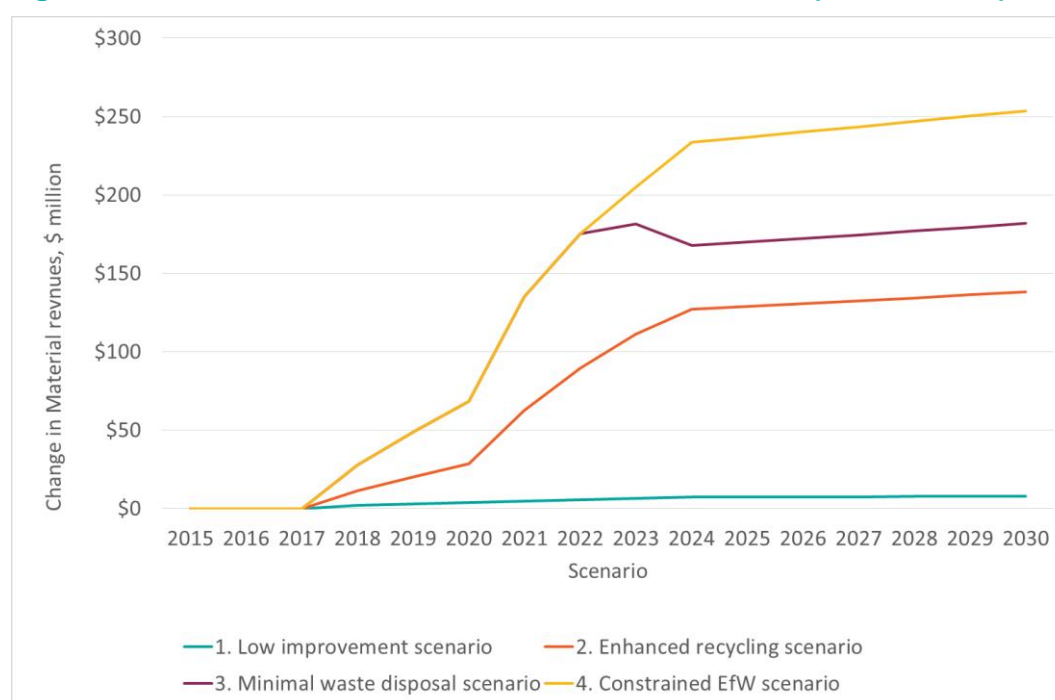


Figure 4-12 depicts the change in material revenues under different scenarios from 2015 to 2030. As expected, highest increase in material revenues are observed in scenario 4 which has the highest recycling rate. It can also be observed that the material revenues under scenario 3 diverges away from scenario 4 in 2022 when cost of disposal is becomes high enough to make incineration economically viable.

**Figure 4-12: Additional Material Revenues over Time (2015 – 2030), \$ million**



## 4.7 Costs of Achieving the Benefits

The main benefits from increasing the levy, in terms of jobs and GVA, have been outlined above. However, there will be some additional costs to the economy for achieving these benefits. For example, there will be a cost to councils and businesses for investing in and operating the recycling infrastructure which would be needed to ensure waste was actually diverted from landfill. In our modelling of GVA we have assumed that future costs on alternative services would be equal to the avoided cost of disposal. The additional cost is thus calculated in this way i.e. waste diverted x avoided disposal cost.

In additional, when considering how taxes affect the economic operators, there is also a loss to be taken into account called the 'dead weight loss'. This represents a loss to producer and consumer surplus which cannot be recovered. Producers would be expected to pass this onto the consumers, in this instance those disposing of waste at landfills, for example through increased gate fees. Thus the loss would be felt by those waste producers who are still disposing of waste in landfill. The dead weight loss can be approximated by the following:

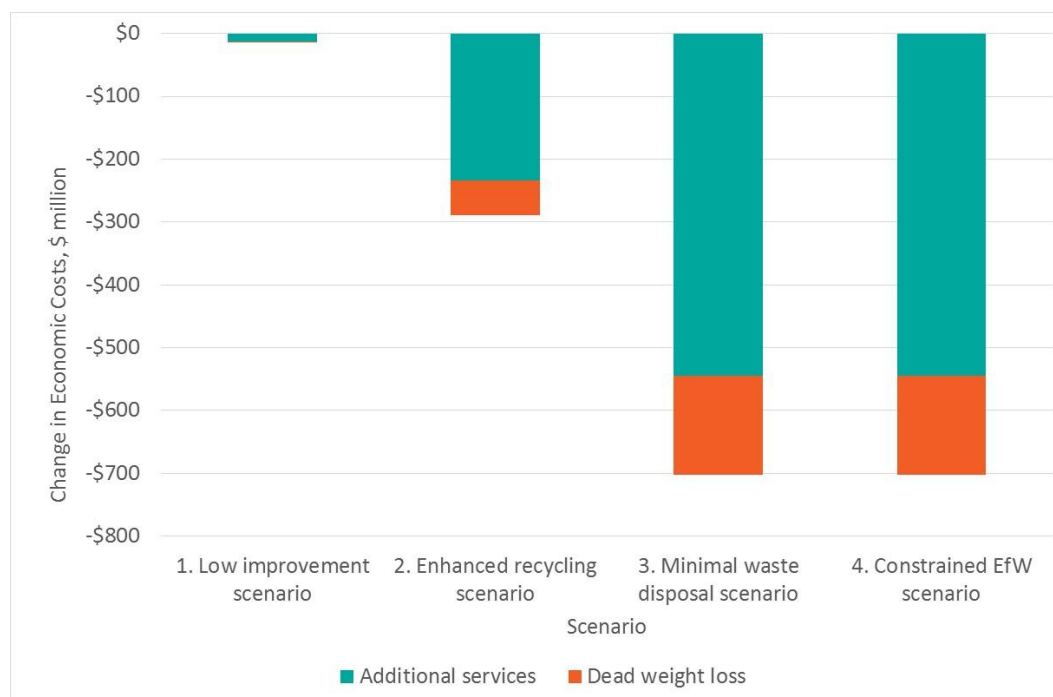
$$= \text{Change in tax rate} \times \text{change in quantity of landfill demanded} / 2$$

Summing up both these elements will give an approximate cost to the economy for increasing the levy. There would be some additional costs to businesses for administering the levy, but many are already paying so we assume the cost for additional tax payers is not significant and is therefore not estimated in the calculations. The costs for regulation are being taken out of the levy revenue so the net position is zero (i.e. this is simply a transfer from waste producers to the regulator), and are not included in these

figures. The additional cost of regulation is estimated in Section 5.2.2.2 below, for illustrative purposes.

The overall additional costs in 2025 are shown in Figure 4-13. These costs are only just over half of the value of the economic benefits that would be achieved, so the benefits appear quite considerably higher than the costs.

**Figure 4-13: Additional Economic Costs, \$ million (2025)**



## 4.8 Additional Sensitivities Modelled

In addition to the 4 scenarios discussed above, we have modelled two additional sensitivities to analyse the potential for waste diversion from and to farm dumps and to illegal or unregulated disposal (see Appendix A.4.3 for a detailed discussion), these are:

- 1) A 'low regulation' scenario in which the increase in landfill levy leads to the diversion of waste from landfill to farm dumps. This scenario also models some diversion to unregulated disposal destinations; and
- 2) A 'high enforcement and services' scenario in which a combination of increased collection services, education, and enforcement leads to a reduction in waste sent to farm dumps and diversion to landfill and recycling.

The levy structure used for modelling the above scenarios are same as scenario 2 (\$90 for the mixed active waste and \$10 for the inert waste). Table 4-4 presents the results for these two scenarios, along with Scenario 2 for comparison. It can be observed that under the low regulation scenario, waste is diverted from landfill to unregulated disposal and farm dumps. For the high enforcement and services scenario, on the other hand, waste is diverted to landfill from farm dumps.



Consequently, it is clear that if a proper regulation and enforcement regime is not implemented then jobs and GVA will be lower. Moreover, extending the regime to cover farm dumps, and therefore ensure all waste is properly managed within the formal waste management system, will lead to further jobs and GVA.

**Table 4-4: Impacts under Additional Sensitivities Modelled (2025)**

Impact	Scenario 2	Low Regulation Scenario	High Enforcement and Services Scenario
Recycling Rate <sup>1</sup>	48.0%	45.8%	50.3%
Landfilled Waste <sup>1</sup>	42.9%	43.4%	42.9%
Unregulated Disposal <sup>1</sup>	0.0%	1.8%	0.0%
Farm Dumps <sup>1</sup>	9.0%	9.1%	6.8%
Change in Levy Revenue (\$ million)	174	174	181
Change in Employment (number of jobs)	4,549	3,917	4,901
Change in GVA (\$ million)	650	610	683
Change in Material Revenues (\$ million)	129	105	151
<b>Notes:</b> 1. Calculated after excluding the VENM wastes from the total waste generation			

## 4.9 Environmental and Societal Impacts

Reduction in waste sent to landfill due to increase in the waste disposal levy will also generate the following environmental and societal benefits:

- Reduced GHG emissions – mainly achieved through waste prevention and higher re-use and recycling. In addition, lower amounts of waste landfilled would result in lower emissions of methane, which is a potent greenhouse gas;
- Reduction in leachate levels – resulting from reduced landfilling of organic materials, which generate leachate when soluble components of the waste stream are transported out of mixed waste through water; and
- Reduced disamenity impacts – primarily for those situated in the vicinity of the landfill site, where impacts mainly include reduction in dust, odour and vermin.

However, modelling these external impacts of landfilling were out of the scope of this research, and hence not quantified.

## 4.10 Preferred Levy Scenario

The outcomes of the modelling indicate that the greatest level of benefit is likely to accrue under the scenario of \$140 per tonne for 'active' waste, \$15 per tonne for 'inert' waste and with an 'incineration' rate of \$40 per tonne. Under this scenario there is the highest level of diversion from landfill, the highest number of jobs created, the largest increase in GVA, and the biggest increase in material revenues. The only metric that does not come out the best in this scenario is levy revenue, as total revenue starts to decline because of the decrease in waste to disposal facilities. However because, under the WMA, all levy revenue has to be spent on promoting or achieving waste minimisation, it could be argued that with lower quantities to disposal the purpose of the levy revenue has already been achieved.

Taking account of potential costs to the economy of achieving the benefits moderates the expected economic benefits somewhat but these are still significant, and the ranking of the scenarios is unaffected. It is recognised however that, as costs and benefits will not accrue to the same organisations, a more comprehensive assessment would be required to better understand the impacts.

On the basis of the above, a levy structure and levy rates similar to what has been modelled in this scenario are likely to deliver the best outcomes and should be considered to be the preferred option. It should be noted however that as has been modelled, and as is discussed further in the sections that follow, the targeted rates are ones that will need to be progressed towards over time, and a levy set at these levels will require the right administrative structures and careful implementation if it is to deliver the outcomes suggested by the modelling.

## 5.0 Implementing Changes to the Levy

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### 5.1 Improved Regulatory Regime

One of the key concerns with implementing changes to the levy regime, in particular where this will lead to increased costs of disposal is that there will be attempts at levy avoidance, including the use of unregulated and illegal disposal. For potential changes to be effective therefore, a well designed and well implement monitoring and enforcement regime will be essential.

It is acknowledged that significant work would need to be done to devise a comprehensive, consistent national approach in New Zealand. Regulation of fill sites takes place at the regional level through regional/unitary plans, with some local variation through land use provisions in district plans.

At present there is no national body with the duty to undertake this type of monitoring and enforcement. Aligning the regional approaches – at least to a level that will enable consistent application of the levy and avoid cross boundary migration – will be important.

Elements of a consistent approach could include the application of consistent definitions for disposal facilities, amendment of regional permitted activity rules so that that there is consistency is what facilities require consenting, and then requiring all consented Class 1-4 disposal facilities to be subject to the levy.

An outline of key elements for an improved regulatory regime is provided below.

#### 5.1.1 Consistent Definitions

Although not strictly necessary to enable the wider application of a levy that targets ‘active’ and ‘inert’ waste regardless of fill type, use of consistent definitions would make it easier to identify sites and apply appropriate levels of monitoring. The typology for fill sites could be based for example on the WasteMINZ Land Disposal Guidelines and MfE Hazardous Waste Guidelines (Ideally this could include development of a National Environmental Standard for disposal to land).

### 5.1.2 Amend Permitted Activity Rules

Cleanfilling is a permitted activity<sup>43</sup> in some parts of the country and is commonly permitted below certain threshold limits (farm dumps are similarly usually a permitted activity). Where it is a permitted activity this means that such activity is not 'visible' to regulatory agencies, and so it would be difficult if not impossible to bring sites that operate as permitted activities into a levy regime. This is something that would need to be addressed on a regional basis. Bearing in mind that our suggested changes would exempt VENM from the levy this would only affect those sites that accept what we have classed as 'inert waste'. It might be expected that by requiring cleanfill sites that accept 'inert' waste to comply with a higher standard of regulation and reporting, and to pay a levy on this material may lead to such sites no longer accepting this material.

### 5.1.3 Register of Sites

It will be necessary to create a register of all facilities that would be subject to the levy (i.e. all facilities that accept material other than VENM). The register would need to compile information on the ownership, location of facilities, their current status, materials accepted, estimates of capacity, and key features such as the presence of staff, locked gates, weighbridges, CCTV etc. It is understood that the Ministry has commissioned work that would provide a useful starting point for this element. The stocktake information would form the basis for planning of monitoring and enforcement approaches, as well as estimates of potential levy income. It is expected that consent information could provide much of this information but not all of it, and that the quality of information available will be inconsistent.

### 5.1.4 Accounting for Unmonitored Sites

It is recognised that a large number of fill sites are not staffed and do not have weighbridges. Monitoring of quantities deposited at these sites is a potential challenge. Appropriate methodologies will therefore have to be developed to allow for accurate accounting of material dumped at these sites. For example, where sites are consented to accept a certain quantity of material, this could be pro-rated over the consent life and levied accordingly. If the site is closed before the full volume is reached, a volumetric survey could be conducted to estimate the fill level and payments adjusted accordingly. Unstaffed sites could be subject to spot checks to further ensure conditions are being complied with and the appropriate levy rate is being paid.

### 5.1.5 Appropriate Resourcing

The key for any monitoring and enforcement regime will be to ensure that it is appropriately resourced. As noted in 2.2.4, and discussed further in 5.2.2.1 below there

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<sup>43</sup> It is worth noting that Councils can recover the cost of monitoring consented activities from the consent holder. There is no mechanism to recover the cost of monitoring permitted activities. In theory enforcement activity is self funding (if prosecution is successful).

may be potential to apply levy revenue to monitoring and enforcement activity. On the face of it, it would be sensible for regional councils to be tasked with the additional monitoring and enforcement (and resourced accordingly), as they are currently responsible for overseeing these sites from a RMA perspective, and it is likely there would be substantial overlap between these requirements and those from a levy monitoring and enforcement perspective.

Regional councils resourced from levy revenue to undertake enhanced monitoring of fill sites, farm dumps, and illegal disposal.

### **5.1.6 Development of Enforcement Protocols**

An appropriate set of monitoring and enforcement protocols will need to be established and applied consistently. It is outside the scope of this report to develop such protocols. However they would need to ensure that monitoring and enforcement activity was appropriately targeted to avoid unnecessary costs of compliance while ensuring those attempting to avoid compliance are identified and appropriate enforcement action is taken. A risk based approach where those that repeatedly fail inspections are inspected more is one such approach. In addition there is an argument that those that repeatedly fail should pay the monitoring and inspection costs to take the burden off the tax payer.

A key part of an effective process will be effective monitoring of wastes in the short term, as miss-classification of wastes to the lower rate band is likely to be a major issue. The regulatory system should include spot check inspection of loads, with offenders fined and closely monitored thereafter.

### **5.1.7 Illegal Dumping Strategy**

The implementation of the levy could be supported by the development and implementation of an illegal dumping strategy similar to that in place in New South Wales.<sup>44</sup> The strategy has a number of elements designed to effectively reduce illegal dumping:

- Building an evidence base
- Stakeholder engagement and capacity building
- Education and awareness
- Prevention, infrastructure and clean-up
- Regulation and enforcement
- Evaluation and monitoring

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<sup>44</sup> NSW Govt. NSW Illegal Dumping Strategy 2017–20

## 5.2 Efficient Use of Levy Funds

### 5.2.1 Constraints on Use of Levy Funds in the WMA

There are a number of constraints in the WMA on how levy funds can be applied. These are:

- Territorial Authorities get 50% of gross revenue, which must be spent on waste minimisation
- The government is able to recover the costs of administration
- The remainder must be distributed to projects that promote or achieve waste minimisation. There is significant flexibility in the criteria that may be applied to approving these projects.

Importantly waste levy revenue cannot be spent on waste treatment or disposal related facilities and activities, and there is no provision for revenue to be directed into the consolidated fund.

### 5.2.2 Potential Uses of Levy Revenue

There is the potential to use levy funds to address issues such as illegal or unregulated disposal that could otherwise undermine the effectiveness of the levy. This could include directing funds towards monitoring and enforcement and by prioritising spending on services and infrastructure in areas where these are lacking (such as rural areas). The review of the South Australian Waste Levy for example noted:

*As a general principle, the first priority for any additional levy revenues should be towards programs that will address any unintended consequences of increasing the levy, such as any increased prevalence of illegal dumping, preventing the incentive for waste shifting or stockpiling, or loss of economic activity to other jurisdictions.*<sup>45</sup>

#### 5.2.2.1 Monitoring and Enforcement

There is not specific legislative provision in the WMA for spending of levy revenue on monitoring and enforcement, but there is provision under Section 30 (c)(i) for revenue to be spent on administering the levy<sup>46</sup>.

The current administration of the levy includes monitoring and auditing of levy revenues and how they are calculated. Our interpretation is that, if the levy were to be extended to all disposal to land, a part of the administration of the levy should be ensuring that material is going to the correct type of facility and is being levied at the correct rate (or exempted from the levy).

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<sup>45</sup> Deloitte Access Economics (2015) *Economic effects of the South Australian solid waste levy* Final Report

<sup>46</sup> As 'administering' is not defined in the legislation the understanding of the term is based on its common usage. Definitions of administer include: 'to control the operation or arrangement of something' (Cambridge English Dictionary); to direct or control, to put into execution; dispense, to manage or distribute (Collins English Dictionary).

Further provision for applying levy revenue to monitoring and enforcement activity could be made through Section 38 which sets the criteria for projects that promote or achieve waste minimisation. It may be possible to demonstrate that monitoring and enforcement is an essential tool to promote the correct application of the levy and hence to promote waste minimisation.

A determination would have to be made regarding the ability to direct levy revenue towards monitoring and enforcement under current legislation.

In Appendix A.6.0 we make an estimate of the likely level of funding required to manage illegal activity that might be stimulated by the increased levy, for example fly tipping, and monitoring landfills and farm dumps. The estimated cost is around \$10 million per annum. This cost could be funded through the increases in the levy itself. Figure 4-4 shows that, even with a relatively minor increase in the levy, reasonably substantial increases in revenue can be achieved; at least \$50 million per annum by 2020 for all scenarios. This additional revenue is enough to pay for the increased regulatory costs estimated above. Levy revenue from additional tonnage that was disposed of illegally but is brought to a levied facility as a result of enforcement would also help offset some of the cost (depending on the tonnages involved). Once the regulatory system is functioning well, this allows for much more significant increases in the levy rate as illegal/unregulated activity should be minimised.

### **5.2.2.2 Spending on Services and Infrastructure**

The additional revenue generated by the levy (see Section 4.6) would be spent within the waste management sector. Section 38 enables the Minister to approve projects that achieve or promote waste minimisation. There is little restriction in the WMA on the criteria for these projects beyond the fact that they have to promote or achieve waste minimisation. This would mean however that spending could not extend to services and infrastructure that dealt with residual waste or with hazardous wastes where these were not being recovered.

It would be sensible in our view if spending was directed towards where there are gaps in infrastructure and service provision. In particular spending could be directed towards rural infrastructure and service provision so as to provide genuine, practical and cost effective alternatives to on-farm disposal and other unregulated and illegal disposal. Targeted spending of levy revenue with the sector would have the benefit of providing a source of funding for infrastructure, offsetting any revenue increases that may be needed to increase recycling. This would help ensure the infrastructure required to increase recycling rates was actually developed. However, additional revenue would still be required, over and above what would be available from the levy fund. It would be important, therefore, to ensure comprehensive and sustainable financing mechanisms are in place in order to fund services in the longer term once landfilling, and therefore revenue, falls. For example, fees from Extended Producer Responsibility schemes on packaging, WEEE, and other waste streams, and variable charging mechanisms for householders.

### **5.2.3 Introduction of Performance Standards**

Given that territorial authorities receive half of the gross levy revenue, where an increase in the levy leads to a substantial increase in the amount of levy money collected, how territorial authorities spend their share will be vital to achieving efficient use of levy funds. Section 49 of the WMA allows the Minister to set performance standards for territorial authorities for the implementation of Waste Management and Minimisation Plans. This is a potentially important mechanism for helping ensure that levy funds are directed effectively towards achieving the purpose of the levy. Clear practical standards (potentially including performance targets) will need to be established alongside careful central government guidance and direction.

### **5.2.4 Efficient Distribution of Contestable Funds**

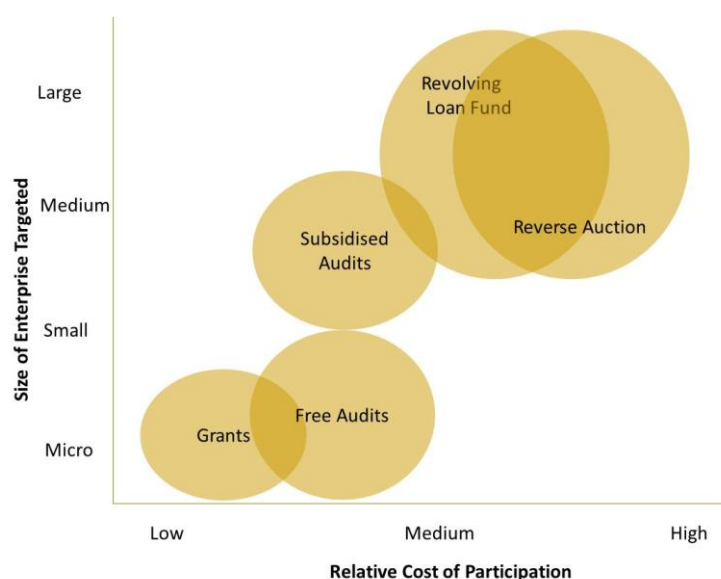
The most appropriate mechanism for distributing the funds should be assessed and implemented. For example, grant funding applications may be appropriate for smaller scale awards, whereas reverse auctions may be more suitable for larger projects. The following sets out the results of analysis undertaken by Eunomia for the UK's Foreign and Commonwealth Office during a study on fiscal instruments for client friendly development.

The same principals apply to distributing levy funds to applicants, but rather by project size than size of enterprise. The previous levy reviews have indicated that levy funds have been applied in a reactive, rather than a strategic manner. Further detailed consideration should therefore be given to allocating levy money using the most appropriate schemes. What has also been highlighted is that the grants currently have a relatively high cost of participation. This might be due to inefficient processes currently, or that the same mechanism is used for both small and large funding applications. The principles set out could still be applied to improve the efficiency of levy spend, by using a slimmed down grant application process for smaller applications, and a reverse auction for larger projects with specified themes.

Funds would also be considered against the local and regional infrastructure requirements which would need to be set out in respective planning documents.



**Figure 5-1: Funding Schemes According to Size of Enterprise and Relative Transaction Costs**



### 5.3 Summary of Proposed Changes

In order to effectively implement the preferred levy structure the following actions will be required:

- Enhance the regulatory regime, including:
  - Consistent disposal facility typology;
  - Consistent permitted activity rules;
  - Develop a register of sites that are potentially liable for the levy;
  - Develop protocols for levying of unmonitored sites;
  - Allocate appropriate levels of resourcing to carry out monitoring and enforcement;
  - Develop effective and efficient enforcement protocols; and
  - Establish an illegal dumping strategy.
- Ensure efficient use of levy funds including:
  - Allocating revenue to monitoring and enforcement;
  - Targeting levy funds towards strategic needs including service and infrastructure gaps;
  - Introduction of performance standards for TAs; and
  - Consider different distribution mechanisms to appropriately and efficiently allocate funds.

## 6.0 Implementation Plan for the Levy

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The following steps outline a plan for implementing the levy:

- 1) Undertake a regulatory impact assessment as soon as is possible. An RIA would be required by legislation when considering a new policy.
- 2) Establish a register of sites to understand exactly who would be affected by the changes and also to have a clear list for the regulator to ensure compliance with the levy regime.
- 3) Undertake public consultation as part of the impact assessment, which is also required by legislation.
- 4) Once the RIA and consultation have been completed then finalise what levy regime should be implemented.
- 5) Gain Cabinet approval for the changes to the levy regime.
- 6) Establish budget allocations for working on the changes and implementing and additional regulatory functions.
- 7) Publically announce the planned changes to the levy regime.
- 8) Develop plan for funding additional services required to ensure waste is diverted from landfill and treated or recycled, for example, through improving Extended Producer Responsibility or enhancing the charging structure for householders.
- 9) Set up the administrative structures that would be required to ensure all entities are regulated by an independent body (i.e. no self-regulation).
- 10) Set up the monitoring and enforcement structures within the regulatory agencies.
- 11) Develop funding distribution approaches of the waste minimisation fund to ensure efficient spend of the additional levy funds on new services.
- 12) Carry out communication and training activities to ensure all affected actors are aware of their obligations and how to make levy payments.
- 13) Implement the expanded levy regime, with an escalator signalled in advance that will progressively raise the rates over time.
- 14) Increase levy according to low escalator over 3 years.
- 15) Improve monitoring and enforcement activities as additional funding is received from short term levy increases.
- 16) Increase levy according to high escalator over 4 years.
- 17) Review rate and outcomes every 3 years in line with legislative requirements.

**Figure 6-1: Implementation Plan**

#	Description	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
1	Undertake RIA										
2	Public consultation										
3	Finalise levy regime										
4	Register of sites										
5	Cabinet approval										
6	Budget allocations										
7	Announcement of new regime										
8	Develop funding plan										
9	Set up administrative structures										
10	Set up regulatory entities										
11	Improve waste min. fund										
12	Communication and training										
13	Implement new regime										
14	Low escalator										
15	Improve monitoring and enforcement										
16	High Escalator										
17	Review rate on 3 yearly basis										

## 7.0 Key Messages

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This report has reviewed the current situation regarding the landfill levy and presented some detailed analysis, beyond any work previously undertaken. It shows that there are clear economic and waste minimisation arguments for increasing expanding the application of the Levy and for a significantly higher rate for 'active waste' than its current default rate of \$10. The key messages from this report, therefore, are:

- 1) The levy should be applied to all disposal facilities, i.e. all landfill classes, to ensure there are no incentives for waste to be mis-managed or illegally disposed of, which might cause harm to the environment;
- 2) Increasing the rate of the Levy should be a matter of priority for the Ministry, given the significant increase in jobs and gross value added that would be achieved. These increases significantly outweigh the additional costs to the economy;
- 3) The levy should be structured simply but at least differentiating rates between inert and other materials, at a standard rate, to ensure rates for active wastes can be increased significantly, without majorly affecting the management of inert materials which occurs at much lower costs;
- 4) The outcomes of the modelling indicate that the greatest level of benefit is likely to accrue under the scenario of \$140 per tonne for 'active' waste, \$15 per tonne for 'inert' waste and with an 'incineration' rate of \$40 per tonne;
- 5) The changes to the levy should be signalled well in advance and an 'escalator' applied to progressively approach the target levy rate over time. This will enable industry to plan and make appropriate investment;
- 6) A strong regulatory regime of inspection and enforcement activities should be implemented to minimise the risk of illegal activity at higher levy rates. The exact nature of the regime needs careful consideration and further analysis (beyond what was within the scope of this study);
- 7) The increased regulatory costs should be covered by short term increases in levy rates to shift the burden of regulation from the public sector to the waste producers themselves;
- 8) The levy should be widened in scope to include other residual treatments, such as energy from waste, to ensure that, at higher rates, the levy does not simply switch waste from landfill to burning. This would result in increased jobs and GVA;
- 9) The management of wastes at farms should be improved, and the use of informal 'farm dumps' monitored to ensure the environment is not put at risk;
- 10) The significantly increased revenues should be distributed in an efficient manner, with the most appropriate funding mechanism being used based upon the size or nature of the project (e.g. grant funding for smaller projects to reverse auctions

for larger projects). Funds should be distributed according to infrastructure needs in the relevant regional and local waste management planning documents.

Through producing this report it is clear that there is a lack of comprehensive and reliable data on waste management in New Zealand. In addition, there is little information on the economic costs of waste management and no GVA multipliers. Further research in all these areas would be useful going forwards to improve the quality of the evidence around the impacts of changing the levy.

# APPENDICES

## A.1.0 Review of Levy in Other Countries

The aim of this literature review is to provide evidence for the range of options that could be modelled in the latter part of the study. A significant amount of experience has been gathered by Eunomia in this field, and this is drawn upon for this review.

To set the scene landfill levies in Australia are described. This is followed by an investigation into the types of landfill levy seen in European countries. We then present a brief comparison of levy structures and levy escalators, i.e. how the levy rate has evolved over time.

### A.1.1 Waste Levies in Australia

All States and Territories in Australia, with the exception of the Northern Territory and Queensland, have implemented a waste levy of some sort, although the structure and scope of each levy varies greatly between states and territories. Key information for waste levies across Australia is presented in Table 7-1. In all cases the levy rate quoted is per tonne of waste landfilled.

**Table 7-1: Waste Levies Across Australia**

State	Waste Types	Levy Rates, (NZ \$)
<b>Australian Capital Territory<sup>1</sup></b>	Non-commercial waste and some Special waste (this is administered through the landfill operator and not through its environmental agency)	Domestic/self haul – \$73.48 Special waste (WEEE, mattresses etc) – variable cost
<b>Northern Territory<sup>2</sup></b>	A landfill levy does not exist although a levy is to waste tyres in certain local Government areas	
<b>New South Wales<sup>3</sup></b>	Municipal solid waste, commercial and industrial waste, and construction and demolition waste	2016/17 \$145.20 for standard waste (Metropolitan Levy Area) \$83.67 for standard waste (Regional Levy Area) \$130.68 for virgin excavated natural material (Metropolitan Levy Area) \$75.79 for virgin excavated natural material (Regional Levy Area) Reduced rates for shredder floc, liquid waste and coal washery rejects
<b>Queensland</b>	A levy on commercial waste only was introduced in 2013 but removed 18 months later	
<b>Southern Australia<sup>4</sup></b>	All waste	2016/17 \$81.32 for solid waste (metropolitan Adelaide)

State	Waste Types	Levy Rates, (NZ \$)
		\$40.66 for solid waste (non-metropolitan Adelaide) Reduced rate for asbestos and shredder floc
<b>Tasmania<sup>1</sup></b>	All waste (administered through three regional waste groups and not through the central agency)	Roughly \$2.14 in each of the regional waste groups
<b>Victoria<sup>5</sup></b>	Municipal solid waste, industrial, and prescribed	From 1 <sup>st</sup> July 2015 \$66.37 for municipal waste and industrial waste (metro and provincial areas) \$33.27 for municipal waste (rural areas) \$58.18 for industrial waste (rural areas) Increased rates for waste from manufacturing activities and contaminated soils Reduced rate for asbestos
<b>Western Australia<sup>6</sup></b>	Putrescible waste and inert waste	2016/17 \$64.20 for putrescible waste Approx \$53.50 for inert waste (levied on a per m <sup>3</sup> basis) The levy is only applied to waste sent to metropolitan perth

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5. EPA Victoria (2016) *Landfill and Prescribed Waste Levies*, Accessed 28<sup>th</sup> April 2017 <http://www.epa.vic.gov.au/your-environment/waste/landfills/landfill-and-prescribed-waste-levies#Rates>
6. Government of WA (2015) *Landfill levy rates to rise from January 2015*, Accessed 28<sup>th</sup> April 2017, <https://www.der.wa.gov.au/about-us/media-statements/112-landfill-levy-rates-to-rise-from-january-2015>



## A.1.2 Landfill Levies in EU Member States

The review in this section of the report focuses on key EU Member States, and utilizes a report to Enviro, written as part of the UK landfill levy review in 2001, and a review of international waste policy for the Irish Government.<sup>47,48</sup>

The following countries are covered:

- Austria;
- Denmark;
- Finland;
- Belgium (Flanders);
- France;
- Ireland;
- Italy;
- The Netherlands;
- Sweden;
- Norway;
- Slovakia;
- Spain (Catalonia);
- Switzerland; and
- United Kingdom.

Key information for waste levies across a broad selection of EU Member States is presented in Table 1-2.

In all cases the levy rate quoted is per tonne of waste landfilled. Also note, as exchange rates vary, levy levels given in New Zealand dollars will only be approximate.

**Table 1-2: Landfill Levies across Selected European Countries and Regions**

Country	Waste Types	Levy Rates (NZ \$)	Supporting Policies
<b>Austria</b>	Demolition waste Excavated soil Waste with certain concentrations of dangerous elements Domestic waste or similar	<u>Inert</u> \$14.6 <u>Domestic</u> Massive variation dependent on waste type & landfill quality, latest levels are \$47.4 to \$138.3	Landfill Ban on wastes covered by the Landfill Directive, and on wastes with a carbon content of 5% or above (this is to ensure the stabilisation of waste before landfilling).
<b>Catalonia (Spain)</b>	Municipal Waste Construction waste	\$16 for municipalities with separate food waste collection and	Objectives to meet recycling rates. No other policies directly related to landfill.

<sup>47</sup> Eunomia (2001) *Review of Landfill Tax*, Report to Enviro

<sup>48</sup> Eunomia (2009) *International Review of Waste Management Policy*, Final Report for the Department of Environment Heritage and Local Government

Country	Waste Types	Levy Rates (NZ \$)	Supporting Policies
		\$32 for those that don't.	Incineration levy.
<b>Denmark</b>	All waste entering landfill site (exemptions apply, mainly hazardous waste and contaminated soil) Sewage Sludge Other Sludges	1987 – \$8.8 1992 – \$43.2 1998 – \$82.7 2010 – \$82.7 2015 – \$101.2 Higher levels for sludges. From 1998 – \$47 for slag and fly ash.	Waste Levy also covers incineration Landfill ban on combustible waste Natural Resource Levy (equivalent to aggregates levy)
<b>Finland</b>	Wastes at public landfill sites Wastes at private / industrial sites which also accept wastes from multiple sources Hazardous waste	1996 – \$24.4 2001 – \$41.4 2005 – \$48.9 2013 – \$80 2015 – \$87 Hazardous waste – \$439.9	Landfill ban introduced in 2006. Covers landfill directive wastes, waste that is not pretreated (except inert waste) and household waste, or similar, where the bio fraction has not been separately collected.
<b>Flanders (Belgium)</b>	Household Industrial Inert	\$50.4 to \$135 Landfill rates dependent on waste type & landfill quality (Note that a \$79.5 export levy is imposed to prevent waste tourism to Wallonia)	Challenging minimisation and recovery rates. Landfill bans. Incineration levy.
<b>France</b>	Household Waste Municipal Solid Waste Mixed Industrial Waste	1993 – \$5.0 1995 – \$6.3 1998 – \$9.9 1999 – \$15.1 2003 – \$60.2 for non-authorised landfills / \$12.4 for sites with EMAS or ISO 14000 certification. 2015 – Massive variation dependent on waste type & landfill quality, latest levels are \$63.6 to \$238.5	Ban on untreated waste from 2002.

Country	Waste Types	Levy Rates (NZ \$)	Supporting Policies
Italy	Inert waste (industrial) Other waste (urban and assimilated) Special waste	MSW – \$15.9 to \$39.8, depending on region \$1.6 - \$15.9 (Inert) \$8 - \$15.9 (Other)	Landfill diversion and recycling targets.
Ireland	All waste at authorised and unauthorised treatment facilities.	2002 – \$24.4 2010 – \$48.9 2011 – \$82.7 2012 – \$111.3 2013 – \$119.3 2015 – \$119.3	Incineration levy.
The Netherlands	Waste <1,100kg/m <sup>3</sup> and certain waste streams (e.g. dangerous waste & shredded waste)  Waste >1,100 kg/m <sup>3</sup> (inert & non-combustible waste)	Combustible waste (low density) 1995 – \$22.6 2000 – \$105.3 2008 – \$144.8  Non-Combustible waste (high density) 2008 – \$24.4 2014 – \$27	Ban on landfilling of recyclable and combustible waste (regulated by density measurements only).
Norway	All wastes delivered to landfill.  Higher rate for wastes with dispensation from the ban on biodegradable wastes.	1999 – \$65.8 2010 – \$52.6 2015 – \$59.5	Incineration levy.  Ban on biodegradable wastes
Slovakia	Hazardous waste Inert waste MSW Other waste Green waste	Rates in 2004: Haz. – \$43.2 Inert – \$0.4 MSW – \$6.5 to \$13.0 Other – \$8.7 Green – \$17.4	None relevant.
Sweden	All hazardous waste  All other waste once a threshold of 50 tonnes per annum is exceeded  Levy element refunded if waste is removed	2000 – \$45.1 2001 – \$50.8 2008 – \$65.8 2008 – \$77.1 2015 – \$87.5	Landfill bans on sorted combustible wastes and all organic wastes.

Country	Waste Types	Levy Rates (NZ \$)	Supporting Policies
	within 3 years		
<b>Switzerland</b>	Residual waste Combustion residues Export to disused salt mines	\$16.0 – \$52.6 2015 – variation dependent on waste type & landfill quality: \$3.7 to \$20.7	Ban on landfilling of combustible wastes.
<b>UK</b>	Active waste Inert waste	Active waste: 1996 – \$13.2 2007 – \$45.1 2010 – \$90.2 2014 – \$150.4 2015 – \$155.3 2016 – \$158.7 2017 – \$161.9 Inert: 2014 – \$4.7 2015 – \$4.9 2016 – \$5.0 2017 – \$5.1	Landfill Allowances Scheme.

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[http://www.cewep.eu/media/www.cewep.eu/org/med\\_557/1406\\_2015-02-03\\_cewep\\_-\\_landfill\\_inctaxesbans.pdf](http://www.cewep.eu/media/www.cewep.eu/org/med_557/1406_2015-02-03_cewep_-_landfill_inctaxesbans.pdf)

*HM Revenue & Customs (2017) Landfill Tax: Increase in Rates, 16th March 2016,*  
<https://www.gov.uk/government/publications/landfill-tax-increase-in-rates/landfill-tax-increase-in-rates>

The table above provides a useful insight into the range of structure and rates other European countries have. The following sections summarise some of the main trends key considerations.

### A.1.3 Levies Structure

The categorisation of wastes differs between EU countries, and between states and territories in Australia. However, in most cases, the majority of the waste generated is covered by the landfill levy. Mixed household and commercial, specific industrial and construction wastes are covered in these cases, and the trend for most countries is that the scope of the levy does not increase over time.

This section provides a brief summary the main landfill levy pricing structures found in our review. As shown in Table 7-1 and Table 1-2, these range from a simple, one rate approach, to complex approaches involving many different rates for different waste types.

#### A.1.3.1 Active/Inert

A common structure for landfill levies in the EU is to have one rate for active waste and another for C&D or inert waste. The exact way in which this is specified in regard to waste type varies across countries, as indicated in Table 7-1. For example, some keep the same rate as for MSW / C&I, some have separate rates for C&D wastes specifically, others differentiate the inert fraction and several do not indicate any specifics at all. Some policies also have measures to exempt all or certain inert material from the levy altogether.

The general argument for setting inert levy rates at a much lower level than active rate wastes is because the environmental damages from landfilling are much lower. Moreover the large quantities and low disposal costs result in significant marginal changes, even at low levy rates.

The UK is an example where a landfill levy with two rates, a 'standard' and 'lower' rate is applied.<sup>49</sup> The lower rate of levy can only be applied to waste that meets the following criteria:

- Non-hazardous;

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<sup>49</sup> HM Revenue & Customs (2017) *Excise Notice LFT1: A General Guide to Landfill Tax*, 1<sup>st</sup> April 2017,  
<https://www.gov.uk/government/publications/excise-notice-lft1-a-general-guide-to-landfill-tax>

- Low potential for greenhouse gas emissions (i.e. waste which are not biodegradable with little or no organic content); and
- Low polluting potential in the landfill environment.

The lower rate is therefore applied mainly to what is commonly termed ‘inert’ waste, however, the guidance, which also includes a full list of qualifying materials for the lower rate, ensures that the lower rate is applied only to waste which meet certain criteria in terms of their environmental impact.

### A.1.3.2 Metropolitan/Rural

Another approach taken to differential pricing for landfill levy is to set a higher rate for metropolitan waste (i.e. waste generated closer to major urban centres) and a lower rate for waste from rural areas. This pricing structure, which is employed in most Australian states and territories, aims to address the different financial and operational considerations for rural and metropolitan areas, such as:

- Lower population densities in rural areas increases the costs of waste transportation relative to metropolitan regions. The imposition of a waste levy compounds these waste transport costs, increasing the relative costs of regional landfills;
- Access to recycling services is reduced for rural populations, for example, there is much more limited implementation of kerbside recycling due to the higher costs associated with population spread.
- Metropolitan areas are in a better position to reduce waste disposal and increase reuse and recycling compared to rural areas
- Demographic trends in Australia are such that younger people tend to migrate from rural areas to metropolitan areas, reducing the available workforce in rural areas.<sup>50</sup> This requires higher salaries in rural areas to attract and retain landfill personnel, pushing up operational costs.

Australia’s population is highly urbanised and rural areas are very sparsely populated. This pricing structure addresses the particular requirements presented by this population distribution, hence it is little seen outside Australia.

The sort of transport distances that apply in Australia are not found in NZ. However there may be instances (for example the West Coast) where a case does exist for a lower rate. S41 (1)(d) allows different rates to be applied to individual facilities. Therefore any issues in respect of distances to markets could be examined on a case by case basis without needing to consider an overall urban/rural split. In general however a better approach would be to first consider using levy income to support remote communities through investment in infrastructure and/or subsidy of appropriate services.

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50 South East Regional Organisations of Councils (2012) *Towards developing a regional waste management strategy for NSW South East Region*

### A.1.3.3 Other Splits by Waste Type

The structure of the levy is also linked to the general policy aims of the country. In the Netherlands the levy supports the ban on waste under a certain density which was enacted to ensure a feedstock of combustible waste for the national incineration capacity, and in Slovakia and Catalonia the structure has been developed to promote a change in upstream collection systems. In addition, Denmark has increasingly differentiated its waste-levy by disposal route in order to stimulate the use of waste as a fuel for district heating networks.

Different countries also have landfill levies which sit within a more general waste-levy. For example, Denmark, Flanders and Norway make use of a levy on waste which covers not only landfill, but also incineration with and without energy recovery. The levy therefore applies more widely to cover all waste disposal routes rather than landfill *per se*.

In some countries that do not levy incineration (e.g. the Netherlands and UK) there is a tendency to levy all forms of ash (i.e. bottom and fly ash), whereas fly ash is exempt from levy in Denmark where an incineration levy applies.

The inclusion of hazardous waste in the levy structure also varies considerably. In Finland, where the state has the majority share in the main hazardous waste reprocessing company, a high rate of levy was set to fund its operation. Slovakia and Sweden also specifically include hazardous waste in the levy structure. Other countries levy all waste and some then include exemptions, and for others, in order to limit the financial burden on businesses and promote the safe disposal of such wastes, hazardous waste is not levied at all.

### A.1.4 Levy Escalators

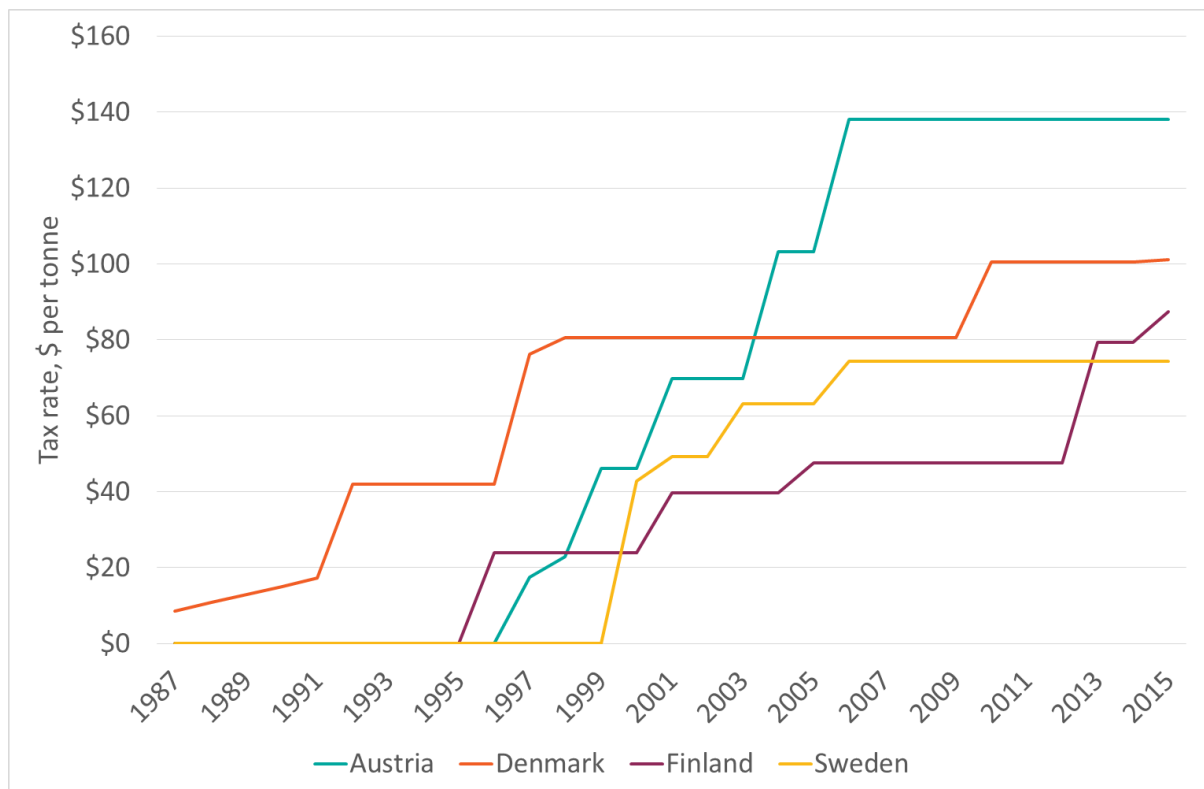
The current rate of taxation is an important factor to consider when assessing landfill levies, but the rate of evolution also reveals something regarding the rationale and success of any policy. Many countries have applied a staged increase in levy rates in the initial 5-10 years (a landfill levy 'escalator') and then kept the levels relatively constant.

The staged increase in the evolution of landfill levies across Europe could be a result of the following factors:

- Uncertainty about the effect of the levy;
- Allowing time for infrastructure to develop without penalising businesses in the short term;
- Nervousness on behalf of Government in introducing significant changes in short periods;
- Desire to maintain revenue generation from the levy.

Example of staged increases in levy rates can be seen in Figure 1-1 below.

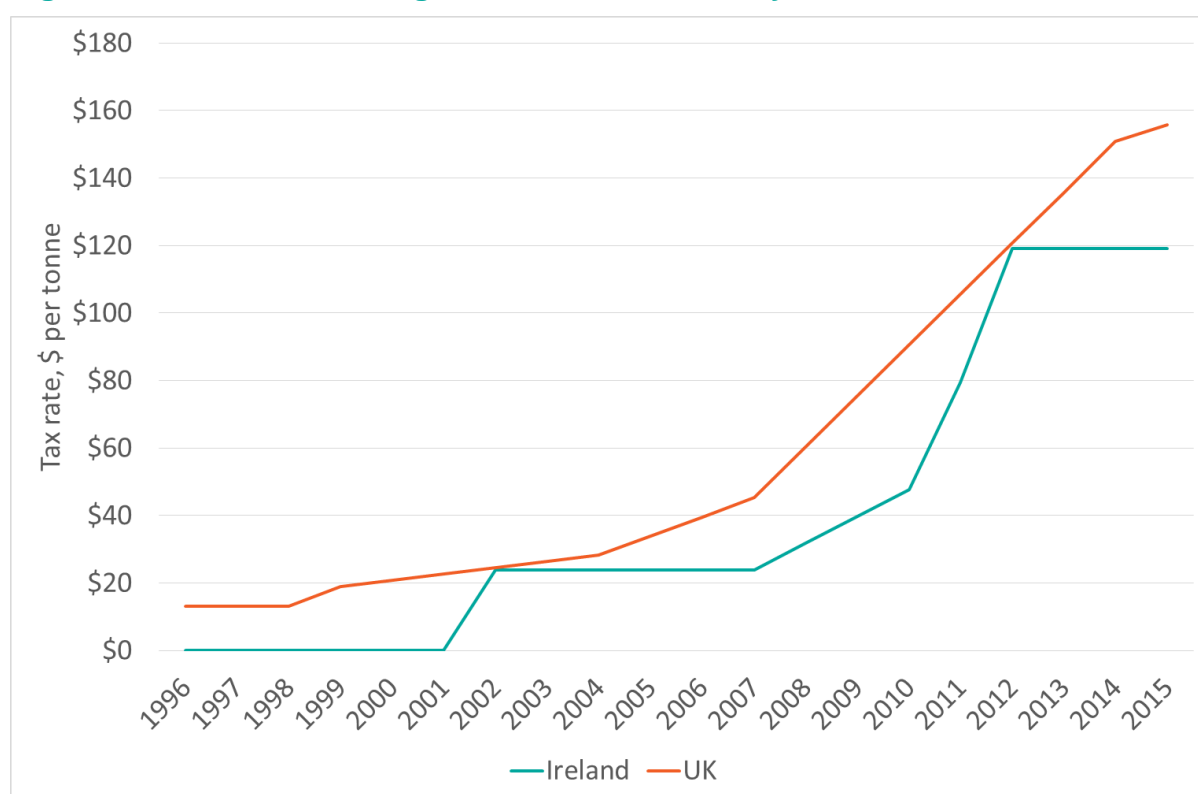
**Figure 1-1: Staged Increases in Landfill Levy Rates**



Two other EU countries, the UK and Ireland, show another trend. In both cases early extended periods of a low levy rate resulted in less diversion from landfill than other European states. To increase diversion from landfill, levy rate escalators have been introduced in recent years. This is also shown in Figure 1-2 below.



**Figure 1-2: Slow Initial Progression of Landfill Levy Rates**



It is only countries that have introduced policies in the last 5-10 years where no increase in levy levels can be seen. It is too early to tell whether they will remain constant or increase over time.

In most countries the following characteristics of the levy hold true:

- Levy levels start at low levels and increase; and
- The progression of levy rates appears to have stagnated in a number of countries. The level will cease to be increased when policy objectives have been met.

### A.1.5 Supporting Policies

Some countries resort to bans on the landfilling of specific waste streams. In the Netherlands, landfilling of municipal waste is banned other than in exceptional circumstances and most organic household waste is separately collected for composting, whilst Austria and Germany have set a maximum fermentability threshold for landfilled wastes.

It seems important to highlight that several countries have levies on incineration. This is set either as a dedicated levy on EfW or, including the landfill levy, as part of a more general waste levy. A levy on EfW could also promote the shift to recycling and act as an additional means to generate revenue (as is the case in Denmark, and to a lesser extent, the Netherlands).

In Sweden a levy on waste-to-energy incineration of municipal solid waste (MSW) was introduced on July 1, 2006. This was designed to give CHP plants an advantage compared

with Heat Only Boilers (HOB), but also to increase the incentive for material recycling, including biological treatment, and to effectively align the taxation of incineration with the energy taxation system, where incineration of wastes of fossil origin was not burdened with energy and CO<sub>2</sub> taxation as other fossil fuels are<sup>51</sup>. The amount of the levy is calculated based on a model of the content of fossil material in the waste<sup>52</sup>. The amount of the levy is dependent on whether the taxable incineration facilities produce electricity and, if so, how efficiently. For facilities without electrical production, the levy is € 49 (SEK 487) per tonne, which would then decrease with increased electricity production. At 15 per cent electricity production, the levy is approx. € 8.3 (SEK 83) per tonne, at 20 per cent approx € 7.6 (SEK 76) per tonne. Since the introduction of the levy material recycling, including biological treatment, has increased from 34.6 per cent to 48.7 per cent and waste-to-energy has increased from 38.1 to 46.4 per cent.

The incineration levy in Norway was also changed to reward operators who reduce pollution below legal limits specified in the EU's 2001 Waste Incineration Directive. This is done by changing the mechanism so that it is emissions based and focuses on pollutants such as CO<sub>2</sub>, NO<sub>x</sub>, SO<sub>x</sub>, particulates and dioxins. The CO<sub>2</sub> charge (€4.85) is per tonne of waste delivered to an incineration plant, and all the additional 14 pollutants are levied on the basis of the quantity of pollutant emitted. The changes were introduced in such a way that the overall revenue take would be more or less unchanged, and so that no major change to the balance of residual waste treatments would be occasioned by this.

Also in Catalonia, from 2008, an incineration levy has been implemented, the first of its kind in Spain. The levy rate will be €5 per tonne. However, there will be an increased levy rate of €15 per tonne for those municipalities that do not have in place separate collection of biowaste, but could have introduced it according to the regional waste strategy.

## A.1.6 Use of Revenue

The vast majority of waste levies in the EU are directed straight into the general budget. Revenue usage is more closely tied to the source of revenue in Austria and Switzerland where funds are used to remediate contaminated land. In fact Austria is the only European country where revenues from a landfill levy are exclusively used for this purpose. Interestingly, in Finland, the levy revenue becomes part of the general budget. However, the Ministry of Finance is understood to have made a 'gentleman's agreement' with the Ministry of Environment when the levy was introduced, so that more money would be made available to fund contaminated land remediation.

Other countries such as Flanders and France started out with innovative schemes. In Flanders, the regulations have since been modified, with money being channelled into the general budget, whilst in France, the new General Tax on Polluting Activities (TGAP) scheme, which includes the landfill levy, is revenue neutral, so that rises in the levy rate will be

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<sup>51</sup> Swedish Ministry of Finance (2006) *Proposition 2005/06:125 Beskattning av visst hushållsavfall som förbränns, m.m. (Taxation of some household waste for incineration)*, [Ministry of Finance, 2006](#)

<sup>52</sup> Avfall Sverige (2008) *Swedish Waste Management*, [http://www.avfallsverige.se/se/netset/files3/web/P01.m4n?download=true&id=2371\\_94867351](http://www.avfallsverige.se/se/netset/files3/web/P01.m4n?download=true&id=2371_94867351)

compensated by a reduction in VAT (5.5% VAT on waste collection and sorting services instead of 20.6%).

The revenue from the system in Catalonia is refunded back to local authorities to finance additional waste collection infrastructure. The main focus of the funds is on the management of separately collected biowastes.

**Table 1-3: Use of Landfill Levy Revenues**

Country	General Budget	Fund Waste Management Schemes etc.	Clean up contaminated sites	Other
Austria			✓	
Catalonia (Spain)		✓		
Denmark	✓			
Finland	✓		( ✓ )*	
Flanders	✓ (Now)	✓ (At the start, Environment & Nature Fund)		
France		✓ (At the start, Modernisation Fund for Waste Management)		✓ (Now, revenue neutral with reduced VAT on collection)
Ireland		✓		
Italy				n/a
Netherlands	✓			
Norway	✓			
Sweden	✓			
Switzerland			✓	
UK		✓ (ENTRUST)		✓ (NIC reductions)
* Note: Although the revenue becomes part of the general budget, the Ministry of Environment made a 'gentleman's agreement' with the Ministry of Finance when the levy was introduced that more money would be made available to fund contaminated land remediation.				

In South Australia 50% of waste levy revenue is allocated to the 'Waste to Resources Fund' which is administered by Zero Waste SA. Zero Waste SA uses a proportion of that fund as provided for in the Zero Waste SA Act 2004. Additional funds are allocated through the Government's budget process. In NSW, 33% of levy funds is dedicated to establish a five-year infrastructure and recycling grants program 'Waste Less, Recycle More' worth \$465.7 million,<sup>78</sup> while the remaining 67% is used by the NSW Government for general service delivery. The grants program has established priorities to invest in infrastructure (\$250m), local government programs (\$138m), and illegal dumping and littering (\$78m).<sup>53</sup>

## A.1.7 Perverse Effects of the Levy

### A.1.7.1 International Experience

The literature outlined in previous chapters on waste levies frequently speaks of the possibility for evasive behaviour. In England, Local Authorities (LAs) bear the costs of clearing up waste that is fly-tipped on public land<sup>54</sup>. Some claim to have experienced increases in fly-tipping in the wake of the levy. However, it is also mentioned in the Eunomia report that this could be due to a greater awareness of the problem post-levy, and that there was a poor baseline, because LAs previously defined fly-tipping in different ways.

The effect is that municipal waste almost certainly increased as a result of the levy. This resulted in the tightening up of procedures at Household Waste Recycling Centres (HWRCs) to stop the switch of C&I wastes into the municipal stream. For example, the drivers of any vans now entering HWRCs in England have to produce a proof of address, copy of hire certificate, and demonstrate to the site operators what is in the vehicle on entrance. The UK also faces a major issue with respect to sham recovery, with increasing quantities of ineligible waste being sent to unlicensed sites<sup>55</sup>.

In England, it has been reported that, following the divergence in levels of inert and standard rate levy, there has been some increase in mis-definition of wastes in order to avoid the higher rate levy.

The issue of 'landfill evasion' through resort to recovery options is also an issue in Denmark and Austria.<sup>56</sup> One loophole in Austrian Law did exist for landfill operators. Under a 1998 amendment to the waste law certain waste may cease to be legally regarded as such if it reaches certain minimum standards for pre-treatment in respect of its stability. If the waste fulfils the criteria and is therefore regarded as 'stabilised' then no levy is due on the waste. Waste that has undergone mechanical-biological treatment (MBT) for sufficient periods of

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<sup>53</sup> Deloitte Access Economics (2015) *Economic effects of the South Australian solid waste levy* Final Report

<sup>54</sup> Eunomia et al (2007) *Household Waste Prevention Policy Side Research Programme*, Final Report for Defra

<sup>55</sup> ECOTEC (2001), *Study on the Economic and Environmental Implications of the use of Env. Taxes & Charges in the EU*

<sup>56</sup> Ibid.

time achieves these requirements. There is, consequently, a possibility for landfill operators to mix waste in order to alter the bulk characteristics of the waste and hence avoid taxation.

In Finland there are no official statistics on illegal dumping, however, newspapers have reported several major incidents of dumping in forests.<sup>57</sup> However, the Ministry of Environment believes it is more a reflection of tightening landfill requirements resulting from the Landfill Directive rather than the landfill.

Waste tourism can also result from waste levies, as experienced in both Austria and the Netherlands - although in Austria regional laws have been drawn up to try to rectify this. Notably, a move from Denmark to Sweden (now relatively easy owing to bridge construction) would enable avoidance of significant levies, and this is believed to have led to waste for recovery moving away from Danish incinerators and into Swedish ones.

#### A.1.7.2 Illegal Dumping in New Zealand

There is no single national definition of illegal dumping (also known as fly tipping) in New Zealand. Rather, illegal dumping is a form of littering that can be characterised by its type, frequency, volume, and location and the circumstances of the littering<sup>58</sup> as being distinct from other types of litter. The Ministry for the Environment refers to illegal dumping as the “disposal of waste in an unauthorised or non-dedicated area”<sup>59</sup>.

Litter is defined in the Litter Act (1979) as:

*“any refuse, rubbish, animal remains, glass, metal, garbage, debris, dirt, filth, rubble, ballast, stones, earth, or waste matter, or any other thing of a like nature”<sup>60</sup>.*

A person is considered to commit the offence of littering who:

*“deposits any litter or, having deposited any litter, leaves it-*

*(a) in or on a public place; or*

*(b) in or on private land without the consent of its occupier.”<sup>61</sup>*

In essence, what we term ‘illegal dumping’ in practice is technically and legally a form of littering. The Litter Act states that local authorities are responsible for the enforcement of the Litter Act. Local bylaws are also able to be used for the purposes of enforcement action against illegal dumping although this is less common.

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<sup>57</sup> Ibid.

<sup>58</sup> Based on a review of relevant industry research interviews with a number of local and regional Councils and reviews of various local authority Waste Assessments and Waste Management and Minimisation Plans. (separately referenced in Eunomia, 2014 *Service Review: Review of Illegal Dumping*. Prepared for Hamilton City Council),

<sup>59</sup> Ministry for the Environment’s “Landfill Full Cost Accounting Guide”, Section 9, available on [www.mfe.govt.nz](http://www.mfe.govt.nz).

<sup>60</sup> Litter Act 1979, s2, available as October 2013 reprint from [www.legislation.govt.nz](http://www.legislation.govt.nz).

<sup>61</sup> Litter Act 1979, s15, as above.

While councils routinely record the incidence of illegal dumping, records of the quantity of illegally dumped material is sparse and inconsistent. There is no national data available on the quantities of illegally dumped material.

Data from New South Wales in Australia suggests that there is in the order of 0.86 kg of illegally dumped per person per year.<sup>62</sup> Available data from NZ municipalities provides figures between 0.4kg per person and 1.0 kg per person. This suggests that the total tonnage of illegally dumped materials is likely to be of this order of magnitude.

If the NSW figures were applied to NZ that would suggest illegal dumping in the order of 4,000 tonnes per annum. While the NSW figures does include illegal landfills it is possible that this figure may be higher in NZ if all sites were identified and measured.

Anecdotally, many local authority officers believe that changes to waste management systems such as restricting refuse transfer station hours, increasing charges, or introducing user pays or otherwise restricting the residual waste collection system can have an impact on illegal dumping. There is little data available to support these views however, and much of the data available is inconclusive or incomplete.

There have been numerous changes over the years in respect of the cost of waste disposal in NZ, and there remain large regional differences in the costs of waste disposal. However there is no evidence to suggest that there has been a significant change in the incidence of illegal dumping over time, or that regions with higher disposal costs necessarily have higher incidence of illegal dumping. It should be noted that a part of the reason for the lack of evidence may simply be a lack of reliable data – both before and after changes are introduced.

A review of international illegal dumping literature similarly showed no firm conclusions about the relationship between illegal dumping and other waste management practices<sup>63</sup>.

The exception to this is where an operator or contractor removing illegal dumping makes a deliberate change to their practices following a change in the waste management system in the area.

In general the literature suggests that the factors that lead to illegal dumping are relatively complex and inter-related, and that it is likely to take a convergence of factors before illegal dumping becomes a significant issue. These factors include<sup>64</sup>:

- Weak formal controls over waste management;
- High costs of legal disposal options (e.g. transfer stations);
- Other incentives to avoid legal disposal (e.g. distance to disposal sites);
- 'Suitable' sites to tip illegally (including ease of access, ability to not be observed);
- It is easy to hide the identity of vehicles and their owners; and

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<sup>62</sup> <https://www.lga.sa.gov.au/page.aspx?u=1896>

<sup>63</sup> As referenced in: Eunomia, 2014 *Service Review: Review of Illegal Dumping*. Prepared for Hamilton City Council)

<sup>64</sup> Based on: UCL Jill Dando Institute of Crime Science (2006) "Fly-tipping: Causes, Incentives and Solutions" available at [www.defra.gov.uk](http://www.defra.gov.uk)

- The risk of getting caught is small.

Therefore while the cost of disposal is likely to be a risk factor it is not sufficient in itself to drive increases in illegal dumping and it is possible to mitigate against illegal disposal through adequate education, monitoring and enforcement and provision of convenient and cost effective waste management options<sup>65</sup>

One of the concerns in respect of increasing the cost of disposal through increases to the Levy is the potential for material to be disposed of illegally. This question was specifically addressed in the 2011 Levy review through a survey of TAs. The survey found the following:

*Of the 66 councils that responded to the WasteMINZ and Ministry for the Environment survey, 56 reported incidences of illegal dumping. For those responses comparing the 2008/09 and 2009/10 reporting periods, 20 out of 26 (77%) indicated a decline in the number of incidents of illegal dumping. Forty-four of the 48 councils (92%) that reported annual tonnages collected from illegal dumping indicated that they collect less than 1000 tonnes annually.*<sup>66</sup>

## A.1.8 Changes in Waste Disposal Costs in New Zealand

An observable trend in waste management in New Zealand has been the consolidation of material sent to disposal from small, local (usually council owned), landfills to large regional facilities (usually private sector, or public/privately owned). This is shown in Figure 1-3. The latest available data (2016) indicates that 33 Class 1 landfills were in operation.

This flow of material from numerous small to fewer larger facilities has been driven primarily by an increased focus on environmental performance. This has resulted in the closure of many smaller (often remote) landfills and an increase in the design, construction and operation costs for remaining landfills. The cost of compliance with the RMA has meant that smaller facilities have higher fixed costs, which necessitates higher pricing to ensure cost recovery. Conversely, the larger facilities are able to have relatively low fixed costs in relation to their capacity. This price differential has meant regional facilities are able to attract waste from a large catchment and be competitive even taking account of transport costs. As tonnage moves from the smaller facilities to the larger ones, this results in less tonnage across which the small facilities can spread fixed costs, leading to price pressure which has further fuelled the flow of material to the large facilities.

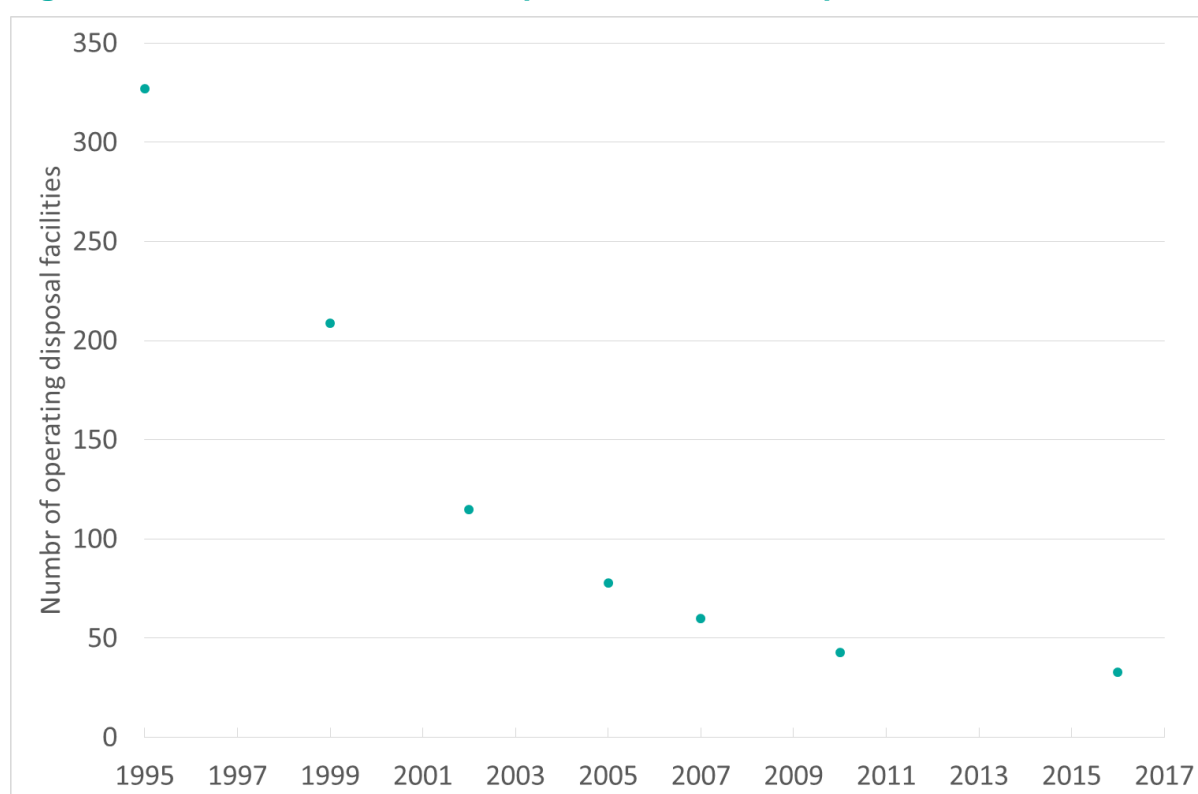
As noted in Appendix A.4.4.2 waste disposal costs (i.e. bulk rates at the landfill) can vary significantly across the country (\$20- \$190). For example bulk rates into large landfills serving Auckland can be in the order of \$35-\$45 per tonne compared with rates in the order of \$105-\$110 per tonne into Kate Valley in Canterbury, and costs in the order of \$150 per tonne for small remote landfills (e.g. Wairoa).

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<sup>65</sup> NSW Govt. NSW Illegal Dumping Strategy 2017–20

<sup>66</sup> Ministry for the Environment. 2011. *Review of the effectiveness of the waste disposal levy*

**Figure 1-3: Number of Class 1 Disposal Facilities in Operation**



Sources: Ministry for the Environment (2007) *The 2006/07 National Landfill Census*, Ministry for the Environment (2014) *New Zealand Non-Municipal Landfill, October 2014*, 2016 data compiled from TA Waste Assessments.

Canterbury is a potentially useful case study in this instance (although it should be noted that it is outside the scope of this report to undertake a proper analysis). Because of the relatively high gates fees at Kate Valley (compared to other facilities of similar size), and relatively large transport distances to the landfill, effective transfer station rates in the region are in the order of \$240<sup>67</sup>, which is among the highest in the country. It could therefore be expected that this would drive high levels of diversion from landfill.

A crude analysis of total waste to Class 1 disposal suggests that Canterbury sends in the order of 540kg per person to landfill<sup>68</sup>. This compares with a national figure of 728kg per person<sup>69</sup> - a differential of approximately 25% less material to landfill. Further analysis would be required to ensure the validity of these numbers, but if taken at face value they are potentially instructive. The relatively low level of waste per capita to disposal is

<sup>67</sup> <http://www.ecocentral.co.nz/services/ecodrop/fees>

<sup>68</sup> Based on 2013 Data: <https://transwastecanterbury.co.nz/media/files/Graph.pdf>, [http://www.stats.govt.nz/Census/2013-census/profile-and-summary-reports/quickstats-about-a-place.aspx?request\\_value=14703&tabname=](http://www.stats.govt.nz/Census/2013-census/profile-and-summary-reports/quickstats-about-a-place.aspx?request_value=14703&tabname=)

<sup>69</sup> Based on 2015 data: <http://www.mfe.govt.nz/waste/waste-disposal-levy/monthly-levy-graph>, <http://www.stats.govt.nz/Census/2013-census>



supported by the fact that Canterbury has been a leading region in respect of waste issues over a long period of time. Notable initiatives in the region include:

- 3 bin kerbside collection systems (in Christchurch and surrounding districts) leading to the highest rates of kerbside diversion in NZ <sup>70</sup>
- Eco-shop – the largest and arguably most successful re-use operation in NZ<sup>71</sup>
- Cleanfill bylaw<sup>72</sup>
- Leading community organisations in Ashburton and Huriuni
- Innovative Waste Kaikoura<sup>73</sup>
- Leading work on rural waste, disaster waste, and C&D waste

The degree to which waste minimisation in the Canterbury region has been driven by or enabled by the high cost of disposal would require further analysis, but it does appear consistent with experience elsewhere.

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<sup>70</sup> <https://www.ccc.govt.nz/services/rubbish-and-recycling/learning-resources/waste-statistics/>

<sup>71</sup> <http://www.ecocentral.co.nz/services/ecoshop>

<sup>72</sup> <https://www.ccc.govt.nz/the-council/plans-strategies-policies-and-bylaws/bylaws/cleanfill-waste-bylaw-2015/>

<sup>73</sup> <http://www.innovativewastekaikoura.com/>

## A.2.0 Model Overview and Scope

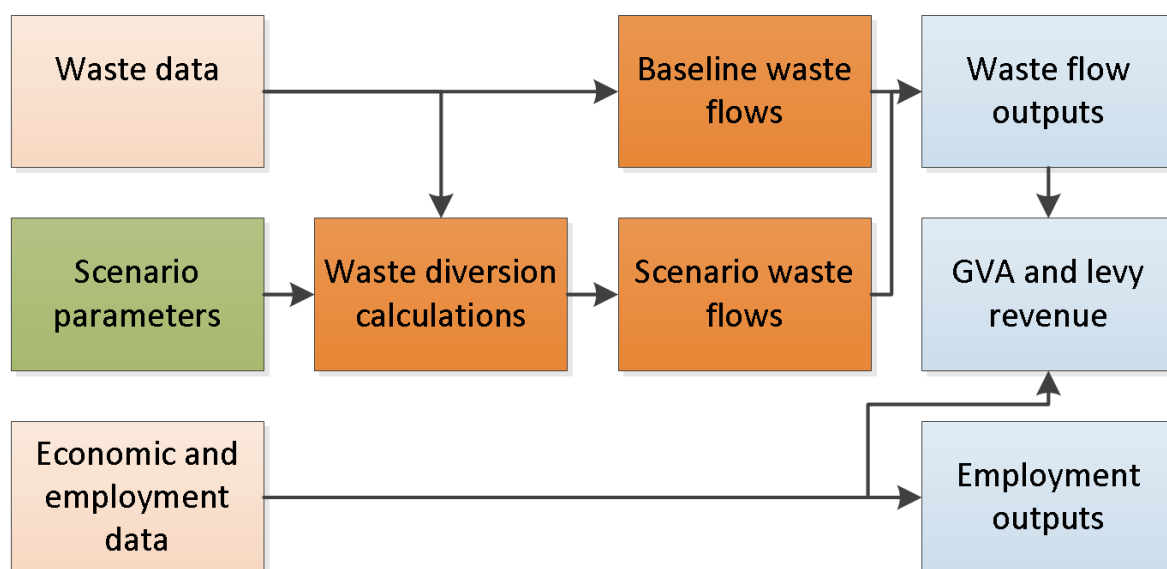
The approach to building a New Zealand specific landfill levy model has been to produce an Excel© based spreadsheet model from first principles. An overview of the model is given in Figure 1-4. The key elements are then described in the text below. The primary aim of the model is to ascertain the effectiveness of any of the proposed landfill levy rises against a baseline scenario in which the levy remains at its current rate.

In essence, the model comprises input data sheets, scenario parameters, baseline waste flows, scenario modelling and economic and employment outputs.

The first task of the study was to source the required input data and assumptions for modelling. Wherever possible, data published by local and national authorities has been used, with data from industry, or consultant reports, used where necessary. The reader should note that detailed statistical reporting of waste data in New Zealand is still relatively undeveloped compared to, for example, many European countries: that is not to say the situation in European countries is satisfactory, rather that the situation in New Zealand is somewhat worse. This has necessitated the use of carefully considered estimates and assumptions for some data inputs and modelling parameters, often based on our knowledge of New Zealand waste management, and experience from overseas. These are noted throughout this report, and wherever possible have been evidenced in reference to known data points.

The overall approach taken to modelling is shown in Figure 1-4.

**Figure 1-4: Modelling Flow Diagram**



Waste flows for the baseline year (2015) were compiled based on historic waste data and estimates of the quantity of waste derived from each activity source and management destinations. The waste composition was based on reported compositional data for New Zealand landfills and an analysis of available data on the tonnage of material recovered from each activity source. Waste growth rates were then applied to create forward projections to 2035. The baseline waste flows, and a full description of the method used to derive these,

were written up and sent to a peer reviewer. Feedback from this process was used to update and finalise the waste flows. These are presented in Appendix A.3.0.

The next stage of modelling was to estimate the quantity of waste diverted from landfill under a range of potential levy rates, and to model the diversion of this waste to recovery, energy recovery and other disposal destinations. A detailed description of the approach taken and scenarios modelled is provided in Appendix A.4.0. Finally, the economic parameters used to estimate the economic impacts are briefly discussed in Appendix A.5.0.

These waste flows were used to calculate four main outputs, these are:

- Additional revenue from the landfill levy;
- Additional material revenue from increased recovery;
- Change in Gross Value Added (GVA); and
- Change in employment (i.e. the number of jobs associated with waste management activities).

## A.3.0 Modelling Baseline Waste Flows

One of the first tasks in the study was to develop a mass flow baseline, against which the effects of scenarios modelling changes in landfill tax rates could be compared.

This section describes the approach taken to gathering the necessary data to understand the historic waste management practices and likely future trends under the baseline. In seeking to understand historic and future mass flows and revenues from the landfill levy the following elements were required:

- Total waste generation and management destinations;
- Waste compositions; and
- Projected growth in waste generation and management destination projections.

These elements are described in the sections below.

### A.3.1 Historic Waste Generation and Destinations

#### A.3.1.1 Summary of Waste Destinations

Historic waste generation used in the model were compiled from a variety of sources and are presented in Table 1-4.

**Table 1-4: Waste Generation and Treatment Destinations (2015)**

Waste Destination	Tonnes	Notes
Class 1 Landfill	3,220,888 <sup>1</sup>	2015 data
Class 2 Landfill	2,575,771 <sup>2</sup>	Estimated from 2013 data with waste growth equivalent to change in real GDP applied
Class 3 Landfill	64,394 <sup>2</sup>	
Class 4 Landfill	3,799,262 <sup>2</sup>	
Farm Dumps	1,362,666 <sup>2</sup>	
Recovery	4,288,743	Estimate based on data from various sources
Total Waste Generated	15,311,725	

Sources:

1. Ministry for the Environment (2016) Monthly Levy Graph (background data), 2016, <http://www.mfe.govt.nz/waste/waste-disposal-levy/monthly-levy-graph>
2. Ministry for the Environment (2014) New Zealand Non-Municipal Landfill, October 2014, <http://www.mfe.govt.nz/publications/waste/new-zealand-non-municipal-landfill-database-report>

Table 1-5 describes the four different types of landfill currently in operation.

**Table 1-5: Description of Landfill Classes**

Landfill Class	Definition
<b>Class 4 Landfill - Cleanfill</b>	Accepts only cleanfill material including virgin excavated natural materials, including soils, clays, gravels and rocks.
<b>Class 3 Landfill – Managed / Controlled Fill</b>	Accepts predominantly cleanfill materials but also other inert materials and soils with chemical contaminants greater than regional background concentrations.
<b>Class 2 Landfill – C&amp;D Landfill or Industrial Waste Landfill</b>	Accepts non-putrescible wastes including C&D wastes, inert industrial wastes, controlled/managed fill and cleanfill.
<b>Class 1 Landfill - Municipal Solid Waste Landfill or Industrial Waste Landfill</b>	Accepts municipal solid waste and generally all Class 2-4 waste.

Source: WasteMINZ. 2016. *Technical Guidelines for Disposal to Land*

### A.3.1.2 Destination by Activity Source

Waste flow data for the landfill model is structured by activity source, in line with the waste data definitions set by the National Waste Data Framework.<sup>74</sup> The requirement to account for waste sent to farm dumps meant that we added one additional activity source to this set – rural waste – which is defined in the table.

A description of each activity source is provided in Table 1-6.

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<sup>74</sup> Eunomia Research and Consulting Ltd & Waste Not Consulting Ltd (2015) *New Zealand Waste Data Framework: Draft Definitions and Protocols for Information about Waste Services and Facilities*, February 2015, <http://www.wasteminz.org.nz/wp-content/uploads/Waste-Data-Framework-Services-and-Facilities-Definitions-Protocols-FINAL-2-Mar-2015.pdf>

**Table 1-6: Activity Source Definitions from Waste Data Framework**

Activity Source	Definition
<b>Domestic Kerbside</b>	Domestic-type waste collected from residential premises by the local council (or by a contractor on behalf of the council), or by private waste collections (through kerbside or similar collection).
<b>Residential</b>	All waste originating from residential premises, other than that covered by any of the other Activity Source categories. For example, a person arriving with a trailer load after cleaning out the garage would classify as residential waste.
<b>ICI</b>	Waste from industrial, commercial and institutional sources (ie supermarkets, shops, schools, hospitals, offices). For the purposes of these protocols Illegal dumping and litter should be classified under ICI.
<b>Landscape</b>	Waste from landscaping activity and garden maintenance (including public gardens), both domestic and commercial, as well as from earthworks activity, unless the waste contains only VENM, or unless the earthworks are for purposes of construction or demolition of a structure.
<b>C&amp;D</b>	Waste produced directly or incidentally by the construction and demolition industries. This includes building materials such as insulation, nails, plasterboard and timber, roofing materials, as well as waste originating from site preparation, such as dredging materials, tree stumps, and rubble.
<b>Special</b>	Waste that fits into significant, identifiable waste streams, usually from a single generator. Special wastes are those that cause particular management and/or disposal problems and need special care. This includes, but is not restricted, to hazardous and medical wastes (including e-wastes). It also includes any substantial waste stream (such as biosolids, infrastructure fill or industrial waste) that significantly affects the overall composition of the waste stream, and may be markedly different from waste streams at other disposal facilities.
<b>VENM</b>	<p>Material that when discharged to the environment will not have a detectable effect relative to the background and comprising virgin excavated natural materials, such as clay, soil, and rock that are free of:</p> <ul style="list-style-type: none"> <li>• manufactured materials such as concrete and brick, even though these may be inert;</li> <li>• combustible, putrescible, degradable, or leachable components;</li> <li>• hazardous substances or materials (such as municipal solid waste) likely to create leachate by means of biological breakdown;</li> <li>• any products or materials derived from hazardous waste treatment, stabilisation or disposal practices;</li> <li>• materials such as medical and veterinary waste, asbestos, or radioactive substances that may present a risk to human health if excavated;</li> <li>• contaminated soil and other contaminated materials;</li> <li>• liquid waste.</li> </ul>
<b>Rural</b>	Waste produced by farms in rural locations. This activity source includes all waste sent to farm dumps as well as a proportion of ICI and domestic kerbside waste sent to landfill which is assumed to originate from farms.

This waste data shown in Table 1-4 was then split out by activity source using estimates of the % of waste sent to each management destination derived from each activity source.

These estimates were derived from published and confidential data, and assumptions made using our expert knowledge of New Zealand waste flows and compositions. For Class 1 landfill, these estimates were based on an aggregation of 5 years of SWAP data, supplied in confidence, and for class 2-4 they were based on limited waste audit data<sup>75</sup> and on our expert knowledge of New Zealand waste flows and compositions.<sup>76</sup> We discuss the estimates used for the composition of waste sent to recovery further later on in this section.

It should be noted that any unregulated disposal of waste (e.g. fly-tipping) and the disposal of excavated material on-site are not included in this data, although the potential diversion of waste to these destinations is modelled as a sensitivity and therefore the change in unregulated and illegal waste disposal will be assessed. Other management routes with minor tonnages of waste, such as reuse at op shops is also not included.

Table 1-7 shows the tonnages of waste sent to each activity source. The proportions of waste from each activity source sent to each waste management destination are also presented graphically in Figure 1-5.

**Table 1-7: Waste Generation and Management Destinations by Activity Source (2015)**

	Class 1	Class 2	Class 3	Class 4	Farm Dumps	Recovery	Total
<b>Domestic Kerbside</b>	1,110,432					367,739	<b>1,478,171</b>
<b>Residential</b>	206,390					253,846	<b>460,235</b>
<b>ICI</b>	913,221	257,577		189,963		2,264,909	<b>3,625,671</b>
<b>Landscape</b>	116,553	128,789				130,000	<b>375,341</b>
<b>C&amp;D</b>	578,901	1,545,463	48,296	949,816		1,233,819	<b>4,356,294</b>
<b>Special</b>	185,114	128,789	3,220	189,963		10,128	<b>517,214</b>
<b>VENM<sup>1</sup></b>		515,154	12,879	2,469,521			<b>2,997,554</b>
<b>Rural Waste</b>	110,278				1,362,666	28,302	<b>1,501,247</b>
<b>Total</b>	<b>3,220,888</b>	<b>2,575,771</b>	<b>64,394</b>	<b>3,799,262</b>	<b>1,362,666</b>	<b>4,288,743</b>	<b>15,311,725</b>
<i>Notes:</i>							
1. <i>Virgin Excavated Natural Material</i>							

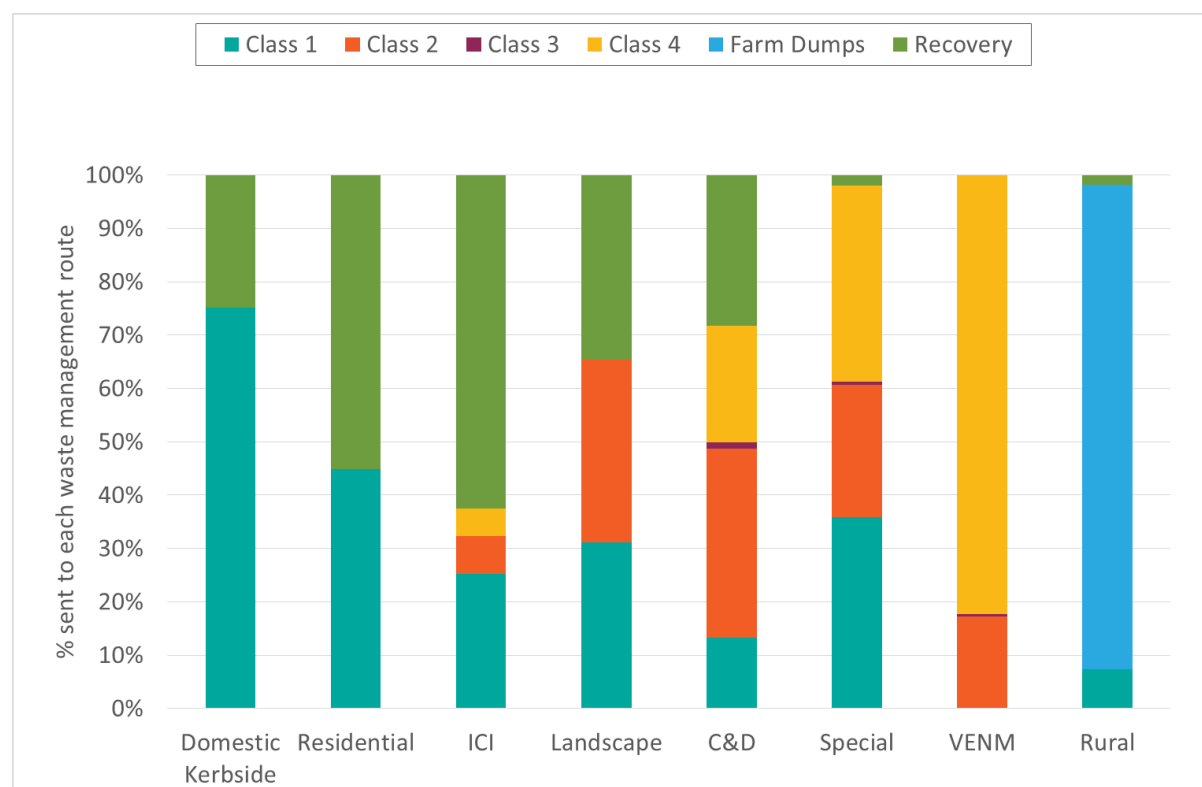
<sup>75</sup> Slaughter G. (2003) Construction of New Zealand's First 100% Recycled Road, Fulton Hogan Ltd, Paper to WasteMINZ Conference.

<sup>76</sup> Aggregation of 5 Years of SWAP Data (2017), confidential commercial data

Additional assumptions were required to estimate the tonnage of ICI and domestic kerbside waste sent to landfill which is assumed to originate from farms and is therefore classified in our study as rural waste. A 2005 survey of rural waste in Taranaki suggested that 20% of farms used skips or landfill to dispose of their waste.<sup>77</sup> We assumed farms that used skips disposed of only non-natural wastes (NNRW) in the skips (i.e. no animal carcasses), and that where skips are used all of their NNRW is disposed of in them. We have further assumed that the farms in the survey were representative of all farms. As Taranaki is relatively easy to service compared to some other areas of New Zealand then this is potentially an over-estimate, however, as there is no further data to refine this figure we have used this value for modelling. By applying these assumptions we calculate that a total of 132,790 tonnes of ICI waste is produced by farms. Also, applying the same logic, 17% of farms used wheeled bins for collection/disposal of domestic waste. This implies that approximately 5,790 tonnes of domestic waste is from rural sources. We assumed that all rural waste not disposed of on-site at farm dumps would be sent to class 1 landfill (due to the very high composition of active waste).

Figure 1-6 provides a breakdown of the origin of waste sent to each landfill class. As shown in Figure 1-5, most of the waste sent to class 1 landfills is from activity sources which are mainly active waste, such as Domestic Kerbside and ICI. Waste from activity sources with higher inert fractions is mainly sent to class 2 to 4 landfills, while most of the waste disposed of at cleanfill sites (class 4) is made up of virgin excavated natural materials (VENM).

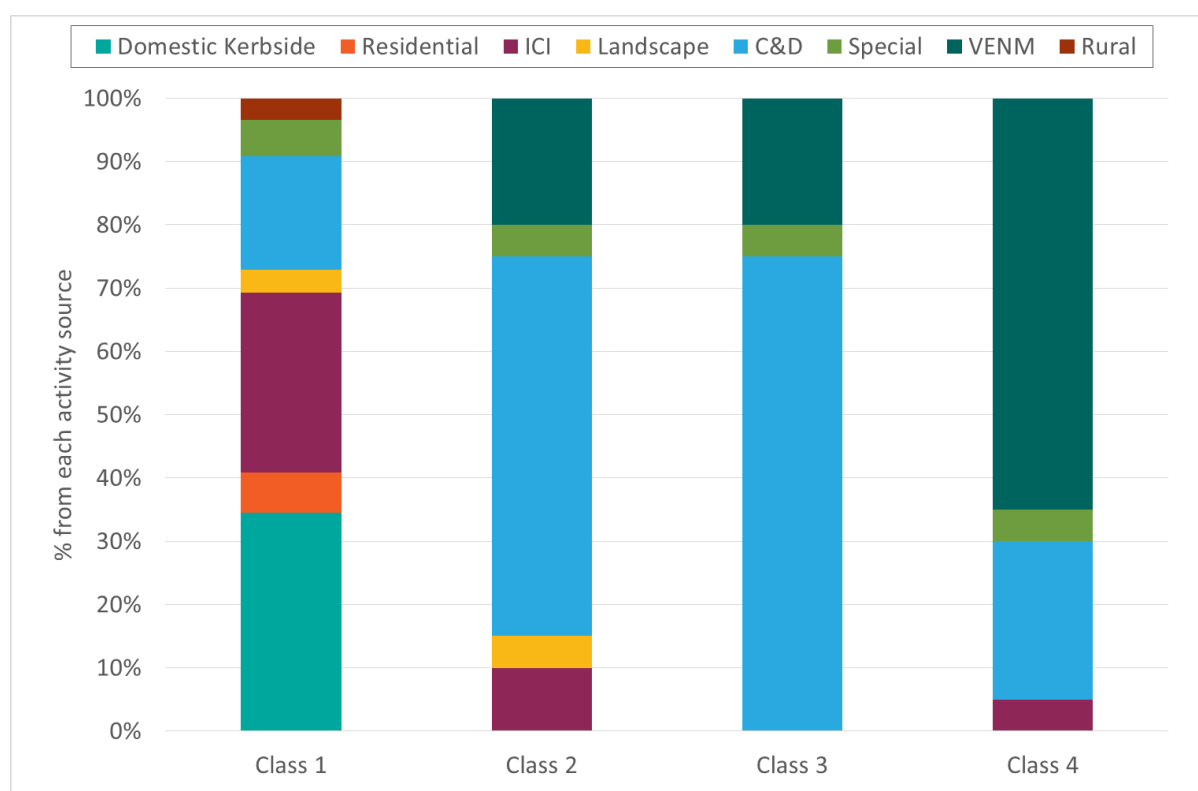
**Figure 1-5: Waste Management Destinations by Activity Source (2015)**



<sup>77</sup> Taranaki Regional Council (2005) *Investigation into Taranaki's Rural Waste Stream*, 2005, <http://www.wasteminz.org.nz/wp-content/uploads/Richard-Fitzpatrick.pdf>



**Figure 1-6: Waste sent to Class 1-4 Landfill from each Activity Source**



### A.3.1.3 Recovered Waste

Data for the recovery of waste is one area where the available data in New Zealand is particularly poor. The tonnage of waste sent to recovery, either as an overall figure, or broken down by material or activity source, is not reported at a national level. This required us to derive recovered tonnages from a wide range of sources and make assumptions where appropriate, requiring different approaches for each material and activity source.

The first stage of compiling this data was to estimate the tonnage of each material recovered in New Zealand. Table 1-8 presents this data and a full description of the data sources used. The data presented in this table is for a range of time periods, and, in some cases, the data year is not specified in the source. We have used the data presented below for the baseline year (2015) and note that this mixture of data years introduces some unavoidable uncertainty into the baseline mass flows.

**Table 1-8: Tonnage of Material Recovered in New Zealand**

Material	Tonnage of Recovery per Annum
Paper <sup>1</sup>	435,000
Plastics <sup>2</sup>	38,998
Putrescibles <sup>3</sup>	1,175,667
Ferrous metals <sup>4</sup>	560,000
Non-ferrous metals <sup>4</sup>	50,000
Glass <sup>5</sup>	163,567
Textiles <sup>6</sup>	8,286
Nappies and sanitary	-
Rubble <sup>7</sup>	1,667,998
Timber <sup>7</sup>	163,200
Rubber <sup>8</sup>	14,700
Potentially hazardous <sup>9</sup>	11,328
<b>Total</b>	<b>4,288,743</b>

Sources:

1. Compiled from data for OJI Fibre, Visy, and Reclaim (with estimates for other key operators): Oji Fibre Solutions (2017) 2015 Highlights, <http://www.ojifs.com/sustainability/>; Auckland Council (2011) Auckland Council Waste Assessment, October 2011, <http://www.aucklandcouncil.govt.nz/EN/environmentwaste/rubbishrecycling/wastemanagementandminimisationplan/Documents/wasteassess-report.pdf>; Personal communication with Peter Thorne, Paper Reclaim
2. Infometrics (2015) Review of Packaging Mass Balance Measurements, Report for Packaging Council of New Zealand, April 2015, <http://www.packaging.org.nz/attachments/docs/review-of-packaging-mass-balance-measurements.pdf>; Covec (2016) Evaluating the Costs and Benefits of Introducing a Container Deposit Scheme for New Zealand, Report for the Packaging Forum's Public Place Recycling Scheme, March 2016, [http://www.recycling.kiwi.nz/files/3014/6101/9990/CDS\\_report\\_2016.pdf](http://www.recycling.kiwi.nz/files/3014/6101/9990/CDS_report_2016.pdf)
3. Based on Eunomia database of North Island compost operations, pro-rated to all of New Zealand; Ministry for the Environment (2011) 2011 Green Ribbon Award Winners – EcoStock, <http://www.mfe.govt.nz/more/awards/green-ribbon-awards/past-winners/2011-winners>
4. Personal communication with Scrap Metals Recyclers Association of NZ; New Zealand Steel (2017) Redefining Waste, <http://www.nzsteel.co.nz/sustainability/redefining-waste/>
5. Covec (2016) Evaluating the Costs and Benefits of Introducing a Container Deposit Scheme for New Zealand, Report for the Packaging Forum's Public Place Recycling Scheme, March 2016, [http://www.recycling.kiwi.nz/files/3014/6101/9990/CDS\\_report\\_2016.pdf](http://www.recycling.kiwi.nz/files/3014/6101/9990/CDS_report_2016.pdf)
6. Based on New Zealand export data compiled from a range of sources: Statistics New Zealand (2016) Global New Zealand – International trade, investment, and travel profile: Year ended June 2016, [http://www.stats.govt.nz/browse\\_for\\_stats/industry\\_sectors/imports\\_and\\_exports/global-nz.aspx](http://www.stats.govt.nz/browse_for_stats/industry_sectors/imports_and_exports/global-nz.aspx). Wellington: Ministry of Foreign Affairs and Trade, and Statistics New Zealand.

7. *Based on Auckland Council Waste Assessment figures pro-rated to NZ based on construction activity - Auckland Council Waste Assessment, October 2011,*  
<http://www.aucklandcouncil.govt.nz/EN/environmentwaste/rubbishrecycling/wastemanagementandminimisationplan/Documents/wasteassess-report.pdf>;
8. *KPMG (2015) Intervention Options to Promote Investment in On-Shore Waste Tyre Recycling, Report for Ministry for the Environment, May 2015,*  
<http://www.mfe.govt.nz/sites/default/files/media/Waste/waste-tyres-economic-research-report.pdf>
9. *Ministry for the Environment (2017) Accredited Voluntary Product Stewardship Schemes,*  
<http://www.mfe.govt.nz/waste/product-stewardship/accredited-voluntary-schemes/>; *Eunomia (2015) Organic Waste Diversion Study, Report for Taranaki Region Councils*

The next stage of our analysis was to split out the tonnages of material recovered by activity source. We took a range of different approaches, depending on the available data, to making these estimates, these are summarised as follows:

- **Domestic kerbside** – The total tonnage of recovery was based on data collected by each district in New Zealand. The composition of recovery from this activity source was estimated based on recycling composition data for Auckland and Wellington districts and cross-checked with the composition from the Kopu MRF;
- **Residential** – This was based on a range of sources and calculations depending on material type. Putrescible data was derived from an earlier study of organic waste in NZ, textile recovery was assigned to the residential stream, while a fraction of the metals, timber and rubble streams were assumed to originate from residential sources;<sup>78</sup>
- **ICI** – Recovered tonnages for this activity source were defined as the remaining waste tonnage after accounting for domestic kerbside waste, residential, landscape, C&D and rural waste;
- **Landscape** – This was based on data from an earlier study of organic waste in NZ;<sup>79</sup>
- **C&D** - All rubble and timber, with the exception of a small fraction of residential waste, was assumed to be produced by C&D activities. Metal and glass recovery tonnages based on published estimates were used;
- **Special** – Most hazardous waste was allocated to the special category, with a proportion of the tonnages from data for product stewardship schemes apportioned to ICI waste; and
- **Rural** – a small proportion of waste not disposed of at farm dumps was assumed to be recovered. The capture rates were assumed to be similar to ICI waste, except with higher quantities of timber to account for the higher tonnages of this material in the rural waste stream.

The results of this analysis, showing the tonnage of material recovered split by activity source, are presented in Table 1-9.

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<sup>78</sup> Eunomia (2010) *Household Organic Waste Cost Benefit Analysis*, Report to Greenfingers Garden Bags/Earthcare Environmental Limited & Envirofert Limited

<sup>79</sup> Ibid.

**Table 1-9: Tonnage of Material Recovered**

Material	Domestic Kerbside	Residential	ICI	Landscape	C&D	Special	Rural	Total
Paper	148,497		283,219				3,284	435,000
Plastics	21,214		14,295				3,489	38,998
Putrescibles	64,685	80,000	899,516	130,000			1,466	1,175,667
Ferrous metals	9,092	90,000	403,570		50,000		7,338	560,000
Non-ferrous metals	3,031	4,000	39,138		3,800		32	50,000
Glass	121,222	9,000	29,274		4,000		71	163,567
Textiles		8,286					-	8,286
Nappies and sanitary							-	-
Rubble		54,400	580,000		1,033,598		-	1,667,998
Timber		8,160			142,421		12,619	163,200
Rubber			14,698				2	14,700
Potentially hazardous			1,200			10,128		11,328
<b>Total</b>	<b>367,739</b>	<b>253,846</b>	<b>2,264,909</b>	<b>130,000</b>	<b>1,233,819</b>	<b>10,128</b>	<b>28,302</b>	<b>4,288,743</b>

## A.3.2 Waste Composition

### A.3.2.1 Composition of Waste sent to Landfill

When modelling scenarios, the model provides the functionality to specify different landfill tax rates for two distinct waste types (see Appendix A.4.1 for a further discussion of our rationale in choosing this landfill tax structure), these are:

- Mixed active waste – any waste not specified below; and
- Inert waste – this includes inert manufactured materials (concrete, brick, tiles) and natural materials soils, clays, gravel and rocks. Materials that are not chemically inert but are an aggregate-type materials, e.g. slag from the steel industry and ash, are also included here. This category effectively includes all waste categorised as rubble. This category excludes VENM for which a tax will not be levied.

Waste compositions are therefore required to estimate, for each activity source, the amount of each waste type which is sent to landfill. Assumptions for the composition of waste from each activity source sent to class 1 landfills are presented in Table 1-10.

**Table 1-10: Composition of Waste Sent to Class 1 Landfill**

Material	Domestic Kerbside <sup>1</sup>	Residential <sup>2</sup>	ICI <sup>2</sup>	Landscape <sup>2</sup>	C&D <sup>2</sup>	Special*	Rural
Paper	14.3%	8.8%	14.0%	1.2%	2.6%		1.9%
Plastics	12.1%	9.8%	15.0%	1.2%	3.4%		44.7%
Putrescibles	49.6%	16.8%	14.4%	60.1%	2.7%		1.3%
Ferrous metals	2.1%	12.6%	6.0%	1.0%	4.8%		4.2%
Non-ferrous metals	0.9%	0.8%	0.9%	0.0%	0.4%		0.0%
Glass	3.0%	4.0%	9.2%	0.6%	1.4%		0.1%
Textiles	3.8%	11.6%	7.8%	0.5%	3.1%		0.2%
Nappies and sanitary	10.7%	2.5%	3.2%	0.2%	0.1%		0.6%
Rubble	1.6%	7.0%	5.7%	29.6%	39.2%		0.1%
Timber	0.7%	24.2%	15.2%	5.2%	41.2%		33.9%
Rubber	0.2%	1.0%	7.2%	0.3%	0.8%		0.0%
Potentially hazardous	1.0%	0.9%	1.4%	0.0%	0.5%	100.0%	13.1%
<b>Total</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>

Notes:

\* Special waste is a very broad category, in practice the bulk of waste is sewage sludge, other industrial sludges and contaminated soil. It is difficult to come up with a composition figure because loads are intermittent, and unpredictable.

Sources:

1. Waste Not Consulting (2009) Household Sector Waste to Landfill in New Zealand, Report for Ministry for the Environment
2. Ministry for the Environment (2008) Solid Waste Audits for Ministry for the Environment Waste Data Programme 2007/08, <http://www.mfe.govt.nz/publications/waste/solid-waste-audits-ministry-environment-waste-data-programme-200708-solid-waste-1>

The composition of waste sent to class 2, 3 & 4 landfills and farm dumps used in modelling is shown in Table 1-11.

**Table 1-11: Composition of Waste Sent to Class 2, 3 & 4 Landfills & Farm Dumps**

Material	Class 2-4 Landfill Waste Composition <sup>1</sup>	Farm Dump Composition <sup>2</sup>
Paper	0.1%	1.6%
Plastics	0.0%	15.6%
Putrescibles	1.6%	60.0%
Ferrous metals	0.1%	3.5%
Non-ferrous metals	0.0%	0.0%
Glass	0.0%	0.1%
Textiles	0.0%	0.1%
Nappies and sanitary	0.0%	0.2%
Rubble	88.9%	0.0%
Timber	9.2%	14.7%
Rubber	0.1%	0.0%
Potentially hazardous	0.0%	4.2%
Total	100%	100%

Sources:

1. Greg S. (unknown date) Construction of New Zealand's First 100% Recycled Road, Fulton Hogan Ltd, <http://www.wasteminz.org.nz/wp-content/uploads/Greg-Slaughter2.pdf>
2. Environment Canterbury (2013) Non-natural Rural Wastes -Site Survey Data Analysis, October 2013, <https://ecan.govt.nz/your-region/your-environment/waste-management/rural-waste-minimisation/>

### A.3.2.2 Overall Waste Composition

The implicit overall composition of waste generated used in modelling can be calculated from the data shown in Table 2-1 through to Table 1-11. This is provided in Table 1-12 and Figure 1-7 for reference.

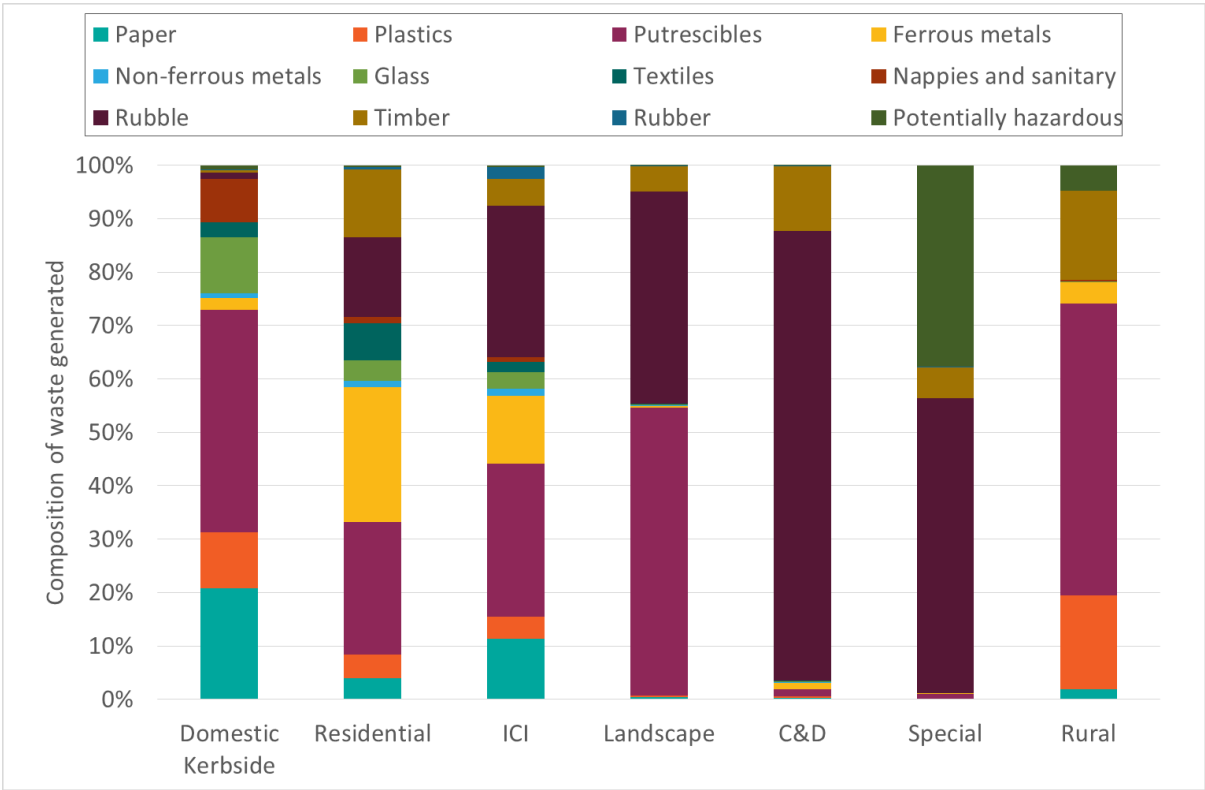
**Table 1-12: Composition of Total Waste Generated by Activity Source**

Material	Domestic Kerbside	Residential	ICI	Landscape	C&D	Special	Rural
Paper	20.8%	3.9%	11.4%	0.4%	0.3%	0.1%	1.8%
Plastics	10.5%	4.4%	4.2%	0.4%	0.3%	0.0%	17.6%
Putrescibles	41.6%	24.9%	28.6%	53.9%	1.4%	1.0%	54.6%
Ferrous metals	2.2%	25.2%	12.7%	0.3%	1.1%	0.1%	4.0%
Non-ferrous metals	0.9%	1.2%	1.3%	0.0%	0.1%	0.0%	0.0%
Glass	10.5%	3.7%	3.1%	0.2%	0.2%	0.0%	0.1%
Textiles	2.9%	7.0%	2.0%	0.2%	0.2%	0.0%	0.1%
Nappies and sanitary	8.0%	1.1%	0.8%	0.1%	0.0%	0.0%	0.2%
Rubble	1.2%	14.9%	28.4%	39.7%	84.1%	55.3%	0.0%
Timber	0.5%	12.6%	5.0%	4.8%	12.1%	5.7%	16.6%
Rubber	0.2%	0.4%	2.2%	0.1%	0.1%	0.1%	0.0%
Potentially hazardous	0.8%	0.4%	0.4%	0.0%	0.0%	37.7%	4.8%
<b>Total</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>

Source: Calculated from landfill and recovery data. Rural composition taken from: Environment Canterbury (2013) Non-natural Rural Wastes -Site Survey Data Analysis, October 2013, <https://ecan.govt.nz/your-region/your-environment/waste-management/rural-waste-minimisation/>



Figure 1-7: Composition of Total Waste Generated by Activity Source



The green and food waste content of the Putrescibles category was also estimated for each waste stream, as shown in Table 1-13. For domestic kerbside the % of green waste is calculated from the overall waste composition, assuming that all material recovered under the putrescibles category is green waste. For other activity source our assumptions are based on the composition found in typical waste management system for these waste streams.

**Table 1-13: Green/Food Waste Split for Putrescibles**

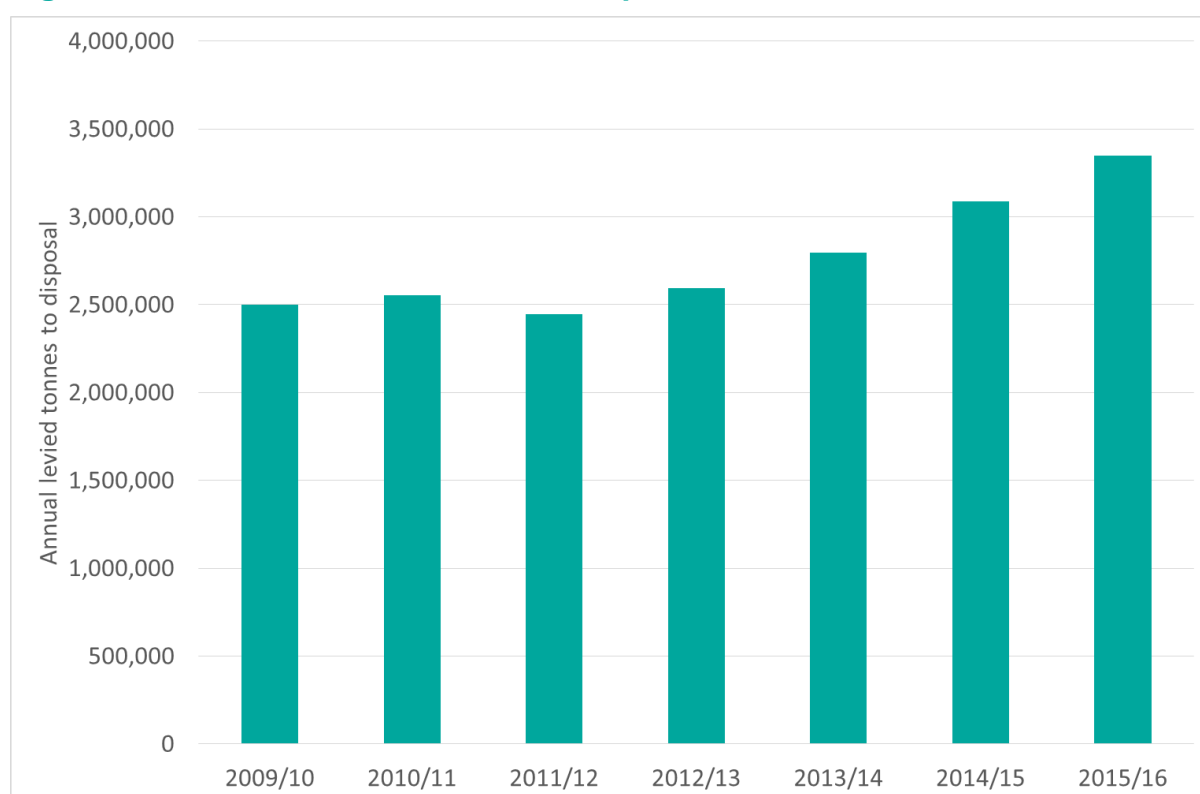
Activity Source	% Green Waste (Remainder is Food Waste)
Domestic Kerbside	27%
Residential	100%
ICI	5%
Landscape	100%
C&D	100%
Special	100%
VENM	100%
Rural	0.3%

## **A.3.3 Future Waste Projections**

### **A.3.3.1 Historic Landfill Trends**

Data from levy returns shows that while quantities to landfill remained relatively flat from the introduction of the Levy in 2009 until 2012, there has been a significant year on year increase in the quantity of material disposed of up until the most recent available data (May 2016). This has resulted in the quantity of levied waste rising by close to 1 million tonnes over this period. The change in tonnes to levied disposal sites is shown in Figure 1-8.

**Figure 1-8: Annual Levied Tonnes to Disposal**

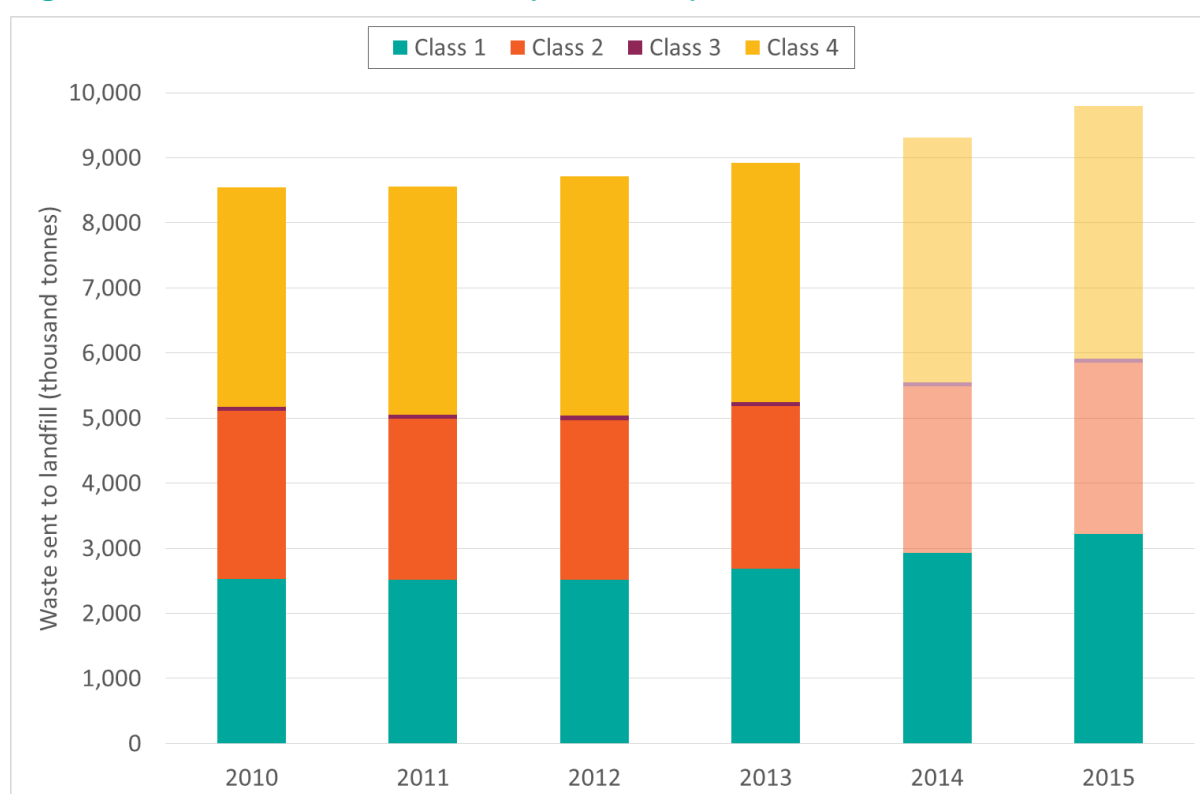


Source: Ministry for the Environment (2016) Monthly Levy Graph (background data), 2016, <http://www.mfe.govt.nz/waste/waste-disposal-levy/monthly-levy-graph>

Regression analysis was undertaken on a range of variables to determine the factors driving the increase in tonnage to disposal. It was found that the increase could be accurately predicted from quarterly data with a combination of real consumption expenditure, population, and building consent data ( $r\text{-squared} = 0.932$ , meaning 93% of the variation can be explained by these factors).

The total quantity of waste sent to all landfills for the period 2010-2015 is shown in Figure 1-9. Note that in contrast to Figure 1-8 the data is presented in calendar years to align with available class 2-4 facility estimates.

**Figure 1-9: Waste Sent to Landfill (2010-2015)**



*Notes: Tonnages for Class 2-4 landfills for 2014 and 2015 are estimated assuming waste growth in proportion to increase in real GDP*

*Source: Ministry for the Environment (2014) New Zealand Non-Municipal Landfill, October 2014, <http://www.mfe.govt.nz/publications/waste/new-zealand-non-municipal-landfill-database-report>*

### **A.3.3.2 Waste Growth Rates**

The regression analysis undertaken above was a very good fit and we can predict growth of Class 1 landfill based on these estimates. However, for the model we need to predict the growth of waste generation, which also include:

- Class 2 - 4 landfilling;
- Recovery; and
- Farm dumps.

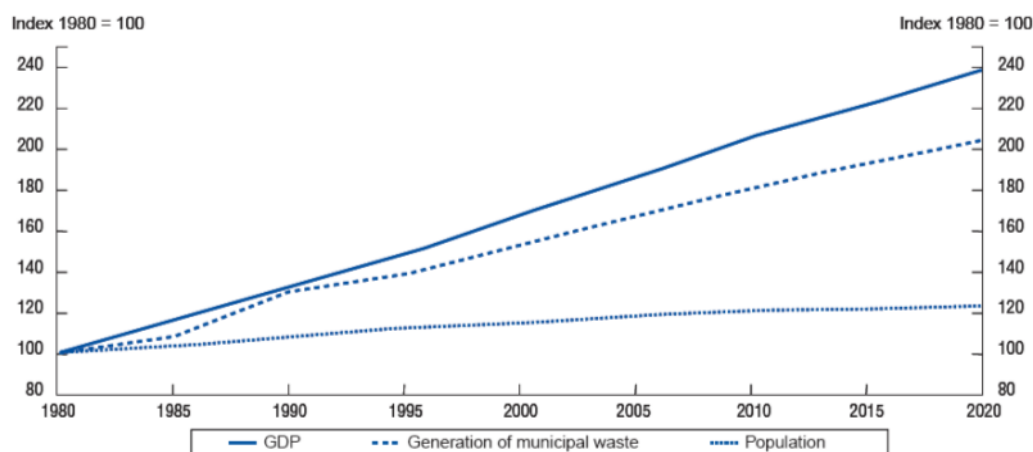
For these material destinations, which account for over 75% of waste material generated, we just have some annual estimates for class 2-4, and no real data for farm-dumps and recovery. If we switch to annual figures we just have seven data points for class 1-4 landfill (there is no data for class 1 before 2009), which is not enough to do an adequate regression analysis.

Because the composition of the material going to other destinations than Class 1 is different to Class 1 composition, the growth rate of these elements is likely to be

different compared to growth of class 1 landfill. Thus it cannot be justified to use the growth rate of Class 1 as a proxy for growth rate of waste generation.

Previous work has found a correlation between change in real GDP and the amount of waste landfilled<sup>80</sup>, while a range of international work suggests a strong link between GDP and waste for developed nations.<sup>81</sup> For reference, Figure 1-10 below shows the growth in municipal waste in the OECD plotted against GDP and population.

**Figure 1-10: Municipal Waste Generation, GDP and Population in OECD 1980 - 2020**



Source: OECD 2001.

Based on this, it is our expectation that over the longer term real GDP will provide a more robust correlation with overall waste generation, and we propose to use GDP forecasts as the main proxy for projecting future waste generation.

We performed our own analysis of the relationship between real GDP and waste growth for all 28 EU Member States.<sup>82,83</sup> A correlation between waste growth and real GDP is observed; on average, waste growth was at 60% of the rate of growth of real GDP from 2007 to 2015. We have applied this same relationship to this study to estimate waste

<sup>80</sup> Eunomia, Waste Not (2014) *Incorporating Waste Minimisation Act Data into New Zealand Greenhouse Gas Emissions Estimates 0715-01*. Report for Ministry for the Environment

<sup>81</sup> For example: Environmental Protection Agency (2014) *Quantity of Municipal Solid Waste Generated and Managed*, <https://cfpub.epa.gov/roe/indicator.cfm?i=53#2>; World Bank (2010) *Urban Development Series – Knowledge Papers: Waste Generation*, <http://siteresources.worldbank.org/INTURBANDEVELOPMENT/Resources/336387-1334852610766/Chap3.pdf>

<sup>82</sup> Eurostat (2017) *Generation of waste by waste category, hazardousness and NACE Rev. 2 activity [env\_wasgen]*, Accessed 1<sup>st</sup> April 2017, [http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=env\\_wasgen&lang=en](http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=env_wasgen&lang=en)

<sup>83</sup> Eurostat (2017) *Real GDP Growth Rate – Volume*, Accessed 1<sup>st</sup> April 2017, <http://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&pcode=tec00115&plugin=1>

growth rates. We recognise that the policy environment in the EU is more comprehensive than New Zealand, however, the data here simply doesn't exist to perform the regression. The consequence of underestimating growth in this study is that the economic indicators would be lower than they would be in reality, so the approach is considered appropriate as it is precautionary.

Data on the annual % change in real GDP was sourced from the most recent economic forecasts published by the Treasury, which provide projections forward to 2021.<sup>84</sup> For future years we have assumed that real GDP will continue to grow at the 2021 rate of change. These forecasts, which provide us with waste growth rates, are shown in Table 1-14. We have assumed that for the base case, there will be no significant change in management destinations for future years.

**Table 1-14: Waste Growth Rate Assumptions**

Year	2016	2017	2018	2019	2020	2021
% Annual Change in Waste Generation	1.7%	2.2%	2.1%	1.7%	1.4%	1.4%

### A.3.3.3 Impacts of the NZ ETS

The Climate Change Response Act 2002 and associated regulations is the Government's principal response to manage climate change. A key mechanism for this is the New Zealand Emissions Trading Scheme (NZ ETS). The NZ ETS puts a price on greenhouse gas emissions, providing an incentive for people to reduce emissions and plant forests to absorb carbon dioxide. Certain sectors are required to acquire and surrender emission units to account for their direct greenhouse gas emissions or the emissions associated with their products. Landfills that are subject to the waste disposal levy are required to surrender emission units to cover methane emissions generated from landfill. These disposal facilities are required to report the tonnages landfilled annually to calculate emissions.

The NZ ETS was introduced in 2010 and, from 2013, landfills have been required to surrender New Zealand Emissions Units (NZUs) for each tonne of CO<sub>2</sub> equivalent (CO<sub>2</sub>e) that they produce. Up until recently however the impact of the NZ ETS on disposal prices has been very small. There are a number of reasons for this:

- The global price of carbon crashed during the GFC in 2007-8 and been slow to recover. Prior to the crash it was trading at around \$20 per tonne, while the price has been as low as \$2, after the crash. But since the Government moved to no

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<sup>84</sup> The Treasury (2016) *Half Year Economic and Fiscal Update*, 8<sup>th</sup> December 2016, <http://www.treasury.govt.nz/budget/forecasts/hyefu2016>

longer accept international units in NZ ETS in June 2015, the NZU price has increased markedly (currently trading at around \$17 per tonne)<sup>85</sup>.

- The transitional provisions of the Climate Change Response Act meant that landfills only had to surrender half the number of units they would be required to otherwise. These transitional provisions however are now being phased out and, between 1 January 2017 and 1 January 2019, landfills will move towards surrendering their full NZU liabilities.<sup>86</sup>
- Landfills are allowed to apply for a methane capture and destruction Unique Emissions Factor (UEF). This means that if landfills have a gas collection system in place and flare or otherwise use the gas (and turn it from Methane into CO<sub>2</sub>) they can reduce their liabilities in proportion to how much gas they capture. Up to 90% capture and destruction is allowed to be claimed under the regulations, with large facilities applying for UEFs at the upper end of the range.

Taken together (a low price of carbon, requirement of only two for one surrender, and methane capture and destruction of 80-90%), these mean that the actual cost of compliance with the NZ ETS has until recently been negligible, particularly for larger facilities claiming high gas capture.

However the removal of the transitional provisions and the increase in the price of NZUs has meant that those landfills without gas capture, or with lower levels of claimed gas capture, are now facing increasing costs of compliance. Using the current price as a reference, approximate costs for landfills without gas capture and without the transitional provisions are presented in Table 1-15. 2015 costs with the 2 for 1 provisions are also shown for reference.

**Table 1-15: ETS Compliance Costs for Landfills without Gas Capture**

Time Period	NZU cost	2 for 1 surrender	Cost per tonne of waste <sup>1</sup>
June 2015	\$6	Yes	\$3.93
March 2017	\$17	No	\$22.27
Notes:			
1. 1.31 NZUs must be surrendered per tonne of waste			

<sup>85</sup> Carbon Match (2017) *Carbon Match*, Accessed 28th March 2017, <https://carbonmatch.co.nz/>

<sup>86</sup> <http://www.mfe.govt.nz/sites/default/files/media/Climate%20Change/one-for-two%20factsheet-final%20%282%29.pdf>

While it is early days in the removal of the transitional provisions, it might be expected that the increased cost of compliance would lead to increased diversion of material from landfill. We do not believe however that this will be the dominant outcome from the current set of drivers and have therefore not modelled any additional diversion due to this change in NZU prices. Our reasoning for this is set out below.

Another observable trend in waste management in New Zealand has been the consolidation of material sent to disposal from small and/or local (usually council owned) landfills to large regional facilities (usually private sector, or public/privately owned). This is shown in Figure 1-11. The latest available data (2016) indicates that 33 class 1 landfills were in operation.

**Figure 1-11: Number of Class 1 Disposal Facilities in Operation**



Sources: Ministry for the Environment (2007) *The 2006/07 National Landfill Census*, Ministry for the Environment (2014) *New Zealand Non-Municipal Landfill, October 2014*, 2016 data compiled from TA Waste Assessments.

This flow of material from numerous small facilities to a few large facilities has been driven primarily by the economics resulting from compliance costs associated with higher environmental standards. The cost of compliance with the Resource Management Act (RMA) has meant that smaller facilities have higher fixed costs, which necessitates higher pricing to recover costs. Conversely, the larger facilities are able to have relatively low fixed costs in relation to their capacity. This price differential has meant that the regional facilities are able to attract waste from a large catchment and be competitive even after taking account of transport costs. Furthermore, as tonnage



moves from the smaller facilities to the larger ones, this results in less tonnage across which the small facilities can spread fixed costs, leading to price pressure which further fuels the flow of material to the large facilities.

Based on the fact that the current ETS policy settings are likely to disproportionately impact small facilities with no (or low levels of) gas capture, our expectation is that the main impact from increases in the price of NZUs and the attendant liabilities will be to increase the flow of material from small facilities to large facilities with high gas capture, rather than to incentivise higher levels of recovery (although this may occur, we expect the impact to be small and relatively localised). In other words, we expect that the ETS will push prices up (to reflect increased landfill and transport costs), but not by the amount that is implied by the prevailing carbon price.

If the cost of carbon rises to approximately \$45 per tonne by 2025 (the mid-range “Mixed Renewables’ scenario in the Governments carbon projections<sup>87</sup> this would equate to additional costs of \$5.86 for a landfill claiming 90% gas capture, but costs of \$58.55 for landfills with no gas capture – a differential of \$52.70. At this level of differential waste could travel up to an additional 285km from a small facility to a large facility, which would extend the catchment of large facilities accordingly. Allowing for the flow of materials to high capture facilities we calculate that the net impact of the NZETS would be an average increase in the cost of disposal in the order of \$12 - \$13 per tonne.

The New Zealand government is pricing carbon into its forward projections at up to \$152 a tonne in 2030 (this level is for a future scenario in which global carbon emissions are substantially reduced).<sup>88</sup> A change of this magnitude in carbon price would be expected to drive a reduction in waste sent to landfill. However, as there is no carbon price floor proposed (to insure that the price will actually reach this level), we cannot be definite on the future trends in carbon price. Without sufficient certainty we have therefore assumed there will be no change in the NZU price.

#### A.3.3.4 Overview of Baseline Projections

Waste flow projections for the period from 2015 to 2030 are presented in Figure 1-12.

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<sup>87</sup> <sup>87</sup> Ministry of Business Innovation and Employment (2016) *Electricity Demand and Supply Generation Scenarios 2016*, November 2016, <http://www.mbie.govt.nz/info-services/sectors-industries/energy/energy-data-modelling/modelling/electricity-demand-and-generation-scenarios/edgs-2016#assumptions>

<sup>88</sup> Ministry of Business Innovation and Employment (2016) *Electricity Demand and Supply Generation Scenarios 2016*, November 2016, <http://www.mbie.govt.nz/info-services/sectors-industries/energy/energy-data-modelling/modelling/electricity-demand-and-generation-scenarios/edgs-2016#assumptions>

**Figure 1-12: Waste Flow Projections (2015 to 2030)**

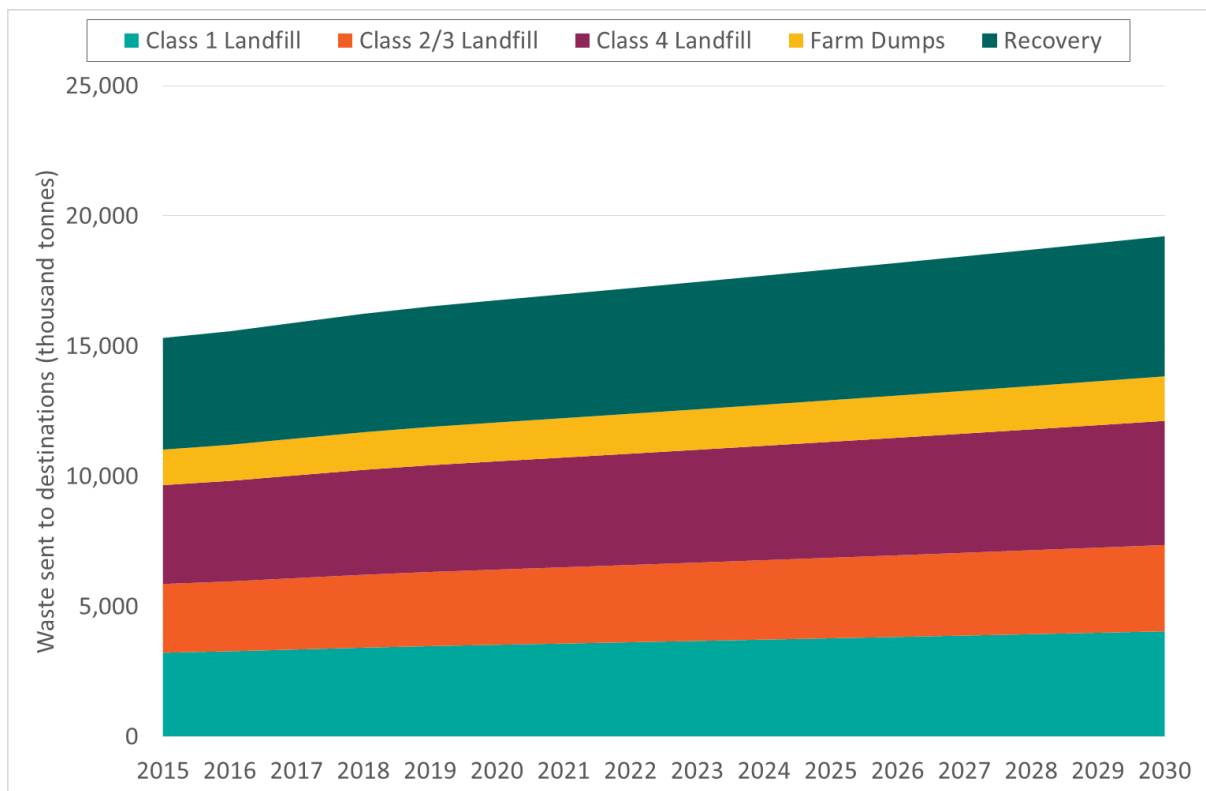


Figure 1-13 depicts the projected waste to landfill by activity source from 2015 to 2030. Revenue projections are shown in Figure 1-14, split by activity source. These were calculated on the basis that the current landfill levy of \$10 will continue to apply to all waste sent to class 1 landfill. Revenues from the landfill levy increase year on year in line with overall waste growth.

Figure 1-13: Landfill Projections by Activity Source (2015 to 2030)

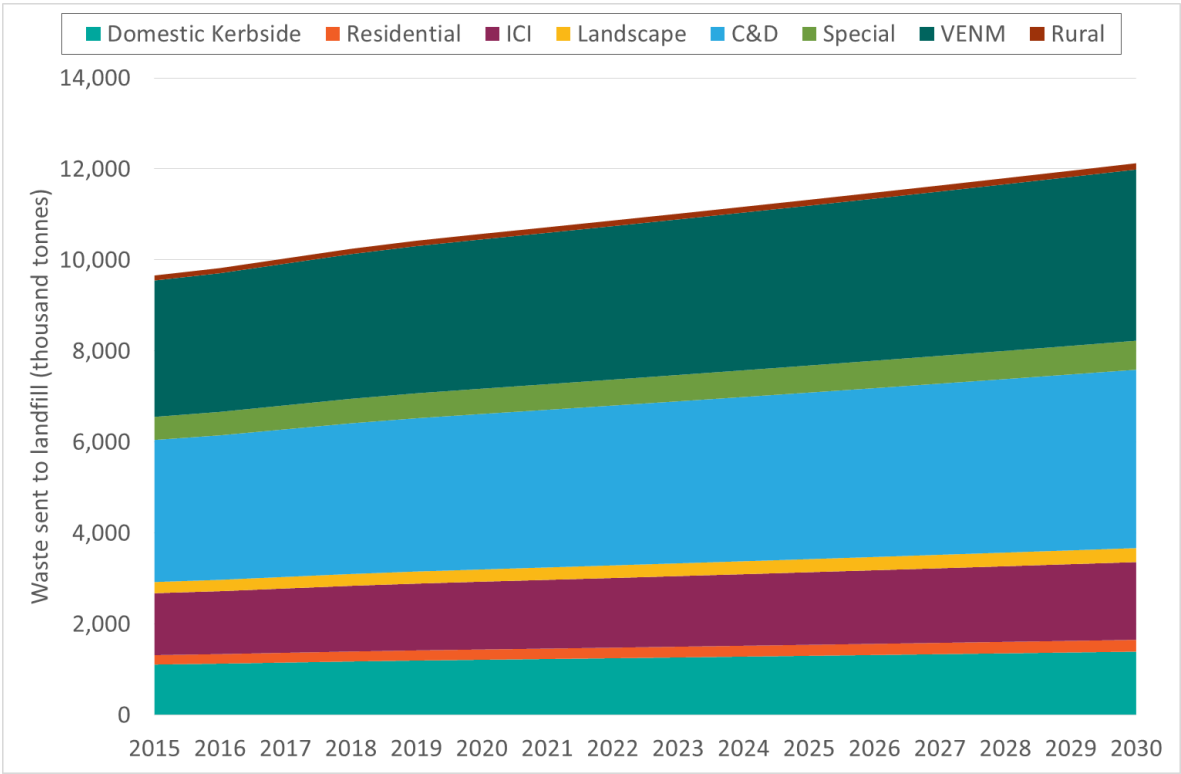
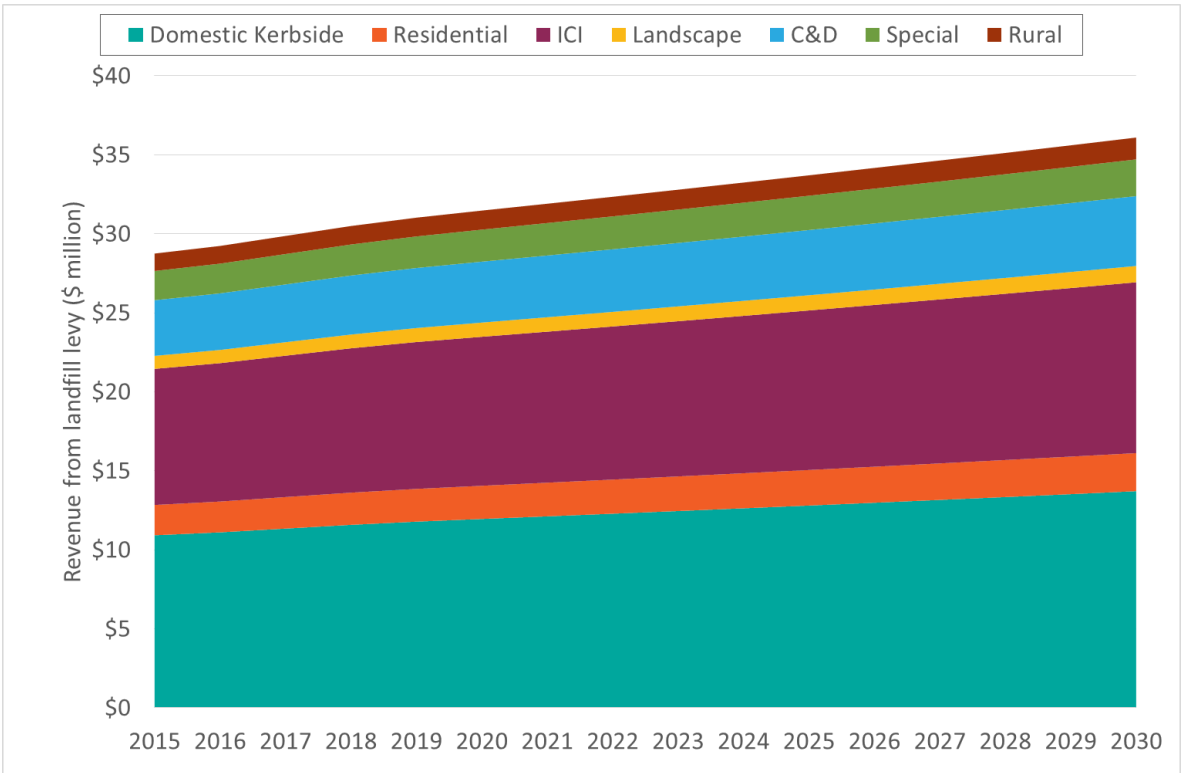


Figure 1-14: Landfill Levy Revenue Projections (2015 – 2030)



Note: levy revenue from inert waste sent to class 1 landfill is excluded

## A.4.0 Scenario Modelling

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### A.4.1 Scenario Specification

Review of landfill levies in other countries (Appendix A.1.3) suggests that most of them have one rate for active waste and another for C&D or inert waste. Our model also provides the functionality to specify two distinct waste disposal levy rates, these are:

- **Standard rate** – any waste not specified below. Applied to class 1, 2 and 3 landfills only; and
- **Lower rate** – this includes inert manufactured materials (concrete, brick, tiles) and natural materials soils, clays, gravel and rocks. Material that is not chemically inert but is an aggregate-type material, e.g slag from the steel industry and ash, is also included here. This category effectively includes all waste categorised as rubble. This category excludes material from the VENM<sup>89</sup> activity source, for which it is assumed that no levy will be applied. This rate is proposed to apply to all landfill classes.

We have modelled 4 scenarios, which include different rates of the levy. In all scenarios an adequate inspection and enforcement regime is also implemented (over and above what is currently in place), in order to minimise the increase in illegal activity that may occur due to increased disposal costs. The main assumptions for the scenarios are described in Table 1-16.

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<sup>89</sup> Virgin Excavated Natural Material.

**Table 1-16: Assumptions on Modelled Scenarios**

#	Scenario	Description	Maximum levy rate (\$ per tonne)		Elasticity	Diversion to EfW	Maximum waste minimisation (%)	
			Standard	Inert			ICI	C&D
1	Low improvement scenario	Revenue mainly used to enhance inspection and enforcement activities.	\$20	\$2	-0.2	0%	2%	0.5%
2	Enhanced recycling scenario	The levy is set in the region where the business case to invest in quality recycling services is made, including biowaste collections.	\$90	\$10	-0.6	0%	5%	1.25%
3	Minimal waste disposal scenario	High levy drives majority of waste from landfill, but also stimulates diversion to EfW.	\$140	\$15	-1.0	30%	6%	1.5%
4	Maximum recycling scenario	High levy drives majority of waste from landfill, and a levy of \$40 per tonne on EfW is set, driving a high level of recycling performance.	\$140	\$15	-1.0	0%	6%	1.5%

The assumptions on elasticities, diversion to recovery and incineration, and waste prevention under different scenarios are discussed in detail in Appendix A.4.2.

As discussed in Appendix A.1.4, it is a common practice to implement the levy increase using a levy escalator as opposed to a one time increase. This gives the industry some time to make necessary adjustments for adapting to the changes in the levy. Our model also uses a levy escalator under each scenario to increase the levy from the current rate to the final rate. The levy rates are increased over a period of seven years under each scenario, because it takes around 5-8 years to make infrastructural changes to the collection system to support increased recycling rates as a result of the levy increase. Moreover, to make the adjustment easier for the industry, it is assumed that the levy

increases at a lower rate in the initial three years compared to the rate of increase in the last four years. The levy rates for each year based on this escalator structure are provided in Table 1-17.

**Table 1-17: Modelled Levy Rates (\$ per tonne)**

#	Tax band	2017 <sup>1</sup>	2018	2019	2020	2021	2022	2023	2024 <sup>2</sup>
1	Standard	\$10	\$11.67	\$13.33	\$15.00	\$16.25	\$17.50	\$18.75	\$20.00
	Inert	\$0	\$0.33	\$0.67	\$1.00	\$1.25	\$1.50	\$1.75	\$2.00
2	Standard	\$10	\$13.33	\$16.67	\$20.00	\$37.50	\$55.00	\$72.50	\$90.00
	Inert	\$0	\$0.67	\$1.33	\$2.00	\$4.00	\$6.00	\$8.00	\$10.00
3 & 4	Standard	\$10	\$15.42	\$20.83	\$26.25	\$54.69	\$83.13	\$111.56	\$140.00
	Inert	\$0	\$1.00	\$2.00	\$3.00	\$6.00	\$9.00	\$12.00	\$15.00
<b>Notes:</b> <ol style="list-style-type: none"> <li>1. Current levy rates</li> <li>2. This rate is applied for all future years</li> </ol>									

## A.4.2 Approach to Scenario Modelling

### A.4.2.1 Applying Price Elasticities of Demand

The approach to estimating the effect of changing levy rates is conducted in two steps. First, the reduction in waste sent to landfill is calculated based on elasticities of demand for landfill services, and the landfill levy rates chosen for each of our scenarios (these are specified in Appendix A.4.1). Then, assumptions regarding the destination of waste diverted away from landfill are applied. In principle, it would be useful to have a set of own and cross-price elasticities to cover both of these steps. In practice, such a matrix is difficult to obtain, whilst empirical evidence from other countries suggests that the effects prompted by landfill levies are apt to change in the context of non-marginal price changes.

As noted above, in modelling the reduction in waste sent to landfill, due to an increase in the levy, we have based this on the price elasticity of demand for landfill services. Price elasticities of demand (commonly known as just price elasticities) measure the relative change in demand (in this case, the demand for landfill services) due to a price change, in this case the price of landfilling which includes the levy and the cost of emission units. The higher the elasticity, the greater is the response to price when the cost of landfill

increases (so the quantity sent to landfill falls more sharply). The formula for the Price Elasticity of Demand (PED) is:

$$PED = (\% \text{ Change in Quantity Demanded}) / (\% \text{ Change in Price})$$

After selecting the demand elasticity, the % change in the quantity (of landfill) demanded or chosen landfill levy rate can be calculated

A number of US and European studies have estimated the price elasticity of demand for waste disposal, where the estimated elasticity varies significantly from very low values (close to zero) to very high values (around -0.6).<sup>90</sup>

However, very few studies seek to understand the cross-price effects (though Eunomia has deployed such an approach in the UK in the past). The change in demand for landfill services that occurs as a consequence of changing landfill prices relates to two effects: a quantity effect (waste can be prevented as a result of higher disposal costs) and a substitution effect (the waste previously sent for disposal is sent to an alternative means of managing waste). The latter clearly depends on the availability of alternatives which are competitive at the prevailing landfill price. Because landfill levies often imply changes in landfill price that are very far from being marginal, it is not surprising that the nature of the demand response changes at different price levels. In our experience, this reflects the fact that more alternatives come into play at the higher price levels, and are capable of being more widely diffused.

Another recent study on South Australian solid waste levy estimated the elasticity for Australia using two different approaches.<sup>91</sup> The first was calculated based on the change in observed historical landfill volumes against the change in historical landfill gate fees, where the estimated elasticity ranges between -0.13 to -0.65. These values were estimated based on demand for landfill at gate fees which are lower than the present gate fees. The second approach was a point price elasticity calculation based on current landfill gate fees, where the estimated elasticity value was -1.1. The concept of a tipping point for specific technologies is also mentioned in the report. This was not used here as it would require quite detailed, and broad ranging, analysis of the costs of the alternatives, which was not possible within the scope of this study.

Based on the above discussion, for this study we have assumed a weaker (low value) elasticity of demand for small changes in landfill price as there will not be as many cost effective alternatives at these lower prices. For larger changes in landfill price, on the

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<sup>90</sup> See for example, Institute for Environmental Studies (2005) Effectiveness of Landfill Taxation, Vrije Universiteit ; Fullerton D and Kinnaman (1994) Household Demand for Garbage and Recycling Collection with the Start of a Price per Bag. National Bureau of Economic Research Working Paper No. 4670; Fullerton D and Kinnaman (1999) The Economics of Residential Solid Waste Management. National Bureau of Economic Research Working Paper No. 7326; Iseley P and Lowen A (2007) Price and Substitution in Residential Solid Waste. Contemporary Economic Policy, 25(3): 433-443; Morris and Molthausen (1994) The Economics of Household Solid Waste Generation and Disposal.

<sup>91</sup> Deloitte Access Economics (2015) *Economic effects of the South Australian solid waste levy*. Prepared for Australian Council of Recycling

other hand, more alternative treatment options become viable, resulting in much greater diversion in waste from landfill (higher elasticity values). The assumed elasticity values for different price changes are reported in Appendix A.4.1.

Assumptions regarding the destination of waste diverted away from landfill are described in the next two sections.

#### **A.4.2.2 Diversion to Recovery & Incineration**

In terms of the way the waste that was previously landfilled is managed, we have assumed that for levy rates under \$90 per tonne, any waste diverted from landfill will be sent to recovery (apart from a minor amount of diversion from class 2-3 to class 1 landfill, see Appendix A.4.2.4). Above this level of levy, we have assumed that energy recovery facilities become economically viable as an alternative treatment option in New Zealand (based on the relative cost of these facilities compared to landfill).<sup>92</sup> We have therefore assumed that diversion to energy recovery will steadily increase from 0% at 90\$ per tonne to 30% at 140\$, reflecting a potential move towards incineration as the cost of landfill increases. If an incineration levy was also implemented alongside the increased landfill levy then energy recovery would not be economically attractive at this range of landfill levy rates (i.e. higher landfill levies would be required).

It is recognised that the movement of materials between destinations depends on the presence of appropriate recovery (or EfW) infrastructure. Without viable alternative destinations a higher levy would simply result in increased cost of disposal (which would be passed onto consumers) and/or migration to illegal disposal. While the availability of such infrastructure will vary – and will be more challenging in rural areas, we have assumed that any regime that is implemented would look to address infrastructure and service gaps.

#### **A.4.2.3 Waste Prevention**

In terms of waste prevention, the international evidence on waste minimisation impacts resulting from landfill taxation is inconclusive. A report by Mazzanti and Zoboli on the effectiveness of policies on waste prevention, waste disposal and landfill analysed waste generation and economic data, produced by the EU 25 from 1995 to 2004, and used multi-variant analysis to attempt to find any decoupling of waste and GDP growth at the European level.<sup>93</sup> One of its conclusions is that ‘no landfill or other policy effects seem to provide backward incentives to waste prevention’. The conclusions also indicate that ‘at

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<sup>92</sup> Campbell MacPherson (2011) *Waste to Energy for Auckland, Discussion Paper*. Prepared for Auckland Council

<sup>93</sup> Mazzanti, M. and Zoboli, R. (2007) *Waste prevention, waste disposal and landfill policies effectiveness: A quantitative analysis on delinking at European level*, Report for Societa Italiana di economia pubblica, <http://www-1.unipv.it/websiep/wp/200720.pdf>



all levels other socio-economic factors were impacting on waste trends; highlighting the importance of societies' attitudes in waste management.' This conclusion may have to be considered as a 'loose' one since the cross-country datasets over time on waste are, in our experience, of low quality.

A report on Finnish waste management suggests that waste taxation is considered not to have contributed much to waste prevention, though it does also suggest that the effect is hidden by the combination of waste management policies in place.<sup>94</sup>

Some evidence does exist from UK studies for a link between landfill taxation and waste minimisation. Surveying work by Cambridge Econometrics and ECOTEC, shortly after the introduction of the tax in 1996, showed that 31% of firms contacted were actually considering waste recycling, re-use or minimisation, or stepping up such activity, as a consequence of the tax.<sup>95</sup> For industrial business with large homogenous waste streams this seems logical. Our experience of surveying food manufacturers over the last three years also suggests that, as a direct consequence of increased disposal costs, businesses have sought to change manufacturing processes to minimise waste.

The maximum waste minimisation impacts modelled (i.e. once the levy has reached its highest rate in 2024 and future years) are presented in Table 1-16. These are modelled to increase at the same % rate as the increase in levy. The % waste minimisation impact is defined in the model as the % reduction in waste generated after taking into account waste growth trends.

#### **A.4.2.4 Diversion to Class 1 Landfill**

For waste levied at the standard rate, we have also assumed a minor amount of diversion (no more than 10%) from class 2 and 3 facilities to class 1 following changes in the landfill levy. There is, currently, no levy on class 2, 3 and 4 facilities, and as a result, waste operators are incentivised to send active waste where possible for disposal at class 2 and 3 landfills (this should mean that the waste contains a sufficiently low proportion of biodegradable material) to benefit from lower disposal costs. We propose to apply the standard rate of levy across all classes of landfill. Standardising the levy rates would effectively remove this incentive and therefore it is likely that more waste would be sent to class 1 landfills.

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<sup>94</sup> EIONET: European Topic Centre on Resource and Waste Management (2007) *Finland Waste Factsheet*, Accessed 16th October 2008, [http://waste.eionet.europa.eu/facts/factsheets\\_waste/Finland](http://waste.eionet.europa.eu/facts/factsheets_waste/Finland)

<sup>95</sup> ECOTEC (1998) UK Landfill Tax Study, *PART 2: Effectiveness of the Landfill Tax in the UK: Barriers to Increased Effectiveness and Options for the Future*, A report submitted to the European Foundation for the Improvement of Living and Working Conditions

### A.4.3 Additional Sensitivities

For the main scenarios we have assumed that regulation and enforcement will be sufficient to ensure that no increase in illegal or unregulated disposal of waste takes place. As the levy increases there is a greater incentive to dispose of waste via illegal or unregulated routes and so a greater level of enforcement will be required. We also assume that the amount of waste sent to farm dumps will increase with overall waste growth but otherwise remain unchanged under the main scenarios.

Currently farm dumps are regulated primarily under the Resource Management Act, (Typically as permitted activities - putting the obligation on the land owner to meet the relevant requirements with limited monitoring) which devolves the powers for determining the rules that govern disposal to land, air and water to the Regional Councils. Territorial Authorities can also set rules through their district plans that could have an impact on farm wastes including in particular the management of hazardous substances.

There is therefore significant variation nationally in respect of how farm disposal is regulated – while permitted activity rules are fairly consistent, the level of monitoring conducted is not. There is usually a minimum regulation in place, which generally involve restrictions on disposal of potentially hazardous waste, while allowing disposal of animal carcasses into offal pits (given that the pits properly sited and not close to waterways to avoid possibility of contamination)<sup>96</sup>. Enforcement of these regulations can also vary widely depending on the resources available, the degree to which it is considered a local priority, and the difficulty in carrying out enforcement activity in the area.

Because of these considerations, diversion of waste disposed in farms to landfill and recycling will require the proper combination of increased collection services, education, monitoring and enforcement.

Based on this, we have modelled two additional sensitivities to analyse the potential for waste diversion from and to farm dumps and to illegal or unregulated disposal, these are:

- 1) A 'low regulation' scenario in which the increase in landfill levy leads to the diversion of waste from landfill to farm dumps. This scenario also models some diversion to unregulated disposal destinations; and
- 2) A 'high enforcement and services' scenario in which a combination of increased collection services, education, and enforcement leads to a reduction in waste sent to farm dumps and diversion to landfill and recycling.

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<sup>96</sup> Ministry for the Environment (2014) New Zealand Non-Municipal Landfill Database, October 2014, prepared by Tonkin & Taylor

#### **A.4.3.1 Low Regulation Scenario**

For this scenario we have assumed that there will be insufficient regulation and enforcement to deter the unregulated or illegal disposal of waste. We assume that diversion to unregulated disposal will gradually increase to 20% at \$90 per tonne for the mixed active waste taxed at the standard rate, and to 10% at 10\$ per tonne for the inert waste taxed at the lower rate. As discussed in Appendix A.3.1, any unregulated disposal of waste (e.g. fly-tipping) and the disposal of excavated material on-site are not included in the baseline waste flows. We therefore have modelled only the change in waste sent to this destination.

We also assume that diversion from landfill to farm dumps will gradually increase with the rise in levy to a maximum of 10% of all waste diverted from landfill at \$90 per tonne.

#### **A.4.3.2 High Enforcement and Services Scenario**

In the high enforcement and services scenario we assume that funds gathered from increased levy income will be invested in improved monitoring, education, alternative collection services and facilities and, lastly enforcement. Furthermore, this scenario assumes that Regional Councils will move to increased regulation of waste disposed of at farm dumps. These improvements could reasonably be expected to lead to the diversion of additional waste from farm dumps to landfill and recovery, and that this will grow as the landfill levy increases and more additional funds become available.

We have therefore assumed that up to 25% (at \$90 per tonne rate of levy) of waste sent to farm dumps (after taking into account waste growth) will be diverted to landfill and recovery. We also assume that initially 60% of this waste will be sent to recovery, with the remainder sent to landfill. As the landfill levy increases, it is likely to encourage growth in recycling infrastructure and collection services, and therefore we assume that the amount of diverted waste sent to recycling will steadily increase up to 80% at a \$90 per tonne rate of levy (with the remaining waste landfilled).

### **A.4.4 Other Assumptions**

#### **A.4.4.1 Material Specific Recovery Rates**

Based on the baseline and scenario parameters, the model calculates the tonnage of material sent to recovery in each year for each activity source. This tonnage is compared to the total quantity of waste generated to calculate recovery rates.

Material specific recovery rates, that is, the % of each material recovered for a given overall recovery rate, are a key input to the model, and are used to calculate the tonnage of each material sent to recovery. These rates were baselined using the 2015 tonnages presented in Appendix A.3.0, using the following calculation:

*Material specific recovery rate = Tonnage of material recovered / Total tonnage of material generated*

This provided us with a set of material specific recovery rates based on current New Zealand data. The model also requires assumptions for how these material specific recovery rates will change as the overall rate of recovery increases (in response to an increase in the levy). These are specified in the model at appropriate intervals (for example, if the baseline recovery rate is 20% we would specify material specific recovery rates at 40%, 60%, and 80%) and then calculations were added to interpolate between these intervals to pick the correct material specific recovery rates based on the overall recovery rate of the scenario.

As recovery rates increase, common trends are observed in terms of which materials can achieve high recovery rates, and which are more difficult to recovery. For example, metals are easily sorted for recovery at MRFs and are a high value material so strongly targeted by kerbside collection systems. Therefore the material specific recovery rate for metals is generally higher than the overall recovery rate. Conversely, plastics are difficult or even impossible to sort – plastic films, mixed polymer materials, and black plastic are not recyclable using most sorting and reprocessing technology – and therefore material specific recovery rates are general lower than the overall recovery rate. These general trends, based on our knowledge of waste collection systems from a range of countries and regions, were used to specify material specific capture rates for each activity source.

#### **A.4.4.2 Indicative Gate Fees**

Gate fees were derived from a range of sources and were checked with the steering group and peer reviewer to ensure they were broadly indicative. Indicative gate fees used for cost modelling are presented in Table 1-18.

**Table 1-18: Indicative Charges for Processing/Disposal**

Disposal Costs/Gate Fees (per tonne)	High	Low	Ave
MRF Glass Out <sup>1</sup>	\$ 120.00	\$ 100.00	\$ 110.00
MRF Glass In <sup>1</sup>	\$ 140.00	\$ 120.00	\$ 130.00
Landfill Disposal (Large) <sup>2</sup>	\$ 55.00	\$ 20.00	\$ 37.50
Landfill Disposal (Med) <sup>2</sup>	\$ 90.00	\$ 70.00	\$ 80.00
Landfill Disposal (Small) <sup>2</sup>	\$ 190.00	\$ 110.00	\$ 150.00
Transfer Stations <sup>3</sup>	\$ 180.00	\$ 110.00	\$ 145.00
Class2-3 <sup>3</sup>	\$ 40.00	\$ 25.00	\$ 32.50
Class 4 <sup>3</sup>	\$ 15.00	\$ -	\$ 7.50
Organics – Green <sup>4</sup>	\$ 50.00	\$ 30.00	\$ 40.00
Organics – Putrescible <sup>4</sup>	\$ 160.00	\$ 80.00	\$ 120.00
Stockfood <sup>4</sup>	\$ 40.00	\$ 25.00	\$ 32.50
Incineration <sup>5</sup>	\$ 170.00	\$ 100.00	\$ 135.00
C&D Sorting <sup>6</sup>	\$ 40.00	\$ 5.00	\$ 22.50

Sources:

1. Based on Eunomia (2012) *Kerbside Recycling Options Appraisal*, Report to CHH Fullcircle Recycling, O-I New Zealand, and EnviroWaste Services
2. Based on Eunomia (2012) *Full Cost Accounting and Management Options for Wairoa Landfill*. Report to Wairoa District Council
3. Range of charges from Waste Assessments
4. Source: Eunomia (2011) *Household Organic Waste Cost – Benefit Analysis – Stage 2 Report* to Earthcare Environmental Limited, Envirofert Limited and Lowe Corporation
5. Campbell MacPherson (2011) *Waste to Energy for Auckland Discussion Paper*. Prepared for Auckland Council
6. Personal Communication: Stacy Goldsworthy, Green Vision Recycling

There are a number of reasons for the range in processing and disposal costs. These relate to the economies of scale of the facilities, the differences in technology and methodology employed, transport distances to markets, local competition etc.

Disposal rates can vary widely by region based to a large extent on economies of scale. For example bulk rates into large landfills serving Auckland can be in the order of \$35-\$45 per tonne compared with rates in the order of \$105-\$110 per tonne into Kate Valley

in Canterbury, and costs in the order of \$150 per tonne for small remote landfills (e.g. Wairoa).

#### A.4.4.3 Indicative Collection Costs

High level average collection costs were derived from collection cost modelling that was benchmarked to a range of actual collection scenarios. Feedback was sought from the steering group and peer reviewer to ensure they were broadly indicative. Average per tonne collection costs are presented in Table 1-19. It should be noted that actual costs can vary significantly from these costs according to a range of factors such as rural vs urban, market competition, actual collection methodology etc.

**Table 1-19: Indicative Collection Costs Per tonne**

Waste Type	Total
Kerbside Rubbish	\$50
Kerbside Recycling	\$150
Kerbside Food	\$175
Kerbside Green	\$90
Residential (Skips)	\$165
Residential (Inorganic/Bulky)	\$150
ICI	\$165
C&D	\$22
Landscaping	\$165

#### A.4.4.4 Export of Material for Recovery

Not all material collected for recovery is reprocessed within New Zealand, some is exported to reprocessors in other countries. Table 1-20 sets out our export assumptions, these are used in the model to calculate the 'lost' GVA and employment from reprocessing activities taking place abroad, in other words, the GVA (and jobs) that would have accrued to the New Zealand economy if exported material had instead been sent to domestic reprocessors.

**Table 1-20: Export of Material for Recovery**

Material	% of Material Collected for Recovery Sent to Export
Paper	50%
Plastics	95%
Putrescibles	0%
Ferrous metals	90%
Non-ferrous metals	100%
Glass	0%
Textiles	80%
Nappies and sanitary	0%
Rubble	0%
Timber	0%
Rubber	50%
Potentially hazardous	0%

#### A.4.4.5 Organics Treatment Destinations

There are a range of treatment destinations for organic (i.e. the 'putrescible' fraction from the above classifications) wastes. Our estimates of the proportion of materials currently handled by the different processes is shown in Table 1-21.

**Table 1-21: Organic Treatment Destinations**

Process	Estimated Proportion by Inputs
Aerobic Composting	52%
Vermicomposting	17%
Rendering and stockfood	31%

*Source: Eunomia compiled database*

The major sources of organic waste that provide input into these processes are agricultural by products, woodchip and bark from timber processing, meat, fish, and poultry processing wastes, manures, garden waste, and food processing wastes.

We have assumed that organic wastes from agricultural and food waste processing systems will continue to be managed through current techniques (aerobic composting, vermicomposting and rendering).

In terms of household food waste, the only municipal collections currently operating (Christchurch and Timaru) co-collect food waste with garden waste and process this in in-vessel (Christchurch) or covered windrow (Timaru) aerobic composting systems. If household and/or commercial food waste is collected in significant quantities there may be issues with obtaining sufficient bulking agents (such as green waste or woodchip) to process this material through aerobic composting systems. This may mean that other potentially more expensive aerobic or anaerobic in-vessel type systems are required to process this type of material.

Based on this review we have assumed that currently all food and garden waste is sent to in-vessel/covered composting facilities and that this will continue in the future for the baseline scenario. Any marginal increase in food waste collection driven by an increase in the landfill levy is assumed to go to anaerobic digestion, while any additional garden waste will be sent to open air windrow.

#### **A.4.4.6 Collection Price Sensitivities**

The impact of changes to the levy regime on collection system costs was examined to attempt to ascertain at what point increased levy rates might incentivise kerbside recycling and organic waste collection services.

For this exercise we used Eunomia's proprietary collection cost model 'Hermes', which has been developed and used extensively since 2003 in modelling systems both in New Zealand and in the UK. The model provides a high level of flexibility in application with the ability to adjust an extremely large range of parameters. It is able to model the performance and interaction of up to five different collection systems (e.g. recycling, organics, residual waste etc.) and account for up to six different housing type profiles within each system (e.g. urban, rural, apartments etc.). Furthermore, it is designed with the ability to run multiple scenarios and allows the user to quickly switch between them - a fundamental feature for option appraisal. It should be emphasised that cost modelling exercises cannot necessarily predict actual costs but are useful to compare relative costs of different service options given a common set of assumptions.<sup>97</sup>

The modelling exercise consisted of developing a 'status quo' model that reflects in approximate terms, the costs and performance of existing systems. Household numbers

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<sup>97</sup> There are a wide number of variables than can serve to alter the actual costs including how competitive the procurement process is, the degree to which other elements (e.g. transfer station operation etc) are wrapped up in a contract, whether a company is bidding for strategic reasons (e.g. to establish a base for commercial operations), recycling markets, the level of risk the council is asking the contractor to carry, contract structure, contract term, the pricing of variations and escalations, to name a few.



for urban, suburban, and rural profiles were based on Statistics NZ average household data. The status quo system was assumed to consist of weekly bag and wheeled bin based rubbish collection and average performing weekly dry recycling collection. The assumed collection costs were calibrated against the indicative costs shown in A.4.4.3. Average quantities of material collected were based on per household quantities obtained from a range of modelling work and Waste Assessment work done for local authorities. Disposal and processing costs were based on the data shown in A.4.4.2 and material revenues were based on the data shown in A.5.4.

The 'status quo' model then was run with different rates of landfill levy (at \$10 increments). This then showed the impact changes in the levy rate could have on collection system costs per household and collection system costs per tonne.

An 'optimised' collection system was then developed based on the same collection logistics as the status quo system. The optimised system consisted of 2 Stream fortnightly glass out recycling (165kg per hh), weekly food caddy and liners (100kg per hh), user pays garden, and fortnightly 140L rubbish collection. . This optimised system resulted in higher quantities of material being recovered (particularly organic waste) from a baseline of approximately 130kg per household to 300kg per household. The modelling also showed that, at the current levy rate of \$10 per tonne, optimised systems were in the order of 10% more expensive than the status quo systems.

The 'optimised' model then was run with different rates of landfill levy (at \$10 increments). This showed the impact changes in the levy rate could have on optimised system collection system costs per household and per tonne.

The cost of collection systems under the status quo and optimised scenarios were then compared. The optimised system costs rose more slowly in response to changes in the levy rate because of the lower quantity of material being sent to residual. The exercise showed that when the rate of the levy rose to between \$80 and \$90 per tonne the optimised systems switched from being more expensive to being slightly cheaper. The higher the levy rates from that point, the greater the price differential in favour of the optimised systems.

#### A.4.4.7 Mechanical Biological Treatment (MBT)

MBT processes are essentially forms of pre-treatment which can be applied to mixed waste to enable it to be managed in different ways.

There are different forms of MBT process. The principal ones being:

- **Aerobic Stabilisation.** Waste is 'composted' either before or after it has been subjected to some mechanical sorting to remove recyclable materials. The process reduces the weight and volume and makes the material less likely to generate landfill gas when it is landfilled.
- **Bio-drying.** In this process, once again, an aerobic 'composting' process is used. However, instead of the material being stabilised (through trying to maintain the biological degradation process over a reasonable period of time), the intention is

to dry the material so that its calorific value is increase for use in thermal processes.

- **Treatment for Anaerobic Digestion (AD).** Mixed waste is mechanically 'split' to derive a fraction suitable for digestion. The AD process is then used to generate biogas which can be burned for energy.

To date there has been no use of MBT processes in NZ.

Aerobic Stabilisation may be applied where there is a desire to reduce the level of gas generation in landfill. Because large landfills are able to claim high rates of gas capture it is unlikely that MBT pre-treatment will make economic sense for these facilities. Small facilities that are faced with high NZETS costs may consider MBT as a way of offsetting ETS costs. This would require ETS costs to reach levels that are greater than the MBT gate fee for this to become a viable option. While this may be an option, our calculations suggest that at these rates in many cases it may be more economic for waste to be bulked and transported to a landfill with high gas capture.

Bio-drying likewise is unlikely to be an option unless thermal treatment facilities that require Refuse Derived Fuel (RDF) are constructed in NZ.

Treatment for Anaerobic Digestion is also considered unlikely in the foreseeable future in NZ. The combination of low energy costs and a lack of government incentives for renewable energy (which has helped drive AD adoption in UK and Europe), has meant that the technology has yet to become financially viable here.

For these reasons we have not modelled MBT as a pathway for material in NZ.

## A.5.0 Economic Parameters

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### A.5.1 Approach to Modelling Economic Impacts

Gross Value Added (GVA) and employment were the two primary metrics selected to quantify the economic impact of increasing the waste disposal levy. We also calculated the change in material revenues that would be expected as waste is diverted from landfill to recovery. GVA is a measure of the increase in the value to the economy related to the production of goods and services. This measure – alongside employment impacts (to which GVA is related) – are the commonly used indicators to assess the impacts of different policies and initiatives at the regional and national level in many countries.

GVA can be measured using either the ‘production’ or the ‘income’ approach. The main components of income-based GVA are:

- Compensation of employees.
- Gross operating surplus (includes gross trading profit and surplus, mixed income, non-market capital consumption, rental income, less holding gains).
- Taxes (less subsidies) on production. These are included, whereas unit taxes on products are not. This means that in the waste and resource management sector, the waste disposal levy and the tax on GHG emissions – considered as unit taxes on a ‘product’ – does not fall within GVA calculations.

In 2013, the average income components for NZ industries, as a percentage of GVA, were as follows:<sup>98</sup>

- Compensation of employees – 48%;
- Gross operating surplus – 48%; and
- Taxes (less subsidies) on production – 4%.

This shows that labour and gross operating surplus tend to make up the vast proportion of GVA (96%). In this study, the unit GVA figures have been calculated based on these two elements of GVA, where data permits.

The analysis undertaken for this study takes into account the direct, indirect and induced effects on the economy. The production of goods or services generates value to the economy which is broadly based on the costs of what is sold net of the goods and services purchased from others. This is known as the ‘direct’ effect. The purchase of goods and services from others has an additional impact since each of the relevant industries makes its own contribution to value added. This is known as the ‘indirect’

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<sup>98</sup> Stats NZ (2017) *National Accounts Input-Output Tables: Year ended March 2013*, Accessed 25<sup>th</sup> April 2017, [http://www.stats.govt.nz/browse\\_for\\_stats/economic\\_indicators/NationalAccounts/input-output%20tables-2013.aspx](http://www.stats.govt.nz/browse_for_stats/economic_indicators/NationalAccounts/input-output%20tables-2013.aspx)

effect. Because of the direct and indirect effects, the level of household income throughout the economy will increase as a result of higher aggregate compensation to employees. A proportion of this increased income will be spent on final goods and services, thereby generating additional economic activity and associated value added. This is known as the ‘induced’ effect.

By accounting for the various effects across the economy, it is possible to obtain a more accurate picture of the likely impact that changes to specific sectors, such as waste and resource management, will have on the economy as a whole. The waste flow element of the model calculates the *direct* GVA generated, and lost, through changes in the waste management practices in New Zealand. However, in order to demonstrate the likely wider economic impacts, it is necessary to take into account the aforementioned indirect and induced effects using GVA multipliers. The two types of GVA multipliers used for the purpose are:

- **Type 1 multipliers** – these account for direct and indirect GVA.
- **Type 2 multipliers** – these account for direct, indirect, and induced GVA.

These multipliers are usually expressed as a multiple of the direct GVA that is generated (hence the term multiplier), and are based on empirical studies. New Zealand does not publish Type 1 and Type 2 GVA multipliers for measuring the indirect and induced effects of a change in economic activity. In the absence of such information, we have used GVA multipliers from Scotland to estimate these contributions. While there will be differences in practice, it was believed that this provided a close enough approximation for the purposes of the economic modelling being undertaken as part of this study. Examples of Scottish GVA multipliers used in the modelling are shown in Table 1-22.

**Table 1-22: Scottish GVA Multipliers Used to Account for the Indirect and Induced Impacts on GVA**

Sector	Type 1 Multiplier	Type 2 Multiplier
Waste, remediation and management	1.53	1.88
Construction	1.65	2.01

Source: Scottish Government (2016) *Input-Output Tables 1998-2013 - All Tables*, July 2016, [www.gov.scot/Topics/Statistics/Browse/Economy/Input-Output/Multipliers](http://www.gov.scot/Topics/Statistics/Browse/Economy/Input-Output/Multipliers)

## A.5.2 Employment Assumptions

This section presents the complete set of employment assumptions used for modelling the direct impacts of changes in the landfill levy. Additionally, the change in indirect and induced employment was calculated based on the multipliers shown in Table 1-23.

**Table 1-23: Scottish GVA Multipliers Used to Account for the Indirect and Induced Impacts on Employment**

Sector	Type 1 Multiplier	Type 2 Multiplier
Waste, remediation and management	1.99	2.56

Source: Scottish Government (2016) *Input-Output Tables 1998-2013 - All Tables*, July 2016, [www.gov.scot/Topics/Statistics/Browse/Economy/Input-Output/Multipliers](http://www.gov.scot/Topics/Statistics/Browse/Economy/Input-Output/Multipliers)

#### A.5.2.1 Collection

The collection vehicles in New Zealand generally utilise side loading mechanisms, so the labour fraction is not significant. That being said recycling services may well need additional vehicles, as different fractions are collected of different vehicles (e.g. garden waste, food waste, dry recyclables). So the net change in employment from a shift away from refuse collection to recycling would be expected to be positive.

To properly understand the change in employment would require quite detailed and complex collections modelling, which is outside the scope of this study. We have therefore taken a simple but realistic approach to estimating changes in employment and benchmarked the outputs against detailed collections modelling we have undertaken at the local level in previous studies.

The approach to estimating the change in employment from collection services was first to estimate the change in total labour cost. This was achieved through assuming that half of the avoided cost of disposal related to collection, with the remaining half relating to treatment (composting etc), and multiplying this by the proportion of the total that relates to labour. These assumptions were taken from previous detailed modelling undertaken by Eunomia and are given in Table 1-24 for each relevant activity source. The total labour cost was then divided by the average wage in the waste sector (including 'on-costs' e.g. taxes, insurance, overheads) to estimate the total additional number of employees.

**Table 1-24: Proportion of Labour Cost in Total Collection Costs**

Activity Source	Labour Cost (%)
Domestic Kerbside	30%
Residential	50%
ICI	50%
Landscape	50%
C&D	30%
Rural	50%

### A.5.2.2 Sorting

Employment of 1.1 jobs per thousand tonnes of material processed was assumed for sorting at MRFs.<sup>99</sup> A lower rate of 0.27 jobs per thousand tonnes was used for C&D MRFs. This figure was based on the number of jobs reported for a modern C&D MRF adjusted upwards as many MRFs will be less efficient.<sup>100</sup>

### A.5.2.3 Reprocessing

The employment intensities of different recovery processes were collected from various sources through a brief literature review for this purpose.<sup>101</sup> Number of jobs per thousand tonnes of material reprocessed are summarised in Table 1-25.

**Table 1-25: Reprocessor Employment Assumptions**

Material	Employment (number of jobs/ thousand tonnes)
Paper	2.0
Plastics	10.3
Putrescibles	N/A <sup>1</sup>
Ferrous metals	6.0
Non-ferrous metals	11.0
Glass	2.9
Textiles	5.0

<sup>99</sup> Cascadia (2009) *Recycling and Economic Development: a Review of Existing Literature on Job Creation, Capital Investment, and Tax Revenues*, King Country Linkup, <https://your.kingcounty.gov/solidwaste/linkup/documents/recycling-economic-development-review.pdf>

<sup>100</sup> Powerday (2014) *Construction Commences on State of the Art Recycling Facility in Enfield*, 19<sup>th</sup> August 2014, <http://www.powerday.co.uk/news/construction-commences-state-art-recycling-facility-enfield/>

<sup>101</sup> See for example: Friends of the Earth (2010) *More Jobs, Less Waste: Potential for Job Creation Through Higher Rates of Recycling in the UK and EU*, September 2010, [www.foe.co.uk/sites/default/files/downloads/jobs\\_recycling.pdf](http://www.foe.co.uk/sites/default/files/downloads/jobs_recycling.pdf); Cascadia (2009) *Recycling and Economic Development: a Review of Existing Literature on Job Creation, Capital Investment, and Tax Revenues*, King Country Linkup, <https://your.kingcounty.gov/solidwaste/linkup/documents/recycling-economic-development-review.pdf>; LEPU (2004) *Jobs from Recycling: Report on Stage II of the Research*, London South Bank University; Employment figures that were provided in US tons in the source literature were converted to SI tonnes.

Material	Employment (number of jobs/ thousand tonnes)
Nappies and sanitary	N/A <sup>2</sup>
Rubble	0.8
Timber	0.8
Rubber	2.8
Potentially hazardous	1.8
Notes: <ol style="list-style-type: none"> <li>1. Assumptions for putrescibles are included in Appendix A.4.4.5.</li> <li>2. No reliable employment assumptions were available for the nappies and sanitary waste stream. This waste stream makes up a very small proportion of the total material recovered and was therefore excluded from the analysis.</li> </ol>	

#### A.5.2.4 Treatment and Disposal

The employment figures for various treatment and disposal options were sourced from previous Eunomia research on EU waste model.<sup>102</sup> These are presented in Table 1-26.

**Table 1-26: Treatment and Disposal Employment Assumptions**

Treatment/Disposal Destination	Employment (number of jobs/ thousand tonnes)
Class 1 Landfill	0.1
Class 2/3 Landfill	0.1
Class 4 Landfill	0.1
Incineration	0.1
Anaerobic Digestion	0.2
In Vessel Composting	0.2
Open Air Windrow	0.4

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<sup>102</sup> Eunomia (2015). *Further development of the European reference model on waste generation and management*. Available at: <http://bookshop.europa.eu/en/further-development-of-the-european-reference-model-on-waste-generation-and-management-pbKH0415906/>

### A.5.3 GVA Assumptions

This section presents the complete set of GVA assumptions used in our modelling. The GVA figures for various sorting, reprocessing, residual treatment, and disposal options used in the model include both the cost of labour and a typical operating surplus for the activities concerned.

The labour costs were calculated by multiplying the average annual wage earnings with employment intensities for the respective options. The average annual wage earnings for the sorting, residual treatment, and disposal options were assumed to be \$48,570, the median annual wage earning in the *Water, sewerage, drainage and waste services* sector in NZ in 2015.<sup>103</sup> The wage earning assumptions for the reprocessing facilities are discussed in Appendix A.5.3.3. The employment intensity values are reported in Appendix A.5.2.

The operating surplus for different treatment options were assumed to be 10% of the annualised capital and operating cost for the respective treatment option. The data on capital and operating costs for different activities were sourced from various published and confidential sources.<sup>104</sup> Where needed capital costs were annualised using a discount rate of 12%.

The GVA unit values used in the model were multiplied by the tonnage of additional material, relative to the baseline, sent to different destinations under the alternative scenarios modelled. This enabled the total direct GVA benefit under each scenario to be determined. The indirect and induced GVA benefits were calculated by multiplying the final figures by the Type 2 multiplier for the waste, remediation and management sector shown in Table 1-22.

Further details about the estimated GVA figures for different activities are provided in the following sections.

#### A.5.3.1 Collection

The calculation for GVA from collection services was carried out in a similar manner to that used for employment – see Appendix A.5.2.1. The total additional operating costs

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<sup>103</sup> Available at: [http://www.stats.govt.nz/tools\\_and\\_services/nzdotstat/tables-by-subject/leed-annual-tables.aspx](http://www.stats.govt.nz/tools_and_services/nzdotstat/tables-by-subject/leed-annual-tables.aspx)

<sup>104</sup> See for example: Cascadia (2009) *Recycling and Economic Development: a Review of Existing Literature on Job Creation, Capital Investment, and Tax Revenues*, King County Linkup, <https://your.kingcounty.gov/solidwaste/linkup/documents/recycling-economic-development-review.pdf>; Eunomia (2015). *Further development of the European reference model on waste generation and management*. Available at: <http://bookshop.europa.eu/en/further-development-of-the-european-reference-model-on-waste-generation-and-management-pbKH0415906/>; Eunomia (2011) *Household Organic Waste Cost – Benefit Analysis – Stage 2 Report to Earthcare Environmental Limited, Envirofert Limited and Lowe Corporation*. Available at: <http://www.earthcarenz.co.nz/assets/pdfs/earthcare-environmental-household-organic-waste-cost-benefit-stage-2.pdf>



for collection services was assumed to be equivalent to the total avoided disposal cost. In other words collection services would be invested in where the business case is made. GVA is then calculated by assuming 10% of the total cost is operating surplus, and a fraction is the labour element. The proportion which is labour is given in Table 1-24.

### A.5.3.2 Sorting

A GVA of \$65.43 per tonne was calculated for sorting at material recovery facilities (MRFs).

Table 1-27 shows our assumptions for the amount of waste sorted at material recovery facilities. These assume that most domestic recycling is collected comingled – even where waste is collected separately in New Zealand it is common to send the cans and plastics stream to a sorting facility. As for other activity sources the majority of ICI recycling is source separated, while the majority of C&D waste recovered is sorted at a MRF or transfer station. Other waste types are not sent to MRFs (landscape waste is predominantly garden, and residential waste is mainly transported by residents to civic amenity sites for disposal).

**Table 1-27: Assumption for Waste sent to MRFs**

	Waste Types sent to MRF	% of Recovered Waste sent to a MRF
Domestic Kerbside	Paper, plastics, metals, glass	80%
ICI		30%
Rural		30%
Residential	Rubble	50%
C&D	All waste types	70%

### A.5.3.3 Reprocessing

The direct GVA associated with reprocessing different materials was calculated based on the method presented in Appendix A.5.3. Table 1-28 presents the average annual wage earnings figures used for calculating the labour cost element of the estimated GVA generated through recycling each type of material.

**Table 1-28: Average Wage Earnings for Reprocessing Facilities**

Reprocessing facility	NZSIOC Industry Sector	Average annual wage earnings in 2015 (NZ \$)
Paper	Pulp, paper and converted paper product manufacturing	\$69,760
Plastics	Polymer product and rubber product manufacturing	\$48,680
Ferrous and non-ferrous metals	Primary metal and metal product manufacturing	\$72,610
Glass	Non-metallic mineral product manufacturing	\$52,560
Textiles	Textile, leather, clothing and footwear manufacturing	\$39,040
Rubble	Water, sewerage, drainage and waste services	\$48,570
Timber	Wood product manufacturing	\$45,380
Rubber	Polymer product and rubber product manufacturing	\$48,680

Source: Linked Employer-Employee Data (LEED) tables in NZ Statistics. Available at: [http://www.stats.govt.nz/tools\\_and\\_services/nzdotstat/tables-by-subject/leed-annual-tables.aspx](http://www.stats.govt.nz/tools_and_services/nzdotstat/tables-by-subject/leed-annual-tables.aspx)

Due to lack of reliable data on capital and operating costs for different reprocessing facilities, the operating surplus for each type of facility were assumed to be 10% of the revenue from the sale of the respective reprocessed material. These material revenues are provided in Appendix A.5.4. Table 1-29 presents the direct GVA values for different reprocessing options used in the model.

**Table 1-29: Reprocessor GVA Assumptions**

Material	GVA (\$/tonne)
Paper	\$99.43
Plastics	\$481.70
Putrescibles	N/A <sup>1</sup>
Ferrous metals	\$272.28
Non-ferrous metals	\$634.27
Glass	\$133.78
Textiles	\$392.85
Nappies and sanitary	N/A <sup>2</sup>

Material	GVA (\$/tonne)
Rubble	\$40.86
Timber	\$48.86
Rubber	\$39.66
Potentially hazardous	N/A <sup>2</sup>
<b>Notes:</b> <ol style="list-style-type: none"> <li>1. Assumptions for putrescibles are included in Appendix A.4.4.5</li> <li>2. No reliable GVA assumptions were available for the nappies and sanitary and potentially hazardous waste streams. These waste streams make up a very small proportion of the total material recovered and were therefore excluded from the analysis.</li> </ol>	

### A.5.3.4 Treatment and Disposal

Table 1-30 presents the direct GVA figures for various treatment and disposal options used in the model. It should be noted that, taxes on products, which includes landfill tax, are not a part of GVA and thus not included when estimating GVA. The model, therefore, does not consider landfill tax savings that can be generated by shifting away from landfill. However, because of the low labour intensity of landfill – typically around 1 full time equivalent (FTE) per 10,000 tonnes processed (see Appendix A.5.2.4) – the GVA benefits quickly accrue as waste moves up the hierarchy to more labour intensive activities that can add greater value to materials.

**Table 1-30: Treatment and Disposal GVA Assumptions**

Treatment/Disposal Destination	GVA (\$/tonne)
Class 1 Landfill	\$10.66
Class 2/3 Landfill	\$7.16
Class 4 Landfill	\$3.58
Incineration	\$31.96
Anaerobic Digestion	\$50.29
In Vessel Composting	\$21.28
Open Air Windrow	\$10.92

### A.5.3.5 Construction

The increase in the levy under all 4 scenarios will result in the generation of less residual waste. This means that, relative to baseline, there will be some GVA lost to NZ due to the avoided construction of residual waste infrastructure. However, this is offset, at least in part, by an increased need for MRFs, AD, IVC and OAW facilities to process recyclables. The NZ derived GVA associated with building facilities was calculated based on EU capital cost data for various treatment facilities from previous Eunomia research.

The model calculates the GVA generated through construction, based on the projected mass flows of each scenario and assuming an average capacity for each type of facility. Once the projected tonnage exceeds this threshold it is assumed that a new facility is built and that the GVA associated with construction is realised in the same year. Table 1-31 presents the calculated GVA figures along with the associated assumptions used in the model.

**Table 1-31: Construction GVA Assumptions**

Treatment/Disposal Destination	Assumed Capacity of New Facilities (tonnes per annum)	Assumed Operating Capacity	GVA Per Facility (\$ million)
Anaerobic Digestion	40,000	90%	\$4.48
In Vessel Composting	40,000	90%	\$6.03
Open Air Windrow	40,000	90%	\$3.09
Incineration	250,000	90%	\$30.83
Materials Recovery Facility	100,000	90%	\$6.56

### A.5.3.6 Waste Prevention

All four modelled scenarios assume that the increase in cost of disposal through the increase in waste disposal levy will result in increasing amounts of food waste and non-food waste prevented from arising over time. Accounting for the economic impact of waste prevention is not straight forward as there are a number of upstream and downstream impacts that need to be taken into account. These are presented in Table 1-32.

**Table 1-32: Upstream and Downstream Impacts on GVA from Waste Prevention by Different Sectors**

Waste type	Upstream impacts	Downstream impacts
<b>Household food and non-food waste</b>	Increased GVA from spending the household savings from reduced food and non-food related consumption	Lost GVA for food and non-food retail sector
<b>Commercial and industrial food waste</b>	Increased GVA from increased operating surplus through financial savings	Lost GVA for food manufacturing sector
<b>Commercial, industrial, and C&amp;D non-food waste</b>	Increased GVA from increased operating surplus through financial savings	Lost GVA for relevant non-food manufacturing sector

In order to estimate what the likely impacts of waste prevention would be on GVA we used an approach that was based on the National Accounts Input-Output tables for the year ended March 2013 from the Statistics New Zealand.<sup>105</sup> The data from these tables were supplemented with additional information from other sources to derive GVA values per tonne of food waste and non-food waste prevented.

The first step in calculating the upstream and downstream GVA impacts of food and non-food waste prevention involves estimating the value per tonne of food and non-food waste prevented by different sectors. Research undertaken by WRAP suggests that total preventable household food waste ranges between 4.2 and 5.4 million tonnes per annum and is worth a total of £12.5 billion.<sup>106</sup> On the other hand, the total preventable food waste in the C&I waste stream amounts to the following:

- **Hospitality and food service** – 0.7 million tonnes with associated savings of £2.5 billion;
- **Retail** – 0.2 million tonnes with associated savings of £0.65 billion; and
- **Manufacturing** – 0.9 million tonnes with associated savings of £1.2 billion.

The weighted average savings that could be made per tonne of food waste prevented across these sectors amounts to £2,417 per tonne.

For non-food waste, previous Eunomia research has conservatively estimated that the value per tonne of non-food waste prevented was £2,000 for the household sector, and £3,000 for the commercial and industrial sector.

<sup>105</sup> Statistics New Zealand (2016) *National Accounts input-output tables: Year ended March 2013*, Available at: [http://www.stats.govt.nz/browse\\_for\\_stats/economic\\_indicators/NationalAccounts/input-output%20tables-2013.aspx](http://www.stats.govt.nz/browse_for_stats/economic_indicators/NationalAccounts/input-output%20tables-2013.aspx)

<sup>106</sup> WRAP (2016) *Estimates of Food Surplus and Waste Arisings in the UK*, May 2016, [www.wrap.org.uk/sites/files/wrap/UK%20Estimates%20May%202016%20%28FINAL%20V2%29.pdf](http://www.wrap.org.uk/sites/files/wrap/UK%20Estimates%20May%202016%20%28FINAL%20V2%29.pdf)

Based on the above figures, Table 1-33 presents the estimated values per tonne of food waste and non-food waste prevented by different sectors in the New Zealand economy.

**Table 1-33: Value of per tonne of Waste Prevented by Different Sectors**

Sector	Food Waste Prevention (\$/tonne)	Non-Food Waste Prevention (\$/tonne)
Household	4,688	3,000
Industrial	2,400	4,500
Commercial/Institutional	4,350	4,500
C&D	N/A	4,500

The financial savings made by businesses will help to boost profit margins and thereby a company's operational surplus, resulting in a direct positive impact on GVA. However, businesses often have to make investments, for example, in new equipment, training and so on, in order to achieve the resource efficiency gains. Based on previous Eunomia research, it was assumed that 30% of the savings would have to be invested in order to reduce food waste and non-food waste for the commercial sector. For industrial and C&D sectors, the corresponding assumption was that 20% of the savings from waste prevention would have to be invested in achieving the efficiency savings.

The downstream impacts on direct GVA for the food and non-food retail and manufacturing sectors were calculated using the NZ input-output tables. The calculated direct GVA figures were multiplied by the relevant Type 1 and Type 2 Scottish GVA multipliers to calculate the Type 1 and Type 2 GVA impacts. These are presented in Table 1-34.

**Table 1-34: Downstream GVA Effects for Different Sectors**

GVA Effects	Direct GVA Effect	Type 1 GVA Effect	Type 2 GVA Effect
Food Retail Consumption	0.53	0.66	0.80
Non-food Retail Consumption	0.56	0.69	0.84
Food Manufacturing	0.18	0.35	0.43
Non-Food Manufacturing	0.28	0.43	0.53

Previous research by WRAP has indicated that expenditure of food tends to hold up even where there is evidence of waste prevention, suggesting that households might ‘trade-up’ to higher value products.<sup>107</sup> It might not be unreasonable to assume that this could translate into higher GVA per unit of spend in the sector, but such a change would be extremely difficult to estimate. As a proxy for the fact that household savings related to food waste are likely to translate into an impact on GVA, we have assumed that household savings are effectively spent in a manner reflecting the average spend by households across the economy. From the NZ input-output tables we have estimated that the impact on GVA, on average, of each £1 of final household expenditure is 0.53. Using the relevant Type 1 and Type 2 GVA multipliers for each sector, the estimated impacts on the Type 1 and Type 2 GVA from such expenditure are 0.66 and 0.8, respectively.

Table 1-35 presents the estimated GVA of preventing food waste and non-food waste for different sectors based on the above figures.

**Table 1-35: Waste Prevention GVA Assumptions**

Activity Source	Direct GVA (\$/tonne)		Type 1 GVA (\$/tonne)		Type 2 GVA (\$/tonne)	
	Food Waste	Other Waste	Food Waste	Other Waste	Food Waste	Other Waste
Domestic Kerbside	-\$28	-\$99	\$212	\$35	\$1,053	\$551
Industrial	\$1,495	\$2,190	\$1,078	\$1,863	\$892	\$902
Commercial/Institutional	\$2,274	\$1,878	\$1,518	\$1,226	\$1,181	\$757
C&D		\$2,250		\$1,370		\$879

## A.5.4 Material Revenues

Material revenue prices used for cost modelling are presented in Table 1-36.

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<sup>107</sup> WRAP (2016) *Estimates of Food Surplus and Waste Arisings in the UK*, May 2016, [www.wrap.org.uk/sites/files/wrap/UK%20Estimates%20May%202016%20%28FINAL%20V2%29.pdf](http://www.wrap.org.uk/sites/files/wrap/UK%20Estimates%20May%202016%20%28FINAL%20V2%29.pdf)

**Table 1-36: Material Revenues**

Material	Revenue from Sale of Recyclate (\$/tonne)
Paper	\$120 <sup>1</sup>
Plastics	\$300 <sup>1</sup>
Putrescibles	N/A *
Ferrous metals	\$100 <sup>1</sup>
Non-ferrous metals	\$1,000 <sup>1</sup>
Glass	\$75 <sup>1</sup>
Textiles	\$500 <sup>2</sup>
Nappies and sanitary	N/A **
Rubble	\$20 <sup>3</sup>
Timber	\$100 <sup>4</sup>
Rubber	\$8 <sup>5</sup>
Potentially hazardous	N/A **
<p>Notes:</p> <p>* There are no material revenues from putrescibles. These materials are taken to organic treatment facilities.</p> <p>** No reliable material revenues were available for the nappies and sanitary and potentially hazardous waste streams. These waste streams make up a very small proportion of the total material recovered and were therefore excluded from the analysis.</p>	

Sources:

1. Based on Eunomia (2012) Kerbside Recycling Options Appraisal, Report to CHH Fullcircle Recycling, O-I New Zealand, and EnviroWaste Services
2. EUWID Recycling and Waste Management (2016) Markets and Price Trends in Europe, Accessed 1<sup>st</sup> May 2015, <http://www.euwid-recycling.com/markets.html>
3. Average price from: Winstone Aggregates (2012) Pricelist, <http://winstoneaggregates.co.nz/wp-content/uploads/2012/10/Final-pricelist-July-2012-low-res-final1.pdf>
4. Based on mulch prices: Auckland landscape supplies (2017) Red Mulch, <http://www.aucklandlandscape.co.nz/products/2/landscaping-supplies/258/red-mulch/>
5. KPMG (2015) Intervention Options to Promote Investment in On-Shore Waste Tyre Recycling, Report for Ministry for the Environment, May 2015, <http://www.mfe.govt.nz/sites/default/files/media/Waste/waste-tyres-economic-research-report.pdf>



## A.6.0 Enforcement and Monitoring Costs

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High-level estimates were made for the cost of enforcement and monitoring to support the implementation of changes to the Levy.

Enforcement costs include the costs of activities required to effectively enforce rules and regulations regarding illegal waste disposal. For this study, the scope of the enforcement costs modelled extends to illegal waste sites, illegal burning of waste, and fly tipping.

Monitoring costs include the cost of monitoring Class 2-4 landfills and farm dumps to ensure compliance with regulations.

### A.6.1 Enforcement Cost Assumptions

Enforcement costs were based on a recent UK study conducted by Eunomia which estimated the impacts of waste crime on the economy.<sup>108</sup> The cost of enforcement by both local and national authorities were converted into a per capita figure and applied to New Zealand based on 2017 population estimates.<sup>109,110</sup> We note that while there is some ongoing enforcement already in New Zealand, the current costs of this are not known. The costs calculated here therefore show the overall cost if an effective enforcement program was implemented, rather than the increase in costs required to increase the level of enforcement.

### A.6.2 Monitoring Cost Assumptions

Monitoring costs were calculated based on a number of assumptions which we describe in this section.

#### A.6.2.1 Number of Landfills/Farm Dumps

Class 1 landfills are already well monitored, and therefore we assume that no additional monitoring will be necessary. As of a study in 2011 there were an estimated 185

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<sup>108</sup> Eunomia Research and Consulting (2017) *Rethinking Waste Crime*, Report for Environment Services Association Education Trust & Environmental Services Association, May 2017

<sup>109</sup> Stats NZ (2016) *National Population Estimates: At 30 June 2016*, Accessed 3<sup>rd</sup> May 2017, [http://www.stats.govt.nz/browse\\_for\\_stats/population/estimates\\_and\\_projections/NationalPopulationEstimates\\_HOTPA30Jun16.aspx](http://www.stats.govt.nz/browse_for_stats/population/estimates_and_projections/NationalPopulationEstimates_HOTPA30Jun16.aspx)

<sup>110</sup> Stats NZ (2016) *National Population Projections: 2016(base)–2068*, Accessed 3<sup>rd</sup> May 2017, [http://www.stats.govt.nz/browse\\_for\\_stats/population/estimates\\_and\\_projections/NationalPopulationProjections\\_HOTP2016.aspx](http://www.stats.govt.nz/browse_for_stats/population/estimates_and_projections/NationalPopulationProjections_HOTP2016.aspx)

consented non-levied fills (class 2-4 landfills).<sup>111</sup> A further study in 2014 estimated that there were 270 operating non-municipal landfills.<sup>112</sup> For non-consented fills, WasteMINZ performed a survey in 2010 which found 777 to 1,420 fills in New Zealand.<sup>113</sup> Some additional clean up of this data was conducted to account for double counting which resulted in a revised estimate of between 206 and 565 sites.

There are approximately 58,000 farms in NZ.<sup>114</sup> Estimates suggest 92% of these have at least one dump site, so that would suggest at least 53,000 farm dumps in operation.<sup>115</sup>

#### A.6.2.2 Resource Requirements

We assume that inspections of landfills would take 1 person 1 day to conduct, with an additional two days to research and write up findings. For farm dumps, we assume half a day to visit the farm for inspection, with a further half day to write up the inspection report.

#### A.6.2.3 Monitoring Schedule

An example of a good practice monitoring and enforcement regime in New Zealand is in the Taranaki region.<sup>116</sup> They undertake 1-3 site visits per year and recover their monitoring costs via annual consent fees of around \$1,000-\$1,200. We assume a similar regularity of inspections for modelling, i.e. each landfill will receive 2 site visits per year.

Given the large number of farm holdings and the remoteness of many properties, it would be an enormous undertaking to inspect all farm dumps on a frequent basis. While a future inspection regime would likely focus on more targeted approaches such as identifying higher risk properties for more frequent inspection, we have no basis for estimating likely numbers under a targeted approach. For the purposes of estimating enforcement and monitoring costs for farm dumps we have therefore assumed that each farm will be inspected on average once every 3 years.

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<sup>111</sup> Ministry for the Environment. 2011. *Consented Non-levied Cleanfills and Landfills in New Zealand: Project Report*. Wellington: Ministry for the Environment.

<sup>112</sup> Ministry for the Environment (2014) New Zealand Non-Municipal Landfill Database, October 2014, prepared by Tonkin & Taylor

<sup>113</sup> WasteMINZ. 2010. *Clean Fills, Managed Fills & C & D Fills - Survey Summary Report*

<sup>114</sup> Ministry for the Environment (2014) New Zealand Non-Municipal Landfill Database, October 2014, prepared by Tonkin & Taylor

<sup>115</sup> Environment Canterbury (2013) *Non-natural rural wastes - Site survey data analysis*. August 2013 prepared by GHD

<sup>116</sup> Eunomia, Waste Not, Tong, (2009) *National Best Practice Cleanfill Programme Manual*. Prepared for Ministry for the Environment (unpublished)

### A.6.3 Cost Estimates

The results of our cost modelling are presented in Table 1-37.

**Table 1-37: Enforcement and Monitoring Costs per Annum**

Type	Cost per annum, \$ million
Local and National Enforcement Activities	\$5.19 <sup>1</sup>
Monitoring of Class 2-4 Landfills <sup>2</sup>	\$0.64
Monitoring of Farm Dumps	\$3.30
<b>Total Cost</b>	<b>\$9.13</b>
<p>Notes:</p> <ol style="list-style-type: none"> <li>1. Based on 2017 population data</li> <li>2. The Resource Management Act does provide provision to recover the costs of monitoring but only from consented sites. In practice for various reasons some Regional Councils currently chooses not to do full cost recovery.</li> </ol>	