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Economic Factors of Waste Minimisation in New Zealand

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Executive Summary

Background

This report examines a number of economic issues relating to waste disposal and alternatives in New Zealand. Specifically the report addresses:

- The rationale for government intervention in waste minimisation and the place of the waste disposal levy within this rationale;
- Issues surrounding disposal pricing in New Zealand and the extent to which it is providing efficient incentives for waste minimisation; and
- The overall costs and benefits of waste minimisation and the contribution of the waste disposal levy towards increasing net benefits.

Market Failure

Market costs of landfill disposal may not lead to optimal levels of disposal and waste minimisation if landfill charges:

- do not reflect the full costs of waste disposal borne by the community and
- are not passed on at the point of disposal in a way that reflects how these costs change with each additional unit of waste disposed.

We examined whether the charges for waste disposal in New Zealand reflect the full social, environmental and economic costs. Landfills are operated in New Zealand on a fully commercial basis, by local authorities, or under a private/public partnership.[1] Generally charges are used to recover costs, but some landfills operated by councils include rate funding. In most places we would expect that all financial costs of landfill disposal are included in landfill charges; where they are not, removing subsidies via rates and introducing unit-based pricing would be a sensible starting point for any funding model. However, there will be external costs that reflect the damage to the environment. We examined the size of these relative to the size of the current waste disposal levy. We estimated these external costs using international literature. These suggested that costs not taken into account in current disposal charges relating to environmental damage might range between $1 and $19 per tonne of waste (Table ES1). The current waste disposal levy rate is within this range.

Table ES1 Summary of External Costs of Landfill

Category	Cost estimate ($/t)
Disamenity	1 to 9
Greenhouse gas emissions	Not applicable
Other air emissions	<1
Leachate	0.3 to 10.4
Total	1-2 to 19

[1] For example, Kate Valley which is owned 50:50 by five local authorities (Christchurch City Council, Hurunui, Waimakariri, Selwyn and Ashburton District Councils) and Canterbury Waste Services Ltd. (www.hurunui.govt.nz/services/hurunui-district-council-waste-and-recycling/kate-valley-landfill/)

Actual costs are likely to be at the lower end of this range because:

- landfills are located away from centres of population—amenity impacts are $1-9/t with the higher rates close to population centres; and

- modern landfills in New Zealand have leachate controls—costs for leachate are estimated to range from $0.3 to 10.4/t, with the higher costs for uncontrolled landfills.

Other costs of landfills are private and will be taken into account already within commercial prices for landfills.

Impacts of Landfill Charges on Waste Minimisation

In the absence of NZ data, international estimates of price elasticities of demand for waste disposal services have been used to calculate the expected response to landfill prices in New Zealand. The analysis suggests an approximate 3% overall diversion of waste as a result of the waste disposal levy in New Zealand, with estimated net benefits that range from negative to close to $1 million per annum (Table ES2).

Tables ES2 Estimated Annual Net Benefits of Levy

Impact	low	High
Thousand tonnes diverted	68	68
Benefits ($/tonne)	$1	$19
Total benefits ($'000)	$68	$1,300
Costs ($'000)	$350	$350
Net benefits ($'000)	-$292	$950

Direct Encouragement of Waste Minimisation

Landfill charges are passed on imperfectly to waste producers: households may face no user charge for waste disposal or they may face a charge that only varies with significant changes in quantities produced (per bag or per bin charges). In these circumstances, and if this cannot be corrected (cost-effectively) through technical means, there may be a justification for intervention to subsidise waste minimisation.

A primary aim of the waste disposal levy is to raise revenue to fund waste minimisation activities. An analysis of expenditure to date is unable to identify whether the expenditure has led to an increase in recycling or other waste minimisation actions or has replaced alternative sources of funding. This is due partly to the relatively short timeframe that levy money has been available for this purpose and the fact that quite a number of projects funded through the waste minimisation fund are still ongoing with their final outcomes yet to be fully assessed. But it also reflects the number of other factors that will determine levels of waste minimisation, eg significant changes to approaches to recycling that have been introduced over the last few years, independent of waste disposal levy funding.

This includes changes to introduce separate glass collections in Wellington and Dunedin and current shifts to fully commingled recycling in Auckland.

Nevertheless, consideration of the nature of costs and benefits associated with recycling suggests that if use of the funds is to be optimised, consideration needs to be taken of material- and location-specific factors. This includes the location of markets and the local costs of landfill disposal.

1 Introduction

1.1 Scope of this Study

This report examines a number of economic issues relating to waste disposal and disposal alternatives in the wider context of waste minimisation policy. Specifically the report addresses:

- The rationale for government intervention in waste minimisation and the place of a waste disposal levy within this rationale;

- Issues surrounding waste disposal pricing in New Zealand and the extent to which it is providing efficient incentives for waste minimisation; and

- The overall costs and benefits of waste minimisation and the contribution of the waste disposal levy towards increasing net benefits.

1.2 Background

New Zealand government policy on waste management is centred on the Waste Minimisation Act 2008 ('the Act'); the objectives are set out in Part 1, Section 3 as being:

> *"to encourage waste minimisation and a decrease in waste disposal in order to—*
> *a) protect the environment from harm; and*
> *b) provide environmental, social, economic, and cultural benefits."*

The Act defines a number of mechanisms that can be introduced to help to achieve these objectives:

- a levy on all waste disposed of in landfills plus expenditure of the revenue raised to promote or achieve waste minimisation;
- product stewardship schemes;
- regulations making it mandatory for certain groups (for example, landfill operators) to report on waste; and
- requirements for territorial local authorities (TLAs) to "promote effective and efficient waste management and minimisation" under a waste management and minimisation plan.

The waste disposal levy has been in place since 1 July 2009. It is designed to raise revenue for promoting and achieving waste minimisation and to increase the cost of waste disposal, in recognition of the wider environmental costs of waste disposal that are not otherwise included in landfill charges.

Under the Act the government is required to review the effectiveness of the levy on a regular basis.

2 Rationale for Intervention in Waste Minimisation

2.1 Market Failure in Waste Management

2.1.1 Waste Management Economics

Waste is a by-product of production and consumption by industry, commerce and households. Once produced it may need management as a waste or it can provide resources as inputs to other activities through materials or energy recovery. Decisions are made throughout the production and consumption phases of a product's life cycle that affect the amount of waste produced. These include:

- Producer decisions regarding
  - Raw materials use;
  - Recycling of process waste;
  - Product design for recycling or waste reduction;

- Consumer decisions regarding
  - Product purchase choices that limit waste;
  - Disposal or recycling options.

These choices take account of the costs and benefits that accrue to the decision makers, reflecting factors such as the relative costs of different raw materials and other resources, product performance using different materials, consumer preferences for products and for recycling, and the value of their time.

There are delays between product manufacture, purchase and disposal. However, because consumers typically have options for product purchase, they can be expected to make choices that are both consistent with their product preferences, and which take account of product costs and the waste management impacts. Producers will manufacture goods that meet these preferences at least cost. In this context, the volume of waste produced is the outcome of numerous decisions made by producers and consumers continuously.

Governments at central and local levels have intervened in waste management because they have perceived that private decisions result in too much waste being produced, ie more than would be optimal for society. We next address why the market might fail in producing optimal outcomes.

2.1.2 Market Failure and Waste Management

The government aims to improve net national well-being.[2] Given resource constraints, the well-being[3] of society is maximised when resources are used by those that value

[2] For example, the Code of conduct for the State Services (www.ssc.govt.nz/code) sets out that the public service must "strive to make a difference to the well-being of New Zealand and all its people."

them most, and resources are used only when they are valued more than the costs of supplying those resources. In waste management there is an array of resources for which optimal allocation is sought, including:

- resources used in product manufacture;
- land used for disposal of waste;
- the potential resource value of post-consumer waste for materials recovery or energy;
- the natural environment that might be depleted in value as a result of waste management activities, via smell, leachate pollution, greenhouse gas emissions and other effects; and
- time and other resources that are required for collection and treatment of waste and recyclables.

For the majority of decisions, we assume that aggregate well-being is maximised when individuals are allowed to make their own decisions about what improves their well-being. However, this will not always be so. For example, this might not occur where or when:

- there are externalities—the actions of one person may have impacts on others and these impacts are not taken into account by the decision maker. This would occur where, for example, waste disposal charges do not reflect the full costs of supply of disposal services to society; and

- charges do not apply at the margin—even if external costs are charged, efficient allocation will not occur if charges are not structured efficiently. An efficient structure requires that the way waste producers face costs reflects the way that society faces costs. For example, where there is a cost associated with each additional item of waste sent to disposal then an efficient charge would ensure costs increased for each additional amount disposed. This is marginal cost pricing.

In addition, people may make decisions with limited amounts of information such that the choices that they make are not optimal. For example, they may not take account of the future disposal costs of an initial purchase. However, it is not clear that this is a market failure; all the information is available to the purchaser, they are simply not using it. The future disposal costs may not be taken into account simply because people take more account of current than future impacts.

The potential problems of external costs and inefficient charges are examples of market failures where the individual choices of people may not lead to optimal outcomes for New Zealand as a whole. This is the starting point for justifying government intervention. In contrast, if individuals have the ability to make choices about what will

[3] Well-being refers to the total benefits that people obtain from all that they value, including but not limited to consumption of goods and services, participation in individual or communal activities, their environment, health and overall contentment with their life and actions.

improve their well-being, and they are taking account of the impacts that their decisions have on others, then there is no justification to change the choices that they make.

Even where there is a market failure, government intervention to correct it may not be justified. Typically there are costs to the government of intervening and these costs may be greater than the benefits of intervention. A necessary additional consideration is whether the benefits of intervening are greater than the costs.

2.1.3 Responding to Market Failure

There may be market failures in product manufacture that result in more waste, eg where there is under-pricing of certain raw materials because environmental effects are not priced. However, if these market failures exist, it is more appropriate to tackle them generically, eg through policy on air emissions or water discharges rather than through waste management policy that only addresses an outcome rather than the underlying problem. Our consideration of market failures that are appropriately the focus of waste management policy is limited to those associated with disposal and other waste management options.

Theory would suggest that optimal use of disposal facilities would occur if disposal is priced at the marginal social cost of supply, ie if disposal charges were equal to the costs to society as a whole of disposing of another tonne of waste. Under these circumstances, waste will only be disposed of if the value of disposal is greater than the costs of supply of disposal services. If this applies to each tonne (or fraction thereof), waste producers will limit their production and disposal of waste to that which is lower cost than other options: recycling, reuse etc. We examine current charging for waste disposal in the next section.

There may be justification for alternative forms of intervention in waste management. For example, where there is a possibility of unauthorised tipping in response to a disposal charge, or other barriers to optimal outcomes exist, analysts have suggested that the ideal instrument is some combination of a product tax and a recycling (or waste minimisation) subsidy.[4] This combination can provide the desired incentives for input substitution (less material input, more recyclable products) and output reduction (less waste, more recycling) that a disposal charge might only produce in theory. The product charge can ensure that purchasers of products pay a differential amount depending on the recyclability of the products, and the recycling subsidy can change the relative price of recycling and landfill without the incentives for unauthorised tipping. Product stewardship systems can also mimic these effects. They can achieve:

- an output reduction effect through providing requirements to recycle rather than to dispose of waste—this gives the obligated party (be it industry or local government) the incentive to subsidise recycling; and

[4] See especially Walls M (2003) The role of economics in extended producer responsibility: making policy choices and setting policy goals. Resources for the Future Discussion Paper 03-11, and Porter, R C (2004) Addressing the Economics of Waste, OECD, Paris.

- an input substitution effect via an obligation placed on industry that relates to the quantity and type of material used (expected waste)—where an obligation changes with the quantity of product output, the costs falling on firms increase as though they were facing a product charge.

To our knowledge a product charge has not been considered in New Zealand, but recycling subsidies are common throughout the country. This includes the provision of recycling services by councils at no direct cost (paid for in rates) and the recycling projects funded with revenues from the waste disposal levy. Recycling subsidies can be an appropriate response to the market failure problem, to the extent that there are barriers to achieving optimal outcomes simply from correcting disposal pricing.

2.2 Landfill Charges

In this section we consider current landfill charges in New Zealand and the extent to which the charges cover the full costs to society of landfill disposal.

2.2.1 Private Sector Participation in Disposal

Waste management and disposal activities are operated by council and private operators. Private sector involvement is dominated by two companies that operate nationally: Transpacific Industries (TPI, that includes Waste Management Ltd) and EnviroWaste. Other significant players in regional markets are JJ Richards and Remondis.

TPI is one of the two companies with a national presence in the waste industry and has close to 50% market share nationwide. Its businesses include:[5]

- solid waste collection businesses throughout New Zealand;
- ownership interests in and/or operation under contract of refuse transfer stations in Auckland, Hamilton, Levin and Gisborne, Southland, Canterbury, Wanganui, Hawkes Bay, and Northland;
- ownership interests in and/or operation under contract of landfills in Canterbury (Kate Valley), Horowhenua, Manawatu/Palmerston North (Bonny Glen), Fairfield (Dunedin) and Greater Auckland (Redvale); and
- collection and processing of recyclable waste in Auckland, Gisborne, Hawkes Bay, Bay of Plenty, Palmerston North and Greater Wellington.

TPI owns the Redvale Landfill in Auckland and it has a 50% shareholding in Midwest Disposals Limited, which owns the Bonny Glen Landfill near Marton. It also has a 50% shareholding in Canterbury Waste Services Limited (CWS) which owns and operates a transfer station in central Christchurch; has a 50% shareholding in Transwaste

[5] Notice under s66 of the Commerce Act 1986 Application by Transpacific Industries Group (NZ) Limited to acquire the Dunedin solid waste collection business of Enviro Waste Services Limited.

Canterbury Limited (which owns the Kate Valley Landfill north of Christchurch) and manages and operates the Kate Valley landfill.

EnviroWaste's assets currently include:

- New Zealand's largest landfill, Hampton Downs in North Waikato, Greenmount managed fill in Auckland and 50% of Bonny Glen landfill (Manawatu/Palmerston North) under a joint venture with TPI;

- solid waste collection businesses throughout New Zealand, including via the acquisition of Manawatu Waste; and

- transfer stations in Auckland, Franklin, Hamilton, Tauranga, New Plymouth, PalmerstonNorth and Wanganui.

JJ Richards has collection businesses for commercial and industrial waste and recycling in Auckland, Hamilton, Tauranga and Wellington. It also operates domestic waste collection services in the Western Bay of Plenty.

Remondis has one municipal collection contract in Auckland and operates around 10 collection vehicles as well as a refuse transfer station. Since entering New Zealand, Remondis has focused on consolidating its collection and resource recovery operations, and, like its Australian operations, it does not operate landfills. Remondis has stated that it aspires to be a nationally-based organisation, and will seek to expand via a both acquisitions and by winning municipal collections tenders.[6] It has highlighted Wellington, Christchurch and Dunedin as primary centres of interest as well as secondary cities, such as Hamilton and Napier. Although it intends to expand its collections operations and appears to have focus on resource recovery, Remondis does not appear to have signalled any strong intention to engage in greater vertical integration with respect to disposal of refuse material in landfills.

2.2.2 Private and Social Costs

Efficient pricing of disposal is achieved when the charges for disposing another unit of waste are equal to the costs of disposing of that additional unit, ie when costs are equal to marginal costs of disposal.

The marginal cost of disposal differs between the short and the long run.

- In the short run, eg within the lifetime of an existing landfill, the marginal costs might be only the variable costs of managing that waste. This would include the costs of labour to process the waste, plus any environmental costs associated with disposal, but would not include the capital costs associated with the land and its preparation.

[6] http://www.energydigital.com/company-reports/remondis-new-zealand-limited

- In the long run, disposal of additional waste brings forward the time that another landfill is needed. And, at any point, the value of existing landfill space is equal to the costs of supplying space elsewhere.

The efficient price, ie that which would result in optimal levels of disposal, is equal to the long run marginal social costs of disposal, calculated as the operational cost plus the capital cost of establishing a new landfill spread over the lifetime of the landfill and the quantity disposed.[7]

The other element of costs that might not be taken into account is that of aftercare. This is the cost of managing the landfill after it is closed to protect against the environmental and potential hazard impacts. Because disposal brings forward these costs they are a component of long run marginal costs also; very often they are funded through establishing a fund that builds up over the lifetime of the landfill, sufficient to manage it from the date of closure. An example of a government requirement is in Victoria, Australia, where the EPA requires landfill operators/owners to provide financial assurances that provide a guarantee that the costs of remediation, site closure and post-closure liabilities are not borne by the community if the occupiers of the premises abandon the site, become insolvent or incur clean-up costs beyond their financial capacity. Acceptable forms of financial assurance include:[8]

- a letter of credit from a bank;
- certificates of title;
- personal and bank guarantees;
- bonds; and
- insurance.

Thus the full costs of disposal include:

1. Operational costs – labour, fuel and materials;
2. Development costs that include
    - Land costs;
    - Buildings and equipment;
    - Planning and consenting costs;
    - Engineering costs;
    - Costs of lining to prevent leaching plus gas recovery systems;
3. Environmental costs during operation;
4. Aftercare costs.

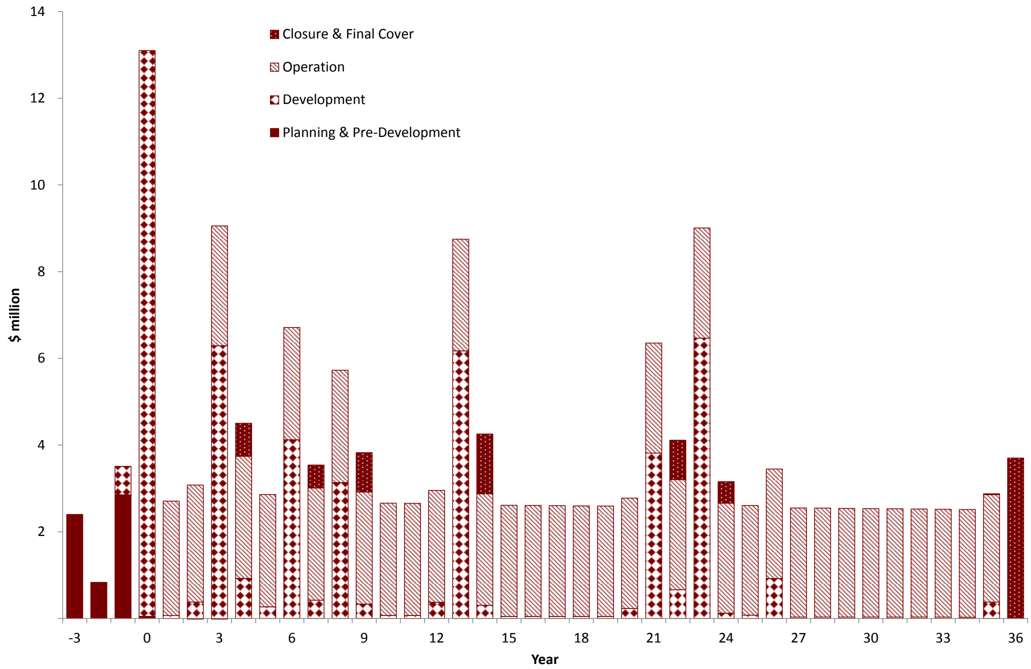
The timing of the financial cost elements is shown in Figure 1 based on the landfill full cost accounting model developed for MfE. This does not include the environmental

[7] It can be estimated for a new landfill as the equivalent annual cost based on the present value of future costs divided by the present "value" of tonnes of waste, ie the quantity of waste in future time periods discounted to the present. This approach is explained with respect to water supply in Fane S, Robinson J and White S (2003) The Use of Levelised Cost in Comparing Supply and Demand Side Options Water Supply, 3(3): 185-192. The principles are the same for waste.

[8] EPA Victoria (2001) Determination of Financial Assurance For Landfills. Publication 777 September 2001.

costs that we discuss below. The costs include up-front planning and predevelopment costs (site selection, geotechnical and groundwater investigations, consenting etc) plus development costs (particularly cell construction costs, ie earthworks, liner, and leachate controls). Operational costs include the day to day site management costs. Using these same data, Table 1 shows the contribution of each element to total costs. It does this using undiscounted and discounted (at 8%) data. Discounting changes the relative significance of the different cost elements significantly.

Figure 1 Timing of Landfill Costs



Source: MfE, Tonkin & Taylor, Waste Management and Ernst & Young. Landfill Full Cost Accounting Model (Spreadsheet model available at: www.mfe.govt.nz/publications/waste/landfill-full-cost-accounting-guide-mar04/index.html)

Table 1 Contribution to Total Costs

Cost element	% of total (un-discounted)	% of total (discounted at 8%)
Planning & Pre-Development	4%	10%
Development	32%	43%
Operation	58%	44%
Closure & Final Cover	6%	3%

These data are private costs that would be expected to be included in commercial disposal charges; and we note that in a 2006 report for MfE, Martin Ward suggested that "most Territorial Local Authority landfills are charging at or above full cost level".[9] Some environmental costs of disposal will be included in private costs when the effects are managed (or mitigated) through management practices (eg dust and vermin control) or through equipment (eg leachate protection and gas recovery systems). However,

[9] Ward M (2006) Issues Associated with a Levy on Solid Waste - A Review of Positions and Possibilities. Report prepared for the Ministry for the Environment.

there will be residual environmental impacts that will not be covered. We discuss these in Section 2.3.

Landfill operators have noted to us that disposal charges in Auckland have dropped to low levels that do not reflect the long run marginal costs. Because there is significant competition between landfill providers, costs have fallen to levels that reflect only the short run operational costs but do not cover the capital costs or the costs of aftercare. However, these low cost levels would not be expected to continue over more than the short run; the market would be expected to correct for these issues in the medium to long run.

The only element of social costs that is not covered by the private costs of operation is that relating to the environmental costs of operation. We limit our assessment of missing costs to these effects.

2.2.3 Current Charge Rates

Data on disposal costs, either to transfer station or landfill directly, are included in Figure 2; this summarises the data included in Table 14 in Annex 1.

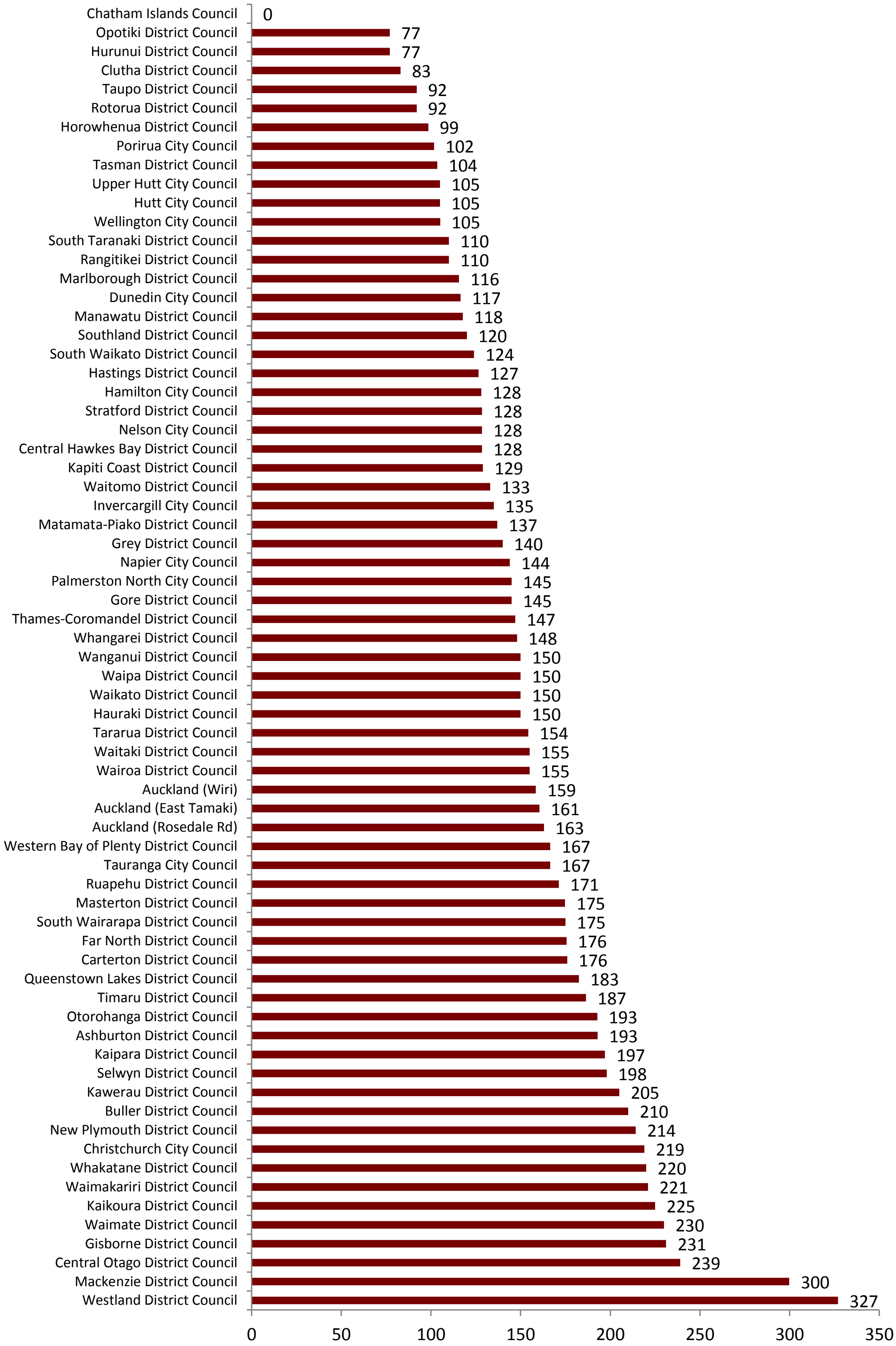
At some sites waste disposal is charged using volume ($/m^3) rather than tonnages.[10] We have used a conversion factor (density) that results in the average $/t charges being the same for sites using $/m^3 charges and those using $/t charges. This is a density of 0.2335t/m^3.

Charges vary widely from zero charged in the Chatham Islands to $327/t in Westland (rising to $450/t from 1st July 2012). The weighted average (by population) across New Zealand is $155/t. These values will not be representative of all waste going to all landfills. For example, in Auckland, the values presented here are relevant for household waste and commercial waste delivered via transfer stations. However, commercial and industrial waste that is collected and taken directly to landfill may face lower charges.

The variation in prices will reflect a wide variety of reasons that include local land costs, the extent of any local government subsidy and the extent to which there is local monopoly provision of landfills. Figure 3 shows the relationship between charges and the estimated volume of waste based on local population; we use a log scale on the x-axis so that the full dataset can be more easily seen. There is no statistically significant relationship. This is more obvious visually if we exclude the two large numbers ($300/t and $327/t) as possible outliers.

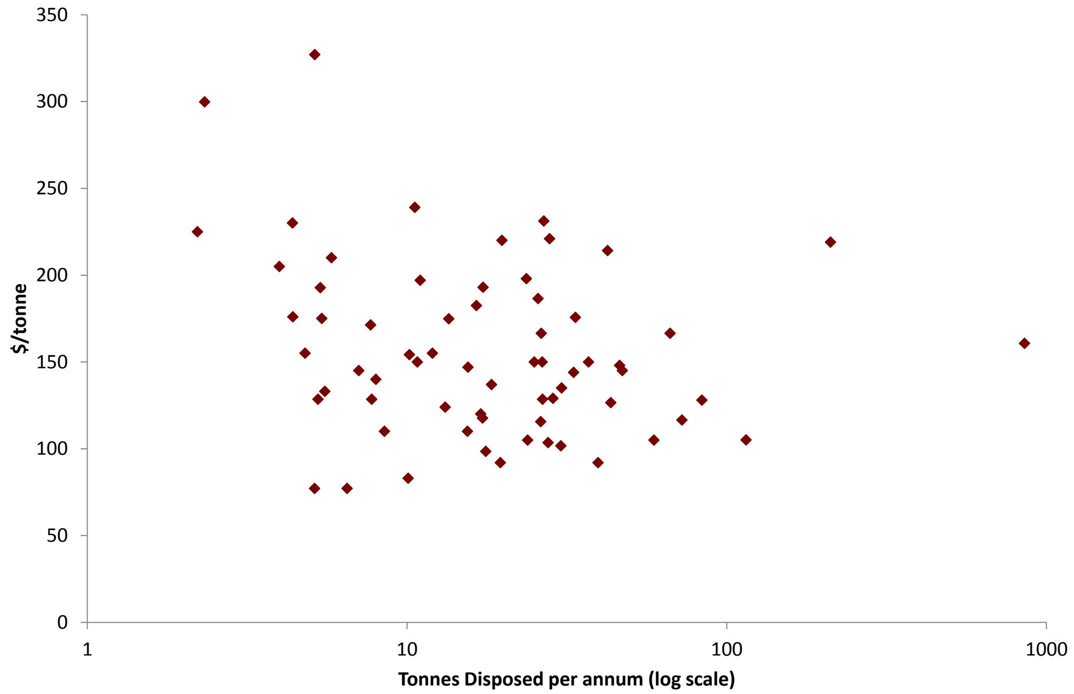
[10] Where $ signs are used in this report it refers to New Zealand dollars unless otherwise stated.

Figure 2 Disposal Charges at Landfills and Transfer Stations (2012)



Source: local authority websites and personal communications (landfill and transfer station operators)

Figure 3 Disposal charges in proportion to total waste volume



2.3 External Costs of Landfill

2.3.1 Absolute versus Relative Costs

One of the rationales for a waste disposal levy is to correct the pricing of landfill disposal to include the full environmental costs. In a previous cost benefit analysis of recycling undertaken for MfE,[11] we examined the external costs of landfill and noted the following effects:

- disamenity, which depends on the location of the landfill;
- emissions to the atmosphere, which depends on the material being landfilled;
- leachate levels, which depend on the material being landfilled.

However, before going on to update these values, we firstly discuss issues to do with the reasons for correcting prices.

Our starting point is that the desired outcome is for resources to be allocated efficiently. This includes resources used in the manufacture of products and in the management or disposal of those products after use. An efficient outcome is achieved when resources are only used by those who value them at least as much as their cost of supply. In this context a levy has a role in ensuring that market prices reflect the costs of supplying another unit of the resource, ie its marginal cost of supply.

However, decisions to dispose of waste are made relative to alternative options for those resources, ie recycling and waste avoidance (not using the resources in production, such

[11] Covec (2007) Recycling: Cost Benefit Analysis. Final Report to Ministry for the Environment.

as via reduced use of packaging). This means correcting relative prices may be more important than correcting absolute prices. We discuss the implications of this below when we consider the pricing of recycling, in particular.

2.3.2 Disamenity effects

Disamenity effects are generally defined as "localised impacts of landfill activity that generate negative reactions from those located in the immediate vicinity of a site;"[12] the impacts include those associated with noise, dust, litter, odour and vermin.

Some of the disamenity effects of waste disposal will apply equally to recycling activity, including those associated with materials recovery facilities. This is relevant if the levy is used to correct the disamenity effects of landfill but not of recycling. It may change relative prices but in a way that is inefficient. The issue is complicated, as increasingly the norm in New Zealand is for waste to go through a transfer station where it is aggregated, prior to transfer to landfill. Thus we have:

$$\text{Disamenity effects of disposal} = E_{TS} + E_{L}$$

$$\text{Disamenity effects of recycling} = E_{MRF}$$

Where: E_{TS} = Effects associated with the transfer station;
E_{L} = Effects associated with the landfill; and
E_{MRF} = Effects associated with the materials recovery facility (MRF)

The disamenity effects associated with the transfer station (E_{TS}) might be similar to those associated with recycling (E_{MRF}). However, it is unlikely that levies will be applied to recycling; it is a service provided with a zero variable or avoidable cost to households. This means:

- Setting a levy to correct for the disamenity effects of the transfer station and landfill would correct the relative prices of disposal and waste avoidance (eg reducing use of packaging) but would over-charge disposal relative to recycling;

- Setting a levy to correct for the disamenity effects of the landfill only would correct the relative prices of disposal and recycling but would under-charge disposal relative to waste avoidance.

The best approach (that most likely to result in allocation of resources to their highest value and/or treatment of waste at least cost) is likely to depend on whether recycling or waste avoidance is a more likely alternative outcome to disposal.

Waste avoidance decisions are more distant in time (and space) from the disposal decision and are less likely to be influenced by changes in price.

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[12] Cambridge Econometrics, EFTEC and WRc (2003) A study to estimate the disamenity costs of landfill in Great Britain. Department for Environment, Food and Rural Affairs. London.

Disamenity Impacts of Landfill

Measuring the disamenity effects of landfill has been undertaken in US and European studies that include:[13]

- hedonic pricing studies that measure the impacts of landfills on property prices; and
- contingent valuation studies that survey households' willingness to pay to reduce the impacts.

These results have been used in a number of Australian studies as the basis for estimates of costs there. Building off these international studies we estimated disamenity costs as ranging from $1-9/t in New Zealand. More recently BDA used a range of A$1-10/t for Australia, partly building off Covec's estimates.[14] This same range of cost estimate has been used more recently in an analysis for the Standing Council on Environment and Water.[15] The studies suggest that the impacts are most likely to be at the lower end of this range, ie close to $1/t. Indeed, the Australian Productivity Commission, citing work for the European Commission, suggested that if a landfill is located more than five kilometres from residential areas, the costs of lost amenity are likely to be less than A$0.01/t of waste. The Commission assumed that the typical amenity cost of a properly-located, engineered and managed landfill is less than A$1.00/t of waste.

2.3.3 Emissions to air

Greenhouse Gases

CO_2 and methane are the most significant emission to air from landfills.[16] However, methane is the only emission that is counted because the CO_2 produced is associated with carbon that was recently absorbed (organic material) or for which emissions have already been counted.[17] Under the recent decision to allow a Harvested Wood Products approach to accounting for greenhouse gas emissions,[18] emissions of CO_2 associated with paper and other wood products may be counted at a later stage,[19] but they would still be counted prior to disposal.

There are different possible approaches to placing a monetary value on emissions: the costs of emission units under the ETS, international emission prices or on estimates of damage costs of greenhouse gases.

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[13] Covec (2007) Recycling: Cost Benefit Analysis. Final Report to Ministry for the Environment.
[14] BDA (2009) The full cost of landfill disposal in Australia. Report for the Department of the Environment, Water, Heritage and the Arts.
[15] PWC and Wright Corporate Strategy (2011) Standing Council on Environment and Water. Attachment C: Cost benefit analysis report.
[16] European Commission DG Environment (2000) A Study on the Economic Valuation of Environmental Externalities from Landfill Disposal and Incineration of Waste.
[17] Emissions from timber and timber products, including paper, are counted when trees are first felled.
[18] Decision CMP.7 Land use, land-use change and forestry. Annex I Definitions, modalities, rules and guidelines relating to land use, land-use change and forestry activities under the Kyoto Protocol. FCCC/KP/AWG/2011/L.3/Add.2
[19] They are lagged over time using half-lives of 2 years (pulp & paper), 25 years (panel products) and 35 years (sawn timber).

Estimates have been made of the damage costs of greenhouse gases—the social costs of carbon.[20] However, these are the global costs per tonne; not the costs per tonne for New Zealand. CO_2 has no local effects at the concentrations emitted; rather it is a global pollutant, and the impacts of emissions from New Zealand, on New Zealand, will be very small. CO_2, and other greenhouse gases, have global effects because it is very long lasting in the atmosphere, mixes thoroughly and thus its impacts are felt worldwide. The impacts that an individual molecule will have are shared with the rest of the world. Because the impacts of emissions from any one country on that country are generally small (they may be significant for large countries), climate change is being pursued as a global problem and policy solutions are being developed in the context of a multi-lateral agreement.

Thus the costs to New Zealand of emissions of CO_2 and other greenhouse gases are defined by its commitment to a quantitative limit to its emissions. Additional emissions in New Zealand result in a cost because it means that:

- Emissions need to be reduced elsewhere in New Zealand; or
- Additional absorption needs to be undertaken; or
- Emission units need to be purchased; or
- New Zealand loses the opportunity to sell emission units to entities in other countries.

Emissions of methane from waste will be included in the NZ Emissions Trading Scheme (ETS) from 1st January 2013. This would be expected to pass on the international cost of emission units capped by a fixed price of $25/t, although the current proposal is for obligations to be limited to less than one tonne of emission units per tonne of emissions until 2015.[21] Thus landfill operators will not be paying the full price of emissions until 2015 based on a deliberate government decision not to impose the whole cost until then.

For analysis our assumption is thus that costs associated with greenhouse gas emissions are internalised via the participation of landfill operators as points of obligation under the ETS. We do not take account of these costs here.

Other Emissions to Air

There are emissions of other air pollutants that include trace quantities of hydrogen sulphide and volatile organic compounds (VOCs). There is little information on the quantities or costs of these emissions in New Zealand, but Australian studies have estimated these to have costs of less than A$1/t of waste.[22] The low levels reflect the small concentrations of these emissions and the general isolation of landfills from

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[20] See discussion of these in Covec (2010) Carbon Price Forecasts. Report to Parliamentary Commissioner for the Environment.

[21] Ministry for the Environment (2012) Updating the New Zealand Emissions Trading Scheme: A consultation document.

[22] Australian Government Productivity Commission (2006) Waste Management. Productivity Commission Inquiry Report No. 38. 20 October 2006; BDA (2009) The full cost of landfill disposal in Australia. Report for the Department of the Environment, Water, Heritage and the Arts.

centres of population. These factors apply in New Zealand as well as Australia, and we would expect these values to be similarly low here.

2.3.4 Leachate

Leachate is generated when soluble components of the waste stream are transported out of mixed waste through the action of water. Leachate can enter groundwater potentially resulting in environmental and/or health problems, particularly if it enters the food chain.

There is no certainty that a particular landfill will generate leachate; it could remain confined in a landfill indefinitely, or until it is appropriately treated and discharged to sewers. In other cases, leachate could leak through landfill liner but be confined by impermeable bedrock. The risks of damage from leachate depend on the location of the landfill, its construction and how leachate is managed. The New South Wales Environmental Protection Agency considered that landfills that comply with environmental management guidelines are unlikely to spill leachate into the surrounding environment and so would not generate any adverse external effects.[23] The Australian Department of the Environment and Heritage stated:

> … the majority of landfills currently servicing major population centres now meet stringent planning and regulatory requirements in relation to location, design, construction and operation. Consequently, such landfills generally do not present significant risks in terms of generating external environmental costs through air and water pollution, noise, dust and the generation and spread of disease. (sub. 103, p. 16)

Various studies have attempted to estimate the cost of leachate, but there does not appear to be much recent research. We build on the studies identified previously[24] and in the recent BDA study in Australia.[25] The BDA Group and EconSearch[26] estimated that the external cost of leachate from Australian landfills is less than A$0.01/t of waste. Miranda and Hale estimated that the external cost of leachate from landfills in the United States is between zero and US$0.98/t (NZ$1.30/t) of municipal waste.[27]

Nolan-ITU estimated the benefits of reduced water emissions that arise from diverting mixed waste from a 'best practice' landfill in Australia.[28] The Australian Productivity Commission's interpretation of Nolan-ITU is that its estimate of the external cost of leachate from a 'best practice' landfill is between $48 - $100/t (A$43 - A$89/t) of mixed waste. The Australian Productivity Commission considered that Nolan-ITU had

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[23] NSW EPA 1996, Proposed Waste Minimisation and Management Regulation, Regulatory Impact Statement , Sydney.

[24] Covec (2007) Recycling: Cost Benefit Analysis. Final Report to the Ministry for the Environment.

[25] BDA (2009) The full cost of landfill disposal in Australia. Report for the Department of the Environment, Water, Heritage and the Arts.

[26] The BDA Group and EconSearch, 2004, Final Report to Zero Waste SA: Analysis of Levies and Financial Instruments in Relation to Waste Management, Zero Waste SA, Adelaide.

[27] Miranda and Hale, 1997 'Waste not, want not: the private and social costs of waste-to-energy production', Energy Policy, vol. 25, no. 6, pp. 587–600.

[28] Nolan-ITU, 2004, Global Renewables: National Benefits of Implementation of UR-3R Process: A Triple Bottom Line Assessment, Sydney.

assumed that all the leachate generated in a landfill would escape and cause environmental damage, and that the cost of the damage is not influenced by the geological or other characteristics of the surrounding area. These assumptions do not appear to be consistent with the siting and design of a 'best practice' landfill. The Commission also considered that the Nolan-ITU estimate did not fully take into account the capture of contaminants by leachate treatment, or the capacity of clay liners to adsorb some of the pollutants in leachate.

The widespread use of best-practice landfills limits the likely effects of any leachate that is generated. This suggests that an externality of around $1/t is appropriate for such landfills. This is consistent with most of the international studies. However, because a proportion of landfills are not likely to adhere to best practice standards, a high-end estimate of external leachate costs of $37/t is also included in our analysis. This is based upon the mid-range of the Nolan-ITU estimate, $74/t, scaled down 50% to account for the fact that an increasing proportion of landfills will meet best-practice standards. A 2003 audit of New Zealand landfills[29] predicted that, by 2010:

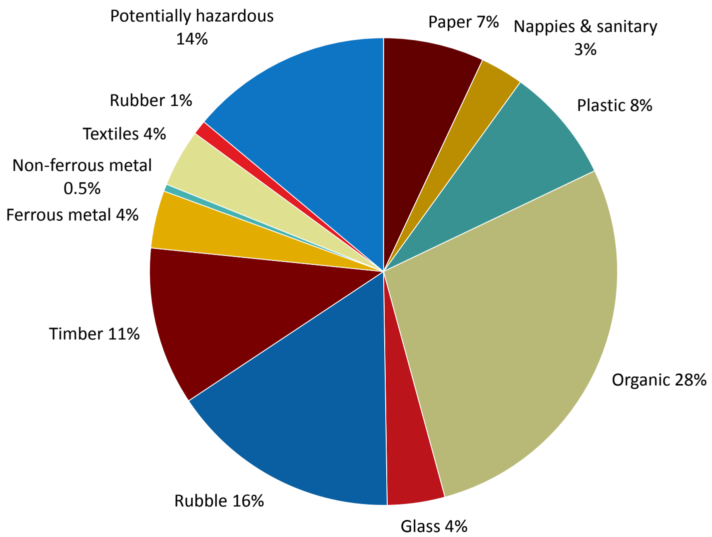
- 43% will be sited over low-permeability material,
- 67% will have an engineered liner,
- 88% will have leachate collection systems,
- all will have effective stormwater diversion in place,
- 67% will treat stormwater prior to discharge, and
- 93% will cover waste on a daily basis.

This audit has not been updated, but the predicted high levels of controls are believed to be accurate.

Leachate benefits are applied to savings in landfilling of organic waste and used oil. If it were to be applied at an average value to all waste it would need to take account of the expected volumes of these materials as a percentage of total waste. Most used oil is reused rather than landfilled;[30] organic waste (putrescibles) represents approximately 28% of total waste disposed of (see Figure 4), suggesting that the leachate costs average $0.28 – $10.36/t.

[29] Ministry for the Environment (2003) 2002 Landfill Review and Audit.
[30] Ministry for the Environment (2010) Used Oil Recovery, Reuse and Disposal in New Zealand: Issues and Options.

Figure 4 Composition of waste to landfill (2007/08)



Source: Ministry for the Environment (2009) Solid Waste Composition. Environmental Report Card July 2009

2.3.5 Summary of External Costs

The different components of external costs are summarised in Table 2. It suggests that total external costs sum to somewhere in the range of $1-2/t to just under $20/t. However, it is most likely that costs are close to the lower end of this range.

Table 2 Summary of External Costs of Landfill

Category	Cost estimate ($/t)
Disamenity	1 to 9
Greenhouse gas emissions	Not applicable
Other air emissions	<1
Leachate	0.3 to 10.4
Total	1-2 to 19

2.4 Internalising Costs via the Waste Disposal Levy

2.4.1 The Legislative Background

Under the Waste Minimisation Act 2008 the waste disposal levy has two main purposes. These are defined under Part 3, Section 25, as being to:

(a) *raise revenue for promoting and achieving waste minimisation; and*
(b) *increase the cost of waste disposal to recognise that disposal imposes costs on the environment, society, and the economy."*

We discuss the second of these two objectives in more detail below. The first objective is then discussed in Section 4.

The levy applies to all waste disposed of at disposal facilities as defined under the Waste Minimisation Act 2008. Section 7 of the Act defines the meaning of a disposal facility to which the levy applies. It specifies that it is "a facility, including a landfill, at which waste is disposed of and at which the waste disposed of includes household waste". Household waste does not include waste that is entirely from construction, renovation, or demolition of the house. Therefore the definition of disposal facilities excludes cleanfills, construction and demolition fills and some other managed fills.

2.4.2 The Levy Size and Structure

Theory suggests that, if environmental damage is measurable in monetary terms, it can be used to define the level of charge that should be applied per unit of waste or pollution.[31] For example, this was the approach used to define the original levels at which the UK's landfill tax was set.[32] Under such an approach, and under a number of assumptions including competitive markets and correct pricing of other resources, an optimal level of landfill disposal and recycling will result.

The theoretical view is that, if a levy had been imposed at the right price and imposed "at the margin",[33] there is no justification for subsidising recycling or other waste minimisation actions. They would result in a level of recycling that was greater than was optimal for society. However, waste management decisions may not be made under circumstances that are consistent with the ideal world of economic theory. Specifically, even if landfill disposal prices are "correct", waste producers may not effectively face these prices. For example:

- households will often face a fee per bin or per bag in a way that reflects an available capacity (the size of the bag or bin) rather than the quantity of waste produced. This provides a limited incentive for waste reduction, ie only when it is sufficient to reduce the requirement from, say two bags to one or a large bin to a small bin;

- they may not even face these prices if disposal costs are passed on as a component of annual property rates; or

- for some bulky items waste disposal costs are incorporated into annual rates bills in some parts of New Zealand via 'free' annual inorganic collections.

However, the starting point here is to analyse whether the levy reflects the external costs of disposal.

[31] Baumol WJ and Oates WE (1988) The theory of environmental policy. 2nd Ed. Cambridge.

[32] Davies B and Doble M (2004) The Development and Implementation of a Landfill Tax in the UK. In: OECD. Addressing the Economics of Waste pp 63-80.

[33] By "at the margin" we mean that each additional unit of waste set out faces a charge and that there is thus a financial incentive for all steps to reduce disposal.

Levy Rate

We noted above (Table 2) that the external costs of landfill are in the order of $1-19/t. At $10/t (plus GST), the current waste disposal levy is within this range, but it is likely that external costs are towards the lower end of the range because:

- landfills are located away from centres of population—amenity impacts are $1-9/t with the higher rates close to population centres; and

- modern landfills in New Zealand have leachate controls—costs for leachate are estimated to range from $0.3 to 10.4/t, with the higher costs for uncontrolled landfills.

Other costs of landfills are private and will be taken into account already within commercial prices for landfills.

Levy Structure

The levy is generally applied by weight to all waste that is disposed in landfills that take household waste. The Waste Minimisation Act states (Section 27) that the levy can be applied at "$10 per unit of volume that … is considered equivalent to a tonne." Although some aspects of costs of disposal will be related to (compacted) volume rather than weight, if the waste delivered is relatively consistent in composition, weight-based pricing will be a good proxy. Thus the way that the levy is structured is consistent with the way in which waste imposes costs.

However, waste producers, particularly households, do not generally face the levy in the same way. We discuss these issues in Section 3.3.1 on page 28. The problems include those that only pay for waste disposal via rates and have no incentive to reduce waste and those that have only partial incentives because the payment methods only differentiate between fairly gross changes in quantities, eg one bag versus two, or a large versus small bin. Thus the system that is implemented at the landfill in a way that passes on the costs to "*increase the cost of waste disposal to recognise that disposal imposes costs on the environment, society, and the economy*" does so very imperfectly for household producers of waste.

3 Landfill Pricing as an Incentive for Waste Minimisation

3.1 New Zealand Data

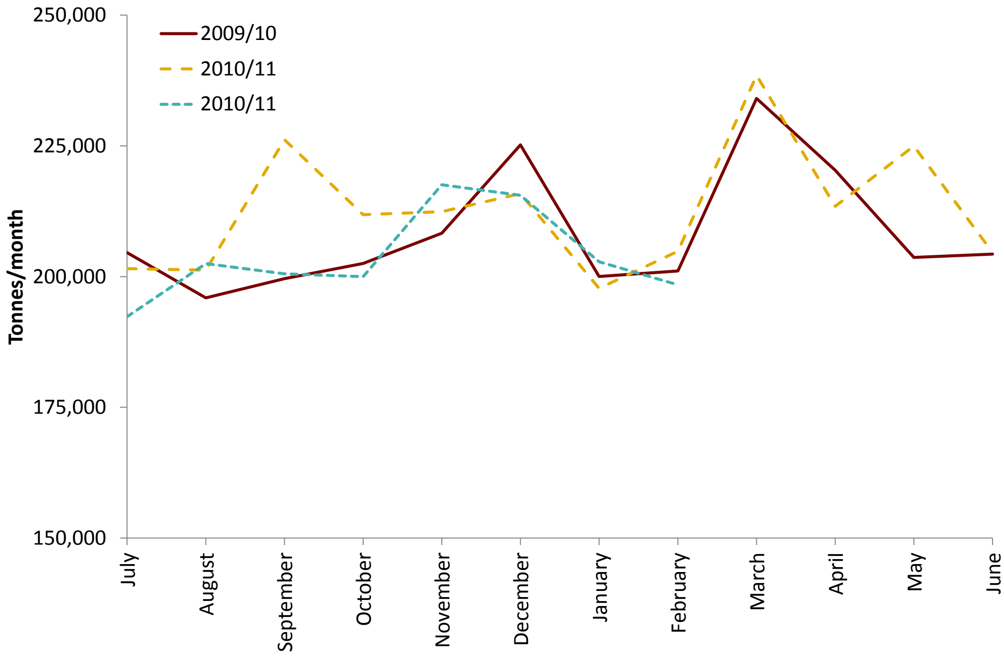
We have not identified data that can be used to identify the response to landfill price in New Zealand. Relevant analytical approaches would include time series analysis that demonstrated a response over time to a change in price and cross-sectional analysis that looked at differences in waste disposal quantities between different territorial authorities with different prices. The data difficulties include the following:

- Missing data relating to private landfills and private recycling activity;
- Changes in activity levels over time that are the result of other effects, including the recession;
- A number of other activities to encourage recycling introduced concurrently with the levy;
- Significant regional differences in waste production reflecting local differences in industrial structure and activity; and
- Confidentiality issues relating to the release of data on a landfill-specific basis.

Conversations with council staff in various parts of New Zealand regarding analysis of the effects of the levy itself, suggested that the analysis would be extremely unlikely to separate out the effects of the levy from other policies and underlying trends. This is likely to be an ongoing issue for assessing its effectiveness. Other issues noted were that, for Auckland, there has been a reduction in underlying landfill prices over time as a result of competition for the supply of waste disposal services.

Figure 5 shows total volumes of waste to disposal facilities since 1 July 2009. This is the period over which the waste disposal levy has been in place and the only period for which MfE has collected a comprehensive dataset. Because it does not include periods prior to the introduction of the levy, and only covers facilities that are subject to the levy (some waste may have been diverted to other disposal sites), it is not possible to draw strong conclusions. We might have expected that volumes would have fallen over time as the effects became clear, however the levy was well publicised prior to its introduction so that those affected would be able to respond to the expected future price signals.

Figure 5 Volumes of waste to Landfill



Source: Ministry for the Environment

3.2 International Results

In this section we review the international experience and reported effects of landfill prices on waste disposal. This includes a number of European studies that describe the experience in reasonably general terms and US studies that have derived price elasticities of demand for waste collection and disposal.

3.2.1 European Studies

In 1999 the EU issued the Landfill Directive to prioritise waste prevention, re-use, recycling and recovery and avoid landfilling. Gate fees and landfill taxes have been used to increase the cost of landfilling and reduce its attractiveness as a destination for municipal waste. Table 3 shows landfill tax rates in European countries; they vary from as low as €1/t (NZ$2/t) in Italy through to over €100/t (NZ$170/t) in the Netherlands.

The European Environment Agency reviews the effectiveness of the Landfill Directive and has found it has led to advancing the closure of landfills and increasing the use of alternative waste management options.[34] However the Landfill Directive does not appear to have reduced waste generation, only its final destination, even in countries where there is considerable success at achieving EU diversion targets. Incineration and energy recovery appears to be a key alternative to landfilling, particularly in colder areas.

[34] European Environment Agency (2009) Diverting waste from landfill - Effectiveness of waste-management policies in the European Union, EEA Report No 7/2009, available at http://www.eea.europa.eu/publications/diverting-waste-from-landfill-effectiveness-of-waste-management-policies-in-the-european-union

Table 3 Landfill Taxes in Europe

Country	Average Net Price for landfilling (€/t)	Landfill Taxes implemented (€/t)	Landfill Taxes/fees planned (€/t)
Austria	€60-130	€87 from 1/1/2006	Adjustment with Consumer Price Index
Belgium, Flanders	Household waste €50 Industrial waste €43	Private Landfill €52.42 combustible waste €30.63 non-combustible Public Landfill €82.03 combustible waste €43.75 non-combustible waste	Adjustment with Consumer Price Index
Belgium, Brussels	No Landfill		
Belgium, Wallonia	2010 €40-80	€65 Hazardous waste €60 non-hazardous waste	Adjustment with Consumer Price Index
Czech Republic	Average €19 for municipal waste	€22.60 incl fees	
Denmark	Average €44 (€10-95)	€63 from 1/1/2010	
Estonia	Landfill gate fee ~€40 incl environmental tax	Environment tax €14.50	Environment tax will rise 20% per year till 2015
Finland		€40/t. Hazardous waste & wastes that are considered technically not possible to recover are not taxed.	From 1/1/2013 to increase to €50/t
France		"non-authorised" €70 "authorised" €20 "authorised + ISO 14001" €17 Energy recovered at 75% level €11	Increasing every 1 January to be in 2015, €150, €40, €32 and €20 respectively
Germany	Landfill ban on untreated municipal waste since 1/6/2005		
Hungary	Average €25	Total price including tax €35	
Ireland	Average net price €30-40	September 2011 €50	July 2012 €65 2013 €75
Italy	Average net price €79-94	Inert waste €1-10, Other waste €5-10, Municipal waste €10-25	
Lithuania	Average net fee €14.5	Total price incl tax 2010 €17.50	2012 €39.50
Netherlands	Average net fee €20-30	2010 High tax €107.49/t combustible waste Low tax €16.49/t non-combustible waste	
Norway	Average net price €100	Waste >10% TOC €59/t <10% TOC €34/t	
Portugal	Total price €3.67	€3.50	Updated every year
Spain	Madrid: €25.36 Catalonia: €40		
Sweden	Average net fee €50-75	€43	
Switzerland		Inert €2.30, Stabilised waste €13, Bottom ashes €12, Salt mines €17	
UK	Average gate fee £22/t (c.€27.50/t)	From 1/4/2012 £64/t (c.€80/t)	Rising by £8 (c.€10/t) per annum

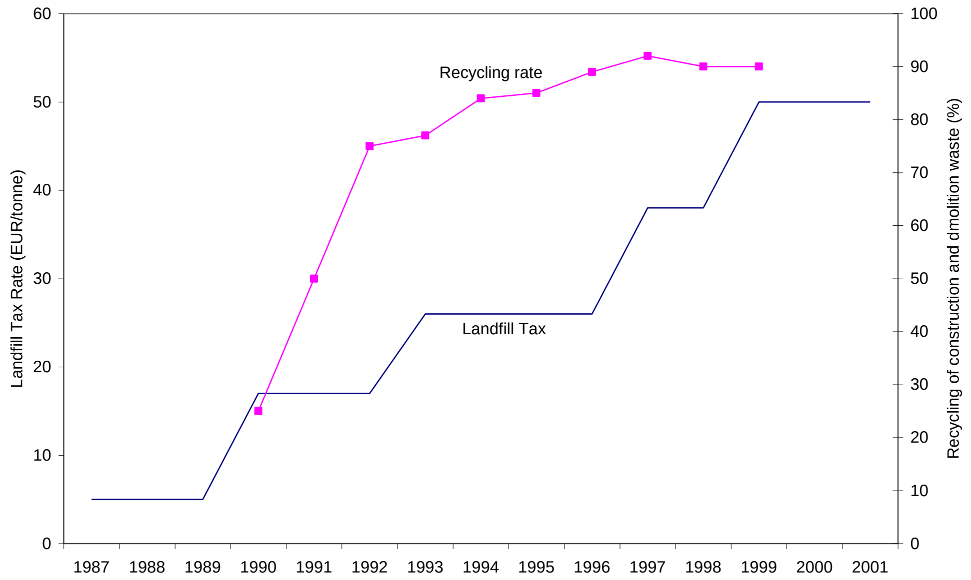
Source: http://www.cewep.eu/information/data/landfill/index.html

Denmark

Denmark and the Netherlands introduced landfill charges earlier than other countries, have relatively high rates of tax, and have low dependencies on landfill for waste management.[35] A study of the effects of the landfill tax in Denmark suggests that it has led to "a remarkable increase in the recycling of construction and demolition waste",[36] although other measures were introduced alongside the tax including technological and institutional solutions.[37] Landfill of construction waste is now very expensive but recycling (especially of concrete, bricks and asphalt) is very low cost.

Figure 6 shows the landfill tax rates (and the corresponding recycling rates). Whereas recycling rates have increased with tax rates, the introduction of a range of other measures alongside the landfill tax means that conclusions on effectiveness cannot be easily drawn.

Figure 6 Landfill Tax and Recycling Rate for Construction and Demolition Waste in Denmark



Source: Jacobsen H and Kristofferson M (2002) Case Studies on Waste Minimisation Practices in Europe. European Environment Agency.

The Netherlands

Landfill taxation has been implemented in the Netherlands since 1995. The tax rate in 2011 was €107.49/t. The tax was introduced to increase the attractiveness of alternatives to landfilling (recycling and incineration) and, as a result, waste to landfill had decreased from 35% for households and 43% for the service sector in 1995 to 6% and 11% respectively in 2003.[38]

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[35] Integrated Skill Limited (2004) An Assessment of Options for Recycling Landfill Tax Revenue. Final Report for HM Treasury.

[36] Jacobsen H and Kristofferson M (2002) Case Studies on Waste Minimisation Practices in Europe. European Environment Agency.

[37] These included subsidies for cleaner technology and recycling projects, establishment of local government sorting schemes, virgin material taxes, regulations on use of waste material in construction, rules on selective demolition so that waste materials (bricks, concrete) are not mixed at source.

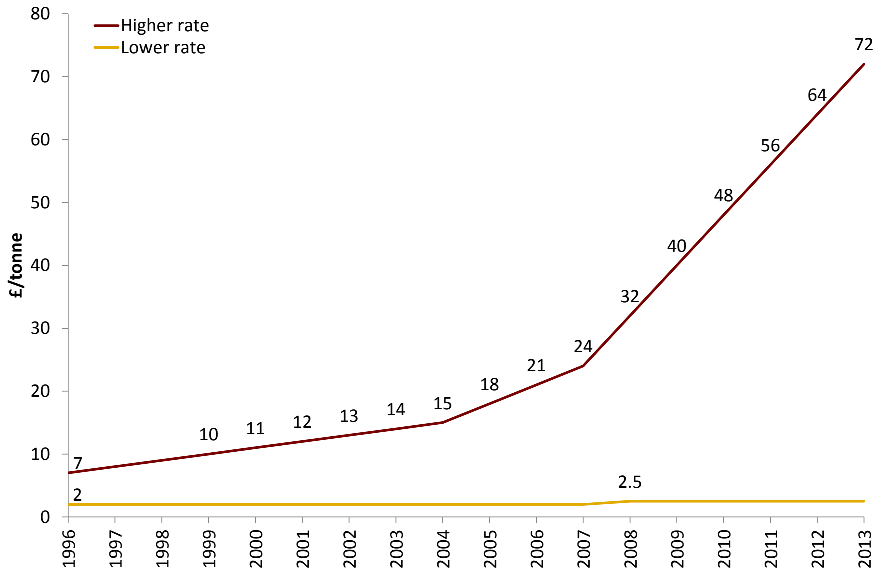
[38] Institute for Environmental Studies (2005) Effectiveness of Landfill Taxation, Vrije Universiteit.

A literature review by the Institute for Environmental Studies (IES) suggests that landfill taxes only have an effect at high levels and when applied to the source of waste with unit-based pricing schemes, ie which measure the quantity disposed. They find a variety of evidence regarding the price sensitivity of waste supply. In some cases there are large reductions in waste with a unit based pricing scheme but this is possibly due to illegal dumping. However, part of recycling behaviour in households appears unrelated to the cost of waste disposal and might be better explained by attitude factors. IES also suggests that landfill taxes are more effective when used in a package with other policies for waste prevention and recycling.

United Kingdom

The UK introduced a landfill tax in 1996. When introduced the tax rates were based on estimates of the environmental externalities associated with disposing of waste at landfill. [39] There are two tax rates: a lower rate of £2.50/t that applies to less polluting wastes[40] and a higher rate for other wastes, originally set at £7/t but rising annually; as from 1 April 2012 it is £64/t (Figure 7). While the lower rate has only increased to £2.50/t since inception, the standard rate has increased several times, to £64/t in April 2012 (approximately NZ$140/t) with annual increases of £8/t until at least 2014. Through introducing an escalator, and breaking the link to measured damage costs, the landfill tax has become more of an incentive-based or "behavioural" tax, designed to reduce landfill disposal[41].

Figure 7 UK Landfill Tax Rate



Source: HM Revenue & Customs (2012) Notice LFT1 - A general guide to Landfill Tax

The annual tax revenue is used to replace other sources of government revenue; it is offset by a 0.2% reduction in employer National Insurance Contributions, a tax used to

[39] Davies B and Doble M (2004) The Development and Implementation of a Landfill Tax in the UK. In: OECD. Addressing the Economics of Waste pp 63-80.

[40] rocks and soils, ceramic or concrete materials, minerals, furnace slags, ash, low activity inorganic compounds, calcium sulphate, calcium hydroxide and brine.

[41] Strategy Unit (2002) Waste Not, Want Not. A strategy for tackling the waste problem in England. www.number-10.gov.uk/su/waste/report/downloads/wastenot.pdf

raise revenue for health and social security purposes. This tax offset is consistent with using revenues to reduce distortions as discussed in Section 4.3.

Since the introduction of the landfill tax, there has been a 60% reduction in the volumes sent to landfill sites of 'inactive' waste subject to the lower level of tax, whilst the volume of waste subject to the higher tax rate has remained broadly unchanged. The latter is explained by the fact that the costs of landfill, including landfill tax, remain low compared to alternative methods of treatment/disposal. Moreover, landfill disposal costs represent a relatively small proportion of business operating expenses.

Revenues collected from the UK landfill tax suggest that there has been a significant reduction in the amount of inert waste going to landfill.[42] And the impacts on construction and demolition waste have been particularly significant.[43] There has been less of an impact on quantities of active waste going to landfill, or at least an initial drop that has not been sustained, despite the higher rate of tax and the introduction of the escalator. However, researchers note the difficulty of measuring the impact of the instrument, partly because of the paucity of data and the absence of a pre-tax baseline set of waste statistics. The landfill tax has been introduced alongside a number of other instruments, including local authority-led recycling schemes and the government's producer responsibility regulations for packaging.[44]

3.2.2 Demand Elasticities in US Studies

A number of US studies have estimated the price elasticity of demand for waste collection and disposal (Table 4). These show the percentage change in quantities of waste put out for collection in response to a 1% change in the cost of collection, ie as a fee for bags or bins. Thus an elasticity of -0.5 means that, if the cost increased by 10%, a household that previously put out 10kg of waste would put out 9.5kg. The elasticities range from close to zero (-0.075) to -0.6.

The estimates are the result of a number of different types of study, including:[45]

- Household-level information collected before and after a unit price change. This type of study primarily gathers data from and with the knowledge of households, creating potential self-selection and observational biases.
- Studies that calculate the price elasticity of waste collection for a cross-section of municipalities using different pricing schemes.
- Time series data collected for a single municipality which estimate quantities collected before and after a change in fees.

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[42] Advisory Committee on Business and the Environment (2001) Resource Productivity, Waste Minimisation and the Landfill Tax.

[43] ECOTEC (2000) Effects of Landfill Tax—Reduced Disposal of Inert Waste to Landfill.

[44] ECOTEC, CESAM, CLM, University of Gothenburg, UCD and IEEP (CR) Study on Environmental Taxes and Charges in the EU.

[45] Iseley P and Lowen A (2007) Price and Substitution in Residential Solid Waste. Contemporary Economic Policy, 25(3): 433-443.

A recent review of response to price noted that many of the studies reporting low elasticities of demand (-0.15 and below) are volume-based charging systems, particularly using wheelie bins, whereas those with higher elasticities are weight-based systems.[46] It suggested that sack-based systems, eg pay-per-bag systems as frequently used in New Zealand, were intermediate in their effects.

Table 4 Estimates of Price Elasticity of Demand for Waste Collection

Author	Elasticity Estimate
Hong et al (1993)[a]	-0.03
Fullerton and Kinnaman (1994)[b]	-0.075
Strathman et al (1995)[c]	-0.11
Jenkins (1991)[d]	-0.12
Skumatz and Breckinridge (1990)[d]	-0.14
Wertz (1976)[d]	-0.15
Kinnaman and Fullerton (1997)[c]	-0.19
Morris and Byrd (1990)[d]	-0.22 to -0.26
Iseley and Lowen (2007)[e]	-0.33
Podolsky and Spiegel (1998)[c]	-0.39
Morris and Molthausen (1994)[f]	-0.51 to -0.6

Source: [a] Institute for Environmental Studies (2005) Effectiveness of Landfill Taxation, Vrije Universiteit ; [b] 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; [c] Cited in Fullerton D and Kinnaman (1999) The Economics of Residential Solid Waste Management. National Bureau of Economic Research Working Paper No. 7326; [d] Cited in Fullerton and Kinnaman (op cit); [e] Iseley P and Lowen A (2007) Price and Substitution in Residential Solid Waste. Contemporary Economic Policy, 25(3): 433-443; [f] Morris and Molthausen (1994) The Economics of Household Solid Waste Generation and Disposal http://infohouse.p2ric.org/ref/49/48030.pdf;

The authors recently undertook work for the Auckland Council as an input to its Waste Assessment and cited a Dutch study that included elasticities for different collection systems consistent with the above conclusions. It suggested the elasticities shown in Table 5.

Table 5 Price elasticities under different charging systems

Collection system	Price elasticity	Price elasticity (with environmental activism)
Weight	-0.47	-0.40
Bag, refuse	-0.14	-0.07
Volume	-0.06	-0.00

Source: Dijkgraaf E and Gradus R (2003) Cost Savings of Unit-based Pricing of Household waste, the case of the Netherlands. Research Memorandum 0209, OCFEB, Erasmus University, Rotterdam. In: Eunomia Research & Consulting (2011) Polluter-Pays Charging for Household Waste Collected Refuse. Background Paper No 3, Auckland Council Waste Assessment Appendix B.

Resources for the Future have estimated elasticities specific to the waste type (Table 6).

[46] Hogg D, Wilson D, Gibbs A, Astley M and Papineschi J (2006) Modelling the Impact of Household Charging for Waste in England. Final Report to Defra. Eunomia Research & Consulting.

Table 6 Elasticity Estimates for Specific Waste Types

Material	Demand Elasticity
Paper & Paperboard	
newsprint	-0.301
writing and printing	-0.949
paperboard containers	-0.463
other paper	-0.594
Glass	
beverage containers	-1
durables	-1
Aluminium	
beverage cans	-1.4
other containers/packaging	-1.4
durables and misc non-durables	-1.4
Steel	
cans	-0.63
other containers/packaging	-0.63
durables	-0.63
Plastics	
PET soft drink bottles	-2.05
HDPE liquid containers	-1.2
other plastic non-durables	-1
durables	-1

Source: Palmer K, Sigman H and Walls M (1996) The Cost of Reducing Municipal Solid Waste. Resources for the Future Discussion Paper 96-35

3.2.3 Conclusions and Implications for New Zealand

The international studies have noted that there is some response to price: as landfill charges increase there is less disposed of to landfill. Some more specific conclusions can be identified as follows:

- The most significant impacts on waste diversion have been associated with construction and demolition waste for which there are low cost alternatives including recycling and/or cleanfills;
- For much waste diversion it is not clear what the alternative destination is, but it includes illegal dumping and incineration in addition to recycling and waste reduction;
- Studies of elasticities suggest that
  - the largest effects of waste pricing occur where weight-based systems are used in which households pay more for each additional unit of waste produced;
  - the smallest effects occur with volume-based charges with costs changing only with a change in the size of wheelie-bin used for disposal; and
  - sack-based systems have intermediate effects.

3.3 Effects of Waste Levy on Waste Diversion, Recycling and Waste Minimisation

In the absence of relevant New Zealand data we have used the results of the international studies to generate a possible relationship between landfill prices and disposal that might apply in New Zealand. We use the elasticities as summarised in Table 5 above, but to do so we firstly need to identify the charging systems used.

3.3.1 Charging Approaches

Charging systems vary between household collections and waste taken to transfer stations or landfills directly.

Kerbside Collections

Charging systems for waste vary widely across the country, as shown in Annex 1. In Table 7 we estimate the proportion of waste being collected via the individual systems; the proportions are based on a simple assumption that waste is proportional to population. Approximately 60% of waste is collected using user charges; however they vary in terms of effectiveness.

Table 7 Proportion of Waste Collected under Individual Systems

Collection method	All charged	Some free	All free (rates)	Total
Council bags or labels	39%	4%	1%	44%
Private bags or labels	1%	-	7%[a]	8%
Council bins	17%[b]	-	27%	43%
Commercial bins	4%	-	-	4%
Transfer station or landfill only	0.1%	-	0.01%	0.1%
Total	60%	4%	36%	100%

Notes: [a] These are systems in which households must provide their own bags but are given free council labels; [b] Some of these may include systems where households are given an option of bags or bins

The systems include:

- Pre-paid rubbish bags. These include a number of different systems including
  - Official council bags or stickers that may be sold by the council or retailers, or they may be given to households. In a number of cases households are given enough for one bag per week (or one per fortnight as in Westland District) and must purchase additional bags;
  - Commercially provided collection systems involving pre-paid bags;

- Pre-paid bin services in which households are charged, usually on an annual basis, for a collection. These can be provided by councils or commercial operators. Very often bins are provided free by councils with collection costs covered by rates.

- In two instances there is no kerbside collection of waste. This is in Kaikoura and the Chatham Islands. In Kaikoura households must take their waste to a transfer station where they pay a disposal fee. In the Chatham Islands households take their waste directly to the landfill where there is no charge.

The systems differ with respect to the incentives for waste reduction. Pre-paid bags pass the costs on fairly immediately, but additional waste only has a cost impact where households require an additional bag (or more) or where there is a possibility of reducing the requirements by one bag (or more). Otherwise households effectively face a fixed cost of disposal. For example, a household that typically uses one bag per week has no incentive to reduce their waste (assuming they have no possibility of using no bags). In addition, if a household is close to requiring a second bag there are other options available for avoiding this including: (1) compacting their waste; or (2) keeping some until the next week (when there is additional waste in one week only).

In some areas households have the option of reducing the bag size, eg from 60 litres to 40 litres. For example, the current price at one Auckland supermarket is $2.45 for a 60 litre bag and $2.08 for a 40 litre bag, a saving of $0.37 for a reduction in waste of up to 33%. This provides some limited incentive for waste reduction.

Wheelie bins generally have an annual charge and the incentive for waste reduction apply to a household making a decision to opt for a smaller bin. However, this option is only available in some areas with many providing only a single size.

Where there is an incentive for waste reduction, the impact of the waste disposal levy is relatively small. At an assumed density of 0.13 tonnes/m^3,[47] the levy is equivalent to approximately 7.8c/bag or approximately 4% of the typical price of $2.10/60 litre bag.

Transfer Stations and Landfills

Some waste is taken directly to transfer stations or landfills. This includes bulky items, unusually large volumes and some commercial and industrial waste.

3.3.2 Price Elasticity of Demand and Expected Effects

In the absence of actual data on the impacts of the landfill levy on waste to landfill, we estimate it using the published elasticity figures. We use the standard elasticities in Table 5 on page 26 and we combine this with the estimates of the proportion of waste that is facing different charge systems. For waste delivered directly to a landfill or transfer station this is a weight-based system. For kerbside collection this is the mix shown in Table 7.

Data for Auckland suggest that 16% of total waste to landfill is domestic, kerbside-collected waste. We assume this percentage applies across the country as a whole. We estimate the effects in Table 8.

[47] Ministry for the Environment (2009) Calculation and Payment of the Waste Disposal Levy Guidance for waste disposal facility operators.

Table 8 Estimated impact of price changes on disposal quantities

System	Elasticity	Proportion		Quantity (kt)		Price change	% change	Impact (kt)
		Direct	Kerbside	Direct	Kerbside			
Weight	-0.47	100%	0%	2,080	-	6.9%	-3.2%	-67.3
Bag, refuse	-0.14		39%		169	3.9%	-0.5%	-0.9
Volume	-0.06		21%		90	4.2%	-0.3%	-0.2
Unpriced			40%		171	0		0
Total		100%	100%	2,080	430			-68.4

The estimated total quantity delivered to landfill is 2.5 million tonnes of which 16% (430 kt) is collected from kerbside and the remainder (2,080 kt) is delivered directly to a transfer station or landfill.

We assume that all waste delivered to transfer stations or to landfill directly faces a weight-based charge and that this produces the largest incentive for waste reduction. We use the weighted average change of $155/tonne (including the landfill levy) from which we estimate that the levy is 6.9% or resulted in that increase in price; with an elasticity of -0.47 this suggests that quantities delivered directly to transfer stations or landfill would fall by 3.2% or 67kt.

The price changes for bags and bins are estimated as $2.10/60 L bag and $200 per annum for a 120-litre bin ($3.80/week); we assume a density of 0.13t/m^3. This is lower than used for waste delivered to landfill but is based on estimates for household waste collected.[48]

The results suggest that the levy will have an impact of approximately 68,400 tonnes of waste diverted from landfill. Of the total, 98% is associated with waste delivered directly to landfill or transfer station.

[48] Ministry for the Environment (2009) Calculation and Payment of the Waste Disposal Levy Guidance for waste disposal facility operators.

4 Waste Minimisation through Direct Expenditure

4.1 Rationale for Subsidies

4.1.1 The Need for Subsidies to Achieve Recycling

Recycling is subsidised widely in New Zealand. Largely this takes the form of free collections of recyclable materials from households, either as separate kerbside collections or through the provision of drop-off facilities. The materials are subsequently sorted in materials recovery facilities (MRFs) and may be further treated at processing plants for the individual materials. A significant portion of recyclable materials collected in New Zealand is exported for treatment and further use in other countries.

We are not aware of any examples of household recycling schemes that require households to pay for these collections. Rather they are subsidised from revenues raised either from rates or waste collection charges. From the council perspective, recycling generally has net costs. It requires:

- separate collection systems;
- sorting systems; and
- transport of materials to markets.

Set against this there are revenues from the sale of materials and savings in landfill and waste collection costs. Waste collection costs do not reduce proportionally with the weight of recycling collected. This is because much of the cost of collection is associated with the time taken per house; this is relatively fixed for a weekly waste collection. The saved landfill costs may not be a direct benefit to councils as there will be some reduction in revenues also (where households are paying for disposal through disposal charges) or where disposal is operated as a purely commercial service.

Generally councils pay collection companies to undertake the separate recycling collection; arrangements then differ with respect to whether councils or the collection company earn the revenue from sales of materials.

4.1.2 The Rationale for Subsidies

The discussion of market failure in waste management suggests that there are externalities of waste disposal and that these justify a charge on waste disposal. In theory this should be a sufficient policy intervention. If people are charged the full marginal social costs of disposal, ie the full costs faced by the community as a whole as a result of an additional amount of waste produced, and if other waste management options, including recycling, are similarly priced, then an optimal level of recycling will occur.

There are barriers to this. Chief of which is the approach to charging for waste collection that does not pass on the marginal costs as a charge at the margin, ie for every quantity (kilogramme) produced. Under these circumstances a charge on its own may not achieve the level of recycling that would be optimal. A recycling subsidy can be used to obtain a level of recycling that would be closer to optimal than that obtained purely from the use of a disposal charge, because of the way in which the charge is implemented. It might be justified where the costs of introducing systems that weigh the production of household waste directly were too costly. The Auckland Council has been examining such weight-based systems in which bins are weighed when lifted by the truck. They have high costs; their use would reduce the justification for subsidising recycling directly as there would be little remaining market failure.

4.2 Optimal Levels of Recycling

In our 2007 cost benefit analysis of recycling we identified that the net benefits differed by location and material.[49] The study calculated the net benefits as:

- Revenues from sales of materials; **plus**
- The saved costs of landfill, including the external costs;
- The saved costs of waste collection;

  minus
- The costs of collection of recyclable materials;
- The costs of sorting recyclables;
- The costs of transport to markets.

The costs of landfills differed by location reflecting the size of the landfill. Transport costs to market differed also, particularly for glass for which the only high value market is in Auckland. The study also considered direct household benefits of recycling. This is an estimate of the value that households obtain from recycling that is reflected in their willingness to spend time sorting materials for recycling even if they obtain no financial reward for doing so, eg where there are no unit costs for waste collection (it is paid via rates). A survey of households revealed estimates of this benefit that was significant in size.

There were weaknesses in this survey, particularly as it was undertaken as part of a wider survey of household preferences allowing little time to explore the meaning of the questions. In particular, the survey did not adequately identify whether these benefits were obtained at the margin, ie as more recycling occurred or if there was a simple benefit from being able to do some recycling.

Across a number of materials the analysis suggested significant net benefits from recycling, but the net benefits differed by location and some assumptions were critical, particularly the inclusion of the household direct benefits.

The broad conclusions of this are that recycling has net benefits and, in the context of identified market failures, there is justification for intervention to achieve recycling. But there are other important points to note: more recycling is not always worthwhile, particularly when landfill disposal is low cost and/or there is a significant distance to market. Expenditure on additional recycling will not always be worthwhile.

[49] Covec (2007) Recycling: Cost Benefit Analysis. Report to Ministry for the Environment.

In the rest of Section 4 we examine the way in which revenues from the levy have been used to encourage recycling and other waste minimisation activities. In Section 5 we examine the net benefits of waste minimisation and the role of the waste levy in the light of such analysis.

4.3 Revenue Raising Requirement

The revenue raising element of the levy raises the following issues for consideration:

- Is there a need for revenue to be raised for waste minimisation?
- Is the levy a good revenue raising instrument?
- Is the revenue raised being used efficiently?

We address the questions in turn below.

4.3.1 The need for revenue

Above we suggested that there can be a rationale for subsidising waste minimisation where there are barriers to a waste disposal levy providing an effective price signal, eg because of the absence of mechanisms that effectively pass the costs on as variable charges (this would require the weighing of individual bags or bins). Under these circumstances the levy on its own may not be sufficient to achieve the optimal level of recycling or reuse.

There may also be a gap in time between the consumption decision that leads inevitably to waste production and the time of disposal. However, this is not necessarily a market failure; people know that waste disposal has costs. Rather it might suggest simply that individuals or firms take little account of future costs, ie they have a high rate of time preference.

The other argument used to justify recycling subsidies is when a levy on disposal leads to increased unauthorised tipping.[50] However, this is more of an argument for not having a levy and for funding recycling from general taxation.

Thus the main argument for subsidies relates to the efficiency with which waste producers can be made to face efficient disposal prices. If this is not possible, recycling subsidies may be justified as a means for achieving optimal rates of recycling.

However, the justification for a subsidy does not justify raising revenue via a levy. Funds for the subsidies could be raised elsewhere, eg through general taxation. And funds raised through a levy could be used for other things. For example, as discussed in Section 3.2.1 below, in the UK amounts raised via the landfill tax are used to reduce taxation levels (National Insurance contributions – a type of income tax). This adds to the economic efficiency of an instrument that is primarily used to correct under-pricing: it both adds to efficiency by correcting waste disposal prices and reduces the distortionary effects of other forms of taxation, a so-called “double dividend”.

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[50] Walls M (2003) The role of economics in extended producer responsibility: making policy choices and setting policy goals. Resources for the Future Discussion Paper 03-11.

In this context, the justification for using revenues for recycling and waste minimisation subsidies, rather than using the revenue to reduce taxes, needs to be addressed.

4.3.2 Is the levy a good revenue raising instrument?

We analyse the levy as a pure revenue raiser because this is set out as an objective of the levy. In other words it is not incidental; it is not in recognition that a price instrument with another purpose (an incentive effect) will raise revenue that we have to do something with.

The economic theory underlying taxation, and other revenue-raising instruments, includes the assumption that individuals and businesses make purchase decisions consistent with what will best improve their well-being. This might be profit maximisation for businesses and happiness or satisfaction for individuals. Taxation, in any form, can distort decisions when it changes prices and thus the consumption levels of specific goods or services relative to others. In some circumstances this distortion is desirable, and specifically where goods are under-priced because of external costs not taken into account in existing market prices; in these circumstances consumption is already distorted from what is optimal. However, where the price change is not justified on such grounds any distortion of behaviour reduces well-being.

Given this, optimal taxation theory suggests that taxes that are not correcting prices should be designed to minimise distortions, eg through being small and widely distributed, targeted at items for which there will be little change in consumption (ie inelastic goods) or specified in a way that does not distort behaviour.[51] In this context, a waste disposal levy is a good revenue raising instrument if:

1. It is correcting current price distortions because of missing costs, ie internalising external costs. In Section 2.3 we note that the current level of the levy may be higher than estimated external costs; or

2. If it is non-distortionary because waste disposal has a low price elasticity of demand – businesses and people do not reduce the amount they dispose of very much when the price goes up. In Section 3 we addressed the impact of landfill pricing on disposal quantities and found that international studies find some price response to disposal charges.

4.3.3 Subsidised projects and activities

The objectives for the revenue raising (and spending) element of the levy are: (1) for that revenue to be used to promote and achieve waste minimisation; but underlying this is the overall objectives of: (2) providing environmental, social, economic and cultural benefits. Thus the interests are as follows:

1. Is the revenue raised being used to achieve waste minimisation;

[51] The most obvious example of the latter is a poll tax, ie a tax per person. Property taxes come close to this as do other lump sum taxes.

2. Does it improve well-being?

These issues are addressed below.

4.4 Revenues collected from the Waste Disposal Levy

Revenue raised by the levy is collected by the Ministry for the Environment. Half of the revenue goes to territorial authorities (shared on a population basis) and half is distributed via the Waste Minimisation Fund to waste minimisation projects. The revenue allocated to territorial authorities must also be used for waste minimisation purposes.

Initially the levy has been set at $10/t (plus GST). During the legislative process, the proposed levy was $25/t, but the lower fee of $10/t was set so the levy would be less likely to result in illegal dumping. Under the legislation, the Government can set a higher rate for specific waste products, but $10/t (plus GST) is the default levy for all wastes that have no specific fee set. Currently no specific wastes have a different fee set.

The levy raised approximately $25m in 2010, which was less than initially forecast.[52] This might owe to the paucity of data on waste volumes available in 2006, when the forecast was made, and the impacts of the recession on waste volumes. A very similar amount ($25 million) was raised in 2011.

The 2011 review found that, of the funds allocated to councils in 2010, 63% had been spent on waste minimisation activities and 35% has been carried forward for future projects (2% were not reported). The Waste Minimisation Fund allocated $6.5m to 25 projects in 2010 and attracted a further $6.5m of investment from project partners. However, the first review noted that it was not possible to assess the success of these projects, partly because the projects had only just started. We address these issues in more detail below.

4.5 Waste Levy Expenditure

In this section we will discuss

- What are the revenues spent on?
- Do they displace other spend or is it additional?

Revenues collected from the waste disposal levy are used to promote or achieve waste minimisation either via:

- Monies allocated to territorial local authorities; or
- the Waste Minimisation Fund.

[52] Ministry for the Environment (2011) Review of the effectiveness of the waste disposal levy, 2011. In accordance with section 39 of the Waste Minimisation Act 2008.

4.5.1 Funds allocated to Territorial Local Authorities

Half of the revenue collected is distributed to territorial local authorities (TLAs) in proportion to their population. The TLA may spend the levy money only on promoting or achieving waste minimisation, and in accordance with its waste management and minimisation plan.

TLAs must report on their expenditure, but there is no requirement for detailed reporting on expenditure and the quantified results, if any. Of a total of $12.6 million, the proportions spent on different types of project up until the end of April 2011 are summarised in Table 9. It is possible that TLAs are interpreting these categories differently, but the information provides some indication of the mix. The largest percentage (approximately 45%) is spent on recycling, with smaller amounts on recovery (17%), reduction (14%) and reuse (9%). The largest proportion of the unspecified category (17% of the total) is spent on research and monitoring.

Table 9 Expenditure under the Council Levy Fund – Proportion on Different Classifications (to end of April 2011)

	Reduction	Reuse	Recycling	Recovery	Unspecified	Total
Education and Communication	6.8%	0.3%	1.8%	0.3%	2.4%	11.6%
Services	0.1%	0.7%	13.9%	0.3%	4.4%	19.4%
Infrastructure	0.9%	1.1%	3.0%	2.0%	0.7%	7.8%
Research & Reporting	0.4%	0.4%	0.4%	1.5%	7.5%	10.2%
Monitoring & Compliance	0.0%	0.0%	0.0%	0.0%	0.2%	0.3%
Hazardous Waste	0.0%	0.0%	0.0%	0.0%	0.4%	0.4%
Other	0.9%	4.2%	0.5%	0.8%	1.3%	7.8%
Unspecified (Period 1)	4.7%	2.0%	25.2%	10.7%	0.0%	42.6%
Total	13.9%	8.8%	44.8%	15.5%	17.0%	100.0%

Source: Ministry for the Environment

4.5.2 Waste Minimisation Fund

A biannual funding round is run for the Waste Minimisation Fund (WMF), in which the Ministry calls for applications for funding. Funding is allocated to selected projects following consideration of the applications received during a funding round. The applications are assessed against:

- the WMF eligibility criteria (Table 10);
- the WMF assessment criteria;
- the purpose of the Waste Minimisation Act 2008;
- the goals of the New Zealand Waste Strategy; and
- their merit compared with other applications.

Only projects that promote or achieve waste minimisation are eligible for funding. This includes educational projects that promote waste minimisation activity.

Table 10 Eligibility Criteria

No.	Description
1	Only waste minimisation projects are eligible for funding. Projects must promote or achieve waste minimisation. Waste minimisation covers the reduction of waste, and the reuse, recycling and recovery of waste and diverted material. The scope of the fund includes educational projects that promote waste minimisation activity.
2	Projects must result in new waste minimisation activity, either by implementing new initiatives, or a significant expansion in the scope or coverage of existing activities.
3	Funding is not for the ongoing financial support of existing activities, nor is it for the running costs of the existing activities of organisations, individuals, councils or firms.
4	Projects should be for a discrete timeframe of up to three years, after which the project objectives will have been achieved and, where appropriate, the initiative will become self-funding.
5	Funding can be used for operational or capital expenditure that is required to undertake a project.
6	For projects where alternative, more suitable, Government funding streams are available (such as the Community Environment Fund, the Contaminated Sites Remediation Fund, or research funding from the Foundation for Research, Science and Technology), applicants should apply to these funding sources before applying to the Waste Minimisation Fund.
7	The applicant must be a legal entity.
8	The fund will not cover the entire cost of the project. Applicants will need part funding from other sources.
9	The minimum grant for feasibility studies will be $10,000. The minimum grant for other projects will be $50,000.

Source: Ministry for the Environment (2012) Waste Minimisation Fund Guide for applicants.

4.5.3 Additionality of Activities and Initiatives

TLAs receiving money from the waste disposal levy are not required to ensure additionality but only to “consider the effects on any existing waste minimisation services, facilities, and activities”. TLAs can essentially spend the money as they see fit, within the broad requirements, but do not need to ensure that it is resulting in more waste minimisation activities than would occur otherwise.

We spoke to a number of local government waste management staff. The information obtained suggested that there has been some expenditure on new projects with specifically-allocated waste disposal levy funding, and these would appear to be additional. However, to demonstrate additionality would require that these projects would not have been demonstrated to be priority projects for the council in the absence of levy funding.

The issues are similar to those raised in the context of the clean development mechanism (CDM) under the Kyoto Protocol. The Kyoto Protocol allows countries with national commitments for emission limitations to meet those commitments through using the Kyoto mechanisms that include international emissions trading, joint implementation and the clean development mechanism. The clean development mechanism (CDM) enables the creation of emission credits in developing countries through projects that result in emission reductions or absorption by sinks. Because the country that produces and sells these credits does not have to meet quantitative emission limits, if the credits sold are not the result of genuine emission reductions then the trade results in an increase in emissions. For example, if credits are produced as a result of a fuel switching project at an industrial plant (coal to natural gas) that would have happened anyway, the emission credits can subsequently be used to allow a plant in a developed country to increase its emissions.

Because of these risks, criteria for assessing additionality have been developed by the Executive Board established to supervise the CDM. The steps to demonstrate and assess additionality, which are also relevant to the waste disposal levy, include:[53]

- Financial assessment, ie that alternative projects (that were more emissions intensive) would be financially more attractive; and/or
- The investment is not common practice.

There are differences from the waste disposal levy expenditure, particularly that the funding for emission reductions represents only part funding of the project, ie it shifts investment from more to less emissions intensive activities that otherwise are achieving similar ends, such as from fossil-fuel to renewable electricity generation. For the waste disposal levy the expenditure typically represents the whole funding. However, what might be relevant is the examination of whether the expenditure is on projects that typically local councils would be expected to undertake using rates funding and/or that it is less attractive than other investments or expenditures.

We examine the total expenditure on waste and recycling activities by a number of councils over time. We ignore those by Auckland Council (because of the significant changes in institutional arrangements that occurred over the same time period) and Christchurch (because of the significant impact of the earthquake on council expenditure patterns and on waste production). We show data for Dunedin (Figure 8), Wellington (Figure 9) and Hamilton (Figure 10). The data presented include all expenditures on waste and recycling (minus the levy), the levy and total council expenditure on a different axis.

There are quite different patterns.

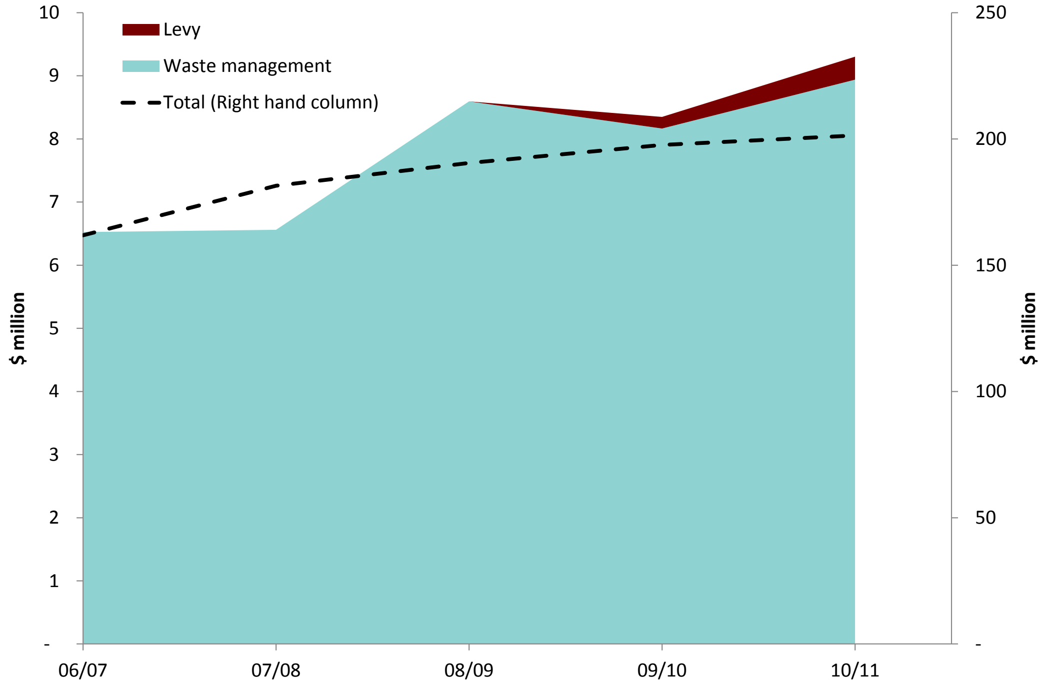
- In Dunedin total council expenditure has increased over time, but expenditure on waste & recycling increased prior to the first payment of levy funding, decreased in the first year and then increased but at a slower rate than the year before the levy. Levy payments in 2010/11 were equal to approximately 5% of council expenditure on waste & recycling;

- In Wellington total council expenditure has increased steadily over time while expenditure on waste & recycling fell prior to the introduction of levy funding, but it has increased by more than the level of additional funding;

- In Hamilton total council expenditure has increased but expenditure on waste and recycling has fallen since the introduction of the levy.

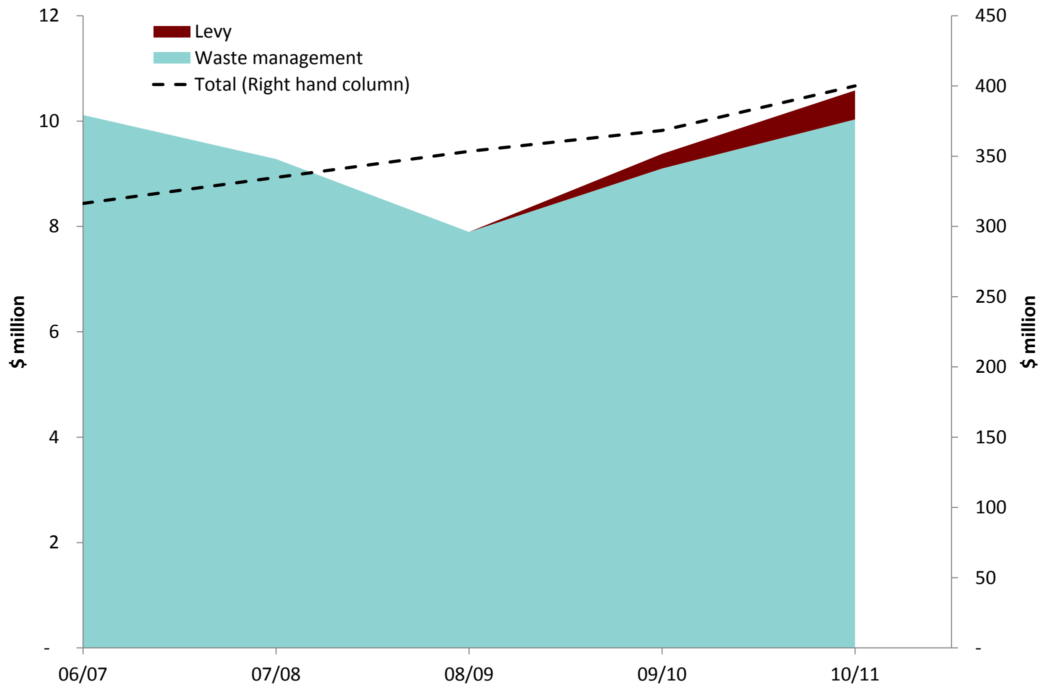
[53] CDM Executive Board. Methodological Tool "Tool for the demonstration and assessment of additionality" (Version 05.2). EB 39 Report Annex 10.

Figure 8 Expenditure on Waste & Recycling compared to Total Council Expenditure - Dunedin City Council



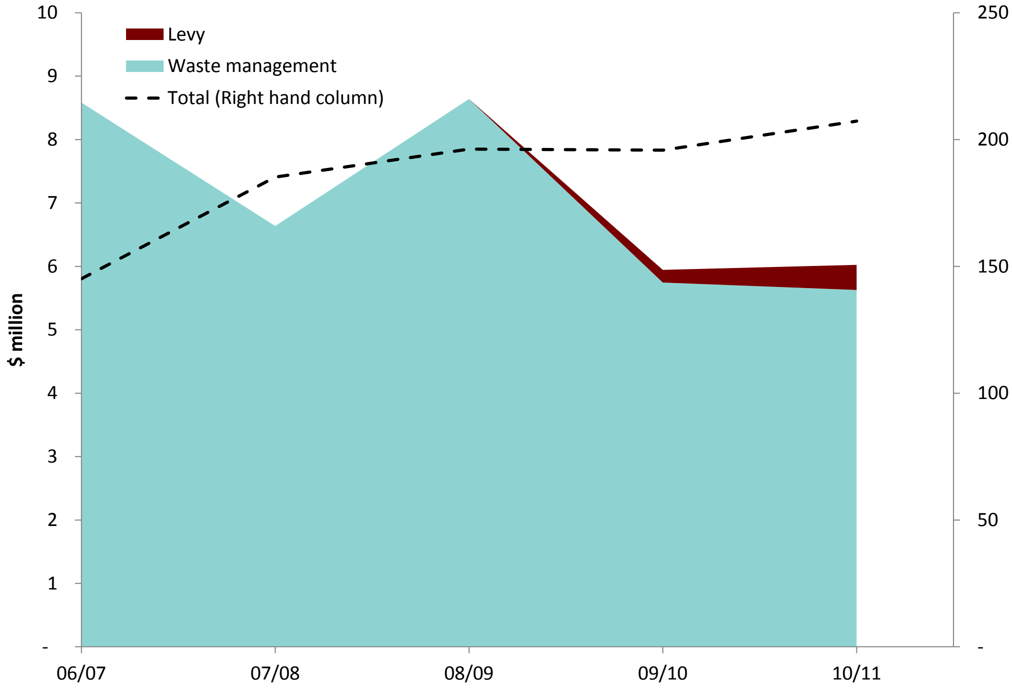
Source: Dunedin City Council Annual Reports

Figure 9 Expenditure on Waste & Recycling compared to Total Council Expenditure - Wellington City Council



Source: Wellington City Council Annual Reports

Figure 10 Expenditure on Waste & Recycling compared to Total Council Expenditure - Hamilton City Council



Source: Hamilton City Council Annual Reports

These cases are typical of others examined and in no case is there any obvious change in expenditure terms. This is not assisted by the fact that most councils report all waste and recycling expenditure in aggregate rather than separately.

The data suggest that it is not possible to identify any additional spend on waste minimisation activities as a result of the levy funding for local authorities.

4.6 Effects of TLA Expenditure on Waste Diversion, Recycling and Waste Minimisation

As noted above we are unable to identify whether the expenditure on projects by councils is additional to what they would have expended anyway. Levy spend reports may identify projects or other activities as new, but this is not necessarily an indication of whether they are additional; they might have happened otherwise using council funds, especially where these activities are consistent with the council's Waste Plan. Similarly we are unable to quantify any effects on waste diversion. Conversations with council staff suggested that:

- A range of other factors was affecting waste volumes over the same time period as the introduction of the levy, including the recession;

- Trends in landfill volumes were not certain in many areas where there are landfill options, some of which are privately-owned and for which historical volume data were not publically available;

- Recycling levels locally include that by private and public (council) participants. Some of the funded measures could be displacing private activities.

Such comments suggest that quantitative analysis is not possible in the absence of data from all landfills (private and publically-owned) and is unlikely to identify perceptible effects from the levy projects.

5 Net Benefits of Waste Minimisation

5.1 Options for Waste Minimisation

In this section we examine the net benefits of encouraging waste minimisation and the role of the waste disposal levy in this overall cost-benefit context.

Waste minimisation covers a broad range of options including reuse and recycling, resource recovery, particularly as energy, and materials reduction. The most prevalent and obvious policy interventions currently are aimed at increasing levels of recycling, particularly via council-subsidised collection schemes.

In contrast, waste reduction measures, ie the use of fewer materials, is encouraged but the incentives are largely private falling directly on manufacturers: there is a financial incentive to reduce material inputs to products. Estimating net benefits of any policy-driven reductions would be highly product-specific.

Other post-consumption measures, such as energy recovery from waste, have largely private benefits also. Examples are largely within-plant recovery measures, eg in pulp and paper manufacture.

We concentrate our analysis here on recycling.

5.2 Net Benefits of Recycling

As noted in Section 4.2 above the 2007 cost benefit analysis[54] identified net benefits for recycling a number of materials. Table 11 shows the summary results for household waste, with the percentage of the material currently (2007) recycled and that estimated to be recyclable with positive net benefits.

Table 11 Summary of Results—currently recycled and quantities that could be recycled with positive net benefits (%)

Material	Currently recycled (%)	Economically recycled (%)
Paper	67	75
Plastic – PET	16	58
– HDPE	16	58
– PVC	16	0-58
– LDPE	16	0-58
Glass	50	64-85
Steel	51	85
Aluminium	51	85
Organics	34	9-85

Source: Covec (2007) Recycling: Cost Benefit Analysis. Report to Ministry for the Environment.

[54] Covec (2007) Recycling: Cost Benefit Analysis. Report to Ministry for the Environment.

Factors that were important in defining the economically recoverable quantities included:

- Material-specific factors such as the value of the materials in end-use markets and the material-specific costs of collection and sorting; and

- Location-specific factors that included distance to market (including ports for export or specific processing plants) and the costs of local landfills (large landfills tend to have lower costs per tonne because there are economies of scale); and

- Assumptions, particularly the extent to which direct household benefits are taken into account.[55]

It means that the benefits of additional recycling cannot be defined in any generic sense. They will differ by material and location.

5.3 Role of the Levy

The waste disposal levy has increased costs for waste disposal and provided additional revenues as a means for supporting recycling. Given the current barriers to households facing disposal costs in a way that changes with the quantity of waste produced, the major impact of the levy is likely to be via the use of the revenue to increase waste minimisation activities.

Nevertheless, the analysis here has suggested that the levy is likely to have had some impact on waste diversion from landfill. However, we have insufficient data to estimate where the waste might have been diverted to. This is consistent with international studies that also show considerable uncertainty over the destination of diversions.[56]

The analysis summarised in Table 8 on page 30 suggests that with a levy of $10/t (plus GST), approximately 68kt of waste would be diverted. We can assume that the costs of diversion, ie the costs of managing waste in some alternative way, will be no more than $10/t; otherwise the diversion would not happen in response to the levy. We can use this approach with the elasticity estimate to calculate the total costs; for example if we estimate the level of diversion on an assumption of a $9/t waste disposal levy, the result would be 61kt (see Figure 11). Thus, we can assume that for 7kt of waste (68kt minus 61kt) the cost of diversion is more than $9/t and less than $10/t.

The line in Figure 11 can be used as an estimate of the costs of supply of diversion to compare with the fixed benefits per tonne diverted (Table 2 on page 17). The total cost is equal to the area under the line (approximately $350,500 per annum). The benefits are estimated to range from $1 to $19/t or $68,000 - $1.3 million per annum; resulting in net benefits that range from negative $0.3 million to $1 million per annum (Table 12).

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[55] This is the benefits that households obtain directly from recycling and are reflected in their willingness to spend time (or money) on recycling despite receiving no financial benefit from doing so.
[56] Hogg D, Wilson D, Gibbs A, Astley M and Papineschi J (2006) Modelling the Impact of Household Charging for Waste in England. Final Report to Defra. Eunomia Research & Consulting.

Figure 11 Quantity diverted at different levy rates

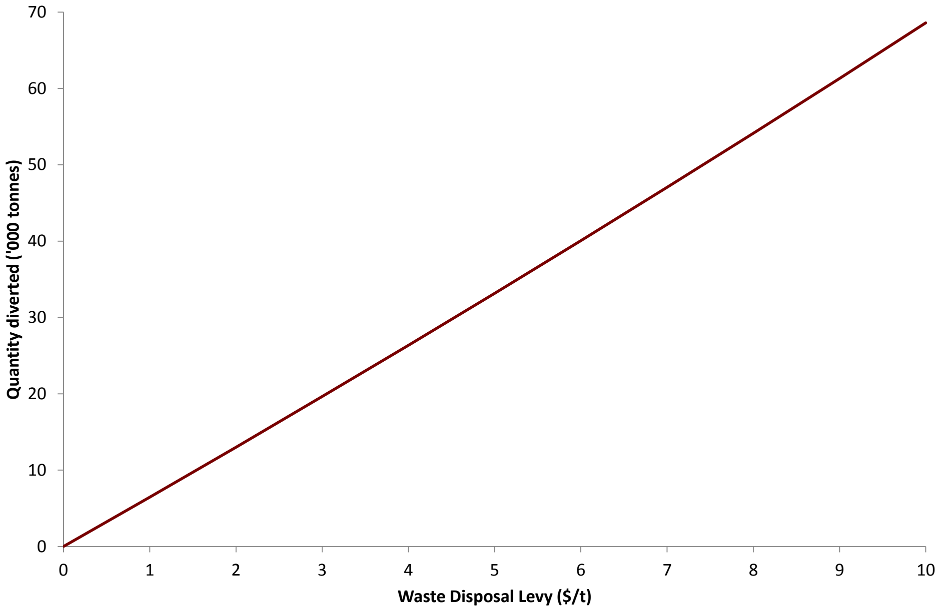

Table 12 Estimated Annual Net Benefits of Levy

	low	High
Thousand tonnes diverted	68	68
Benefits ($/tonne)	$1	$19
Total benefits ($’000)	$68	$1,300
Costs ($’000)	$350	$350
Net benefits ($’000)	-$292	$950

If we undertake sensitivity analysis using the lower elasticities (Table 5 on page 26) based on an assumption of environmental activism, the estimated level of diversion reduces to 58kt. This does not result in the lowest net benefit estimate, however, as this is a negative number and is lowest when more waste is diverted.

In terms of the expenditure of levy revenues, ideally in encouraging waste minimisation, expenditure should take account of local and material-specific factors that determine the net benefits of recycling and other waste minimisation mechanisms.

6 Summary and Conclusions

6.1 Market Failure Justification for Intervention

There are market failures in waste management that justify government intervention to encourage waste minimisation. The failures identified include:

- a number of external costs of waste disposal that are not included in landfill charges; and

- the absence of charging systems that pass on costs to waste producers "at the margin", ie to reflect how costs increase with increasing amounts of waste disposed of.

Theory suggests that the appropriate response to these market failures includes:

- correcting pricing arrangements such that waste producers pay for every unit of waste produced at a price that is equal to the full costs to society of managing another unit. This may include removing subsidies of disposal costs (payment via rates) and unit-based pricing; and

- introducing a disposal charge that ensures that costs of disposal equal the full social costs of that disposal.

Where correcting disposal pricing will not produce optimal outcomes, either because of the absence of efficient charging systems, or because there are externalities of charging (incentives for illegal dumping), alternative interventions that can help to achieve the optimal outcomes can be justified. These include subsidies to encourage recycling or other waste minimisation actions. And other policies consistent with this include producer responsibility systems that essentially privatise the funding and subsidy.

6.2 The Waste Disposal Levy

The waste disposal levy has been introduced in New Zealand with objectives that include correcting for external costs and raising revenues to fund waste minimisation activities.

6.2.1 Correcting External Costs

The external costs of landfill disposal that are not included in current charges include those relating to the disamenity effects and leachate. However, because of the distance of landfills from population centres and the use of leachate controls, these effects are generally minor per tonne of waste delivered.

An additional environmental effect is emissions of methane, which is a greenhouse gas. However, from 1st January 2013 waste disposal facilities will be required to surrender emission units under the emissions trading scheme (ETS), and it is not appropriate to correct for any under-pricing[57] using the waste disposal levy.

It is likely that external costs relevant to most landfill sites in New Zealand are less than the current rate at which the waste disposal levy is applied.

6.2.2 Incentives for Waste Minimisation

The levy will have had some impact in encouraging waste diversion. There are few New Zealand data that can be used to estimate the impacts, but international studies have been used to identify price elasticities of demand for disposal services.

For waste that is delivered directly the results suggest an approximate 3% overall diversion of waste. The net benefits of this level of diversion range from negative to close to $1 million per annum.

6.2.3 Use of Levy Funds

It is not possible to identify whether the expenditure of levy funds has led to an increase in recycling or other waste minimisation actions, or if it has replaced alternative sources of funding. The nature of costs and benefits associated with recycling suggests that, if use of the funds is to be optimised, consideration needs to be taken of material- and location-specific factors. This includes the location of markets and the local costs of landfill disposal.

[57] Initially under the ETS landfill operators will only have to submit 1 emissions unit for every 2 tonnes of waste.

Annex 1 Data

Table 13 User Charges

Council	User charges	Comment
Ashburton DC	✓	Official council bags
Auckland Council	Mixed	45% of households user pays bags or bins; 55% free bins
Buller DC	✓	Official council bags
Carterton DC	✓	$2.50/bag (60 or 65L)
Central Hawkes Bay DC	✓	$2.00/bag (60 or 65L)
Central Otago DC	Rates	Council provided wheelie bins
Chatham Islands Council	Rates	No collections – drop-off at landfill (free disposal)
Christchurch CC	Mixed	$2.04/bag (60 or 65L) in city; free bins in rural areas
Clutha DC	Rates	Council provided wheelie bins
Dunedin CC	✓	$2.10/bag (60 or 65L)
Far North DC	✓	Commercial services for waste disposal (user pays bags or bins)
Gisborne DC	Rates	Own provision of bags (rubbish costs in rates) - council gives free stickers (1/week) - must pay for extra
Gore DC	✓	$2.50/bag (60 or 65L)
Grey DC	Rates	Own bags but council tags - 52 free; extra are $2.30 each
Hamilton CC	Rates	Own provision of bags (rubbish costs in rates)
Hastings DC	✓	$2.10/bag (60 or 65L)
Hauraki DC	✓	$1.90/bag (60 or 65L)
Horowhenua DC	✓	$3.50/bag (60 or 65L)
Hurunui DC	Rates	Own provision of bags (rubbish costs in rates)
Hutt CC	✓	$1.94/bag (60 or 65L)
Invercargill CC	Rates	free collection with bins provided by council
Kaikoura DC	✓	No waste collection service; transfer stations only
Kaipara DC	✓	$2.80/bag (60 or 65L)
Kapiti Coast DC	✓	$3.50/bag (60 or 65L)
Kawerau DC	Rates	Free 60-litre bin; $61 annual charge to upgrade to 120-litre
Mackenzie DC	✓	$2.00/bag (60 or 65L)
Manawatu DC	Rates	No charge - free bags
Marlborough DC	Rates	52 bags free - extras $1.21
Masterton DC	✓	$2.76/bag (60 or 65L)
Matamata-Piako DC	Rates	52 bags free - extras $3.50
Napier CC	Rates	Own provision of bags (rubbish costs in rates)
Nelson Cc	✓	$2.00/bag (60 or 65L)
New Plymouth DC	Rates	Own provision of bags (rubbish costs in rates)
Opotiki DC	Rates	52 bags free (but 25-litre only) - extras $1.00
Otorohanga DC	✓	Provided by retailers
Palmerston North CC	✓	$2.10/bag (60 or 65L)
Porirua CC	✓	$2.50/bag (60 or 65L)
Queenstown Lakes DC	✓	$3.30/bag (60 or 65L)
Rangitikei DC	✓	Completely private service
Rotorua DC	✓	Free bags; additional bags $0.70/bag
Ruapehu DC	✓	$3.50/bag (60 or 65L)

Council	User charges	Comment
Selwyn DC	✓	Options include bags ($1.70 each) or bins ($117 pa for 80L or $383 pa for 240L)
South Taranaki DC	Rates	No charges - free bins
South Waikato DC	Rates	Free bags. Moving to pre-paid bags from 1 July 2012
South Wairarapa DC	Rates	No charge - free bags
Southland DC	Rates	Wheelie bins provided by council
Stratford DC	Rates	Wheelie bins provided by council (rural fully commercial)
Tararua DC	✓	$3.20/bag (60 or 65L)
Tasman DC	✓	$2.00/bag (60 or 65L)
Taupo DC	✓	$1.50/bag (60 or 65L)
Tauranga CC	✓	$2.14/bag (60 or 65L)
Thames-Coromandel DC	✓	$2.04/bag (60 or 65L)
Timaru DC	Rates	Paid in rates. Larger bins cost more
Upper Hutt CC	✓	Commercially provided
Waikato DC	Mixed	$2.50/bag (60 or 65L) (Raglan and Tuakau are prepaid bags; other rates-charged but own bag provision)
Waimakariri DC	✓	$2.10/bag (60 or 65L)
Waimate DC	✓	Options: urban $6 for 60L bag, $204 pa for 80L bin; rural: $225 pa for 240L bin (fortnightly)
Waipa DC	✓	Commercially provided - no council involvement
Wairoa DC	✓	$2.70/bag (60 or 65L)
Waitaki DC	✓	Commercially provided - no council involvement
Waitomo DC	✓	Council bags purchased from retailers
Wanganui DC	✓	$2.10 per sticker (own bag)
Wellington CC	✓	$2.21/bag (60 or 65L)
Western Bay of Plenty DC	✓	Commercially provided
Westland DC	Rates	26 free 60L bags (fortnightly collection); additional bags cost $2/BAG
Whakatane DC	Rates	Free bins
Whangarei DC	✓	$2.25/bag (60 or 65L)

Table 14 Disposal Charges at Landfills and Transfer Stations

Council	Location	$/t	$/m³
Ashburton District Council		193	
Auckland Council	Rosedale Road (North Shore)	163	
	East Tamaki	160.5	
	Wiri	158.5	
Buller District Council	Reefton, Westport	210	
Carterton District Council	Carterton TS	176	
Central Hawkes Bay District Council	Carterton TS	128	30
Central Otago District Council	Patearoa	239	
Chatham Islands Council		0	
Christchurch City Council	Birdlings Flat	219	
Clutha District Council	Mt Cooee Landfill & TS	83	
Dunedin City Council	Green Island Landfill	116.5	
Far North District Council	Transfer Stations	176	41
Gisborne District Council	Transfer Stations	231.16	
Gore District Council	Gore Transfer Station	145	
Grey District Council	McLeans Landfill	140	
Hamilton City Council	Hamilton Transfer Station	128	
Hastings District Council	Transfer Stations	126.5	
Hauraki District Council	Transfer Stations	150	
Horowhenua District Council	Transfer Stations	99	23
Hurunui District Council	Transfer Stations	77	18
Hutt City Council	Landfill charge	105	
Invercargill City Council	Invercargill TS	135	
Kaikoura District Council	Resource Recovery Centre	225	
Kaipara District Council	Transfer Stations	197	46
Kapiti Coast District Council	Otaki Transfer Station	129	
Kawerau District Council	Landfill charge	205	
Mackenzie District Council	Transfer Stations	300	70
Manawatu District Council	Transfer Stations	117.7	
Marlborough District Council	Transfer Stations	116	27
Masterton District Council	Transfer Stations	174.8	
Matamata-Piako District Council	Transfer Stations	137	
Napier City Council	Transfer Stations	144	
Nelson City Council	Transfer Stations	128	30
New Plymouth District Council	Transfer Stations	214	50
Opotiki District Council	Transfer Stations	77	18
Otorohanga District Council	Transfer Stations	193	45
Palmerston North City Council	Transfer Stations	145	
Porirua City Council	Landfill charge	101.7	
Queenstown Lakes District Council	Queenstown & Wanaka TSs	182.5	
Rangitikei District Council	Marton Transfer Station	110	
Rotorua District Council	Landfill charge	92	
Ruapehu District Council	Transfer Stations	171	40
Selwyn District Council	Pines Resource Recovery Park	198	
South Taranaki District Council	Transfer Stations	110	

Council	Location	$/t	$/m³
South Waikato District Council	Landfill charge	124	
South Wairarapa District Council	Transfer Stations	175	
Southland District Council	Winton & Te Anau	120	
Stratford District Council	Transfer Stations	128	30
Tararua District Council	Transfer Stations	154	36
Tasman District Council	Richmond Resource Recovery Centre	103.5	
Taupo District Council	Broadlands Road Resource Recovery Centre	92	
Tauranga City Council	Transfer Stations	166.5	
Thames-Coromandel District Council	Transfer Stations	147	
Timaru District Council	Transfer Stations	186.5	
Upper Hutt City Council	Landfill charge	105	
Waikato District Council	Transfer Stations	150	
Waimakariri District Council	Southbrook	221	
Waimate District Council	Waimate Resource Recovery Park	230	
Waipa District Council	Transfer Stations	150	
Wairoa District Council	Landfill charge	155	
Waitaki District Council	Oamaru Landfill	155	
Waitomo District Council	Landfill charge	133	
Wanganui District Council	Transpacific Transfer Station	150	
Wellington City Council	Landfill charge	105.1	
Western Bay of Plenty District Council	Transfer Stations (Tauranga)	166.5	
Westland District Council	Butlers Landfill (Hokitika)	327	
Whakatane District Council	Transfer Stations	220	
Whangarei District Council	Landfill charge	148	

Note: Conversion from $/m³ to $/tonne uses conversion factor of 0.2335t/m³. This is a value at which the average $/t charges are the same for sites using $/m³ charges and those using $/t charges.