Deloitte Access Economics

Economic effects of the South Australian solid waste levy

FINAL REPORT

Australian Council of Recycling

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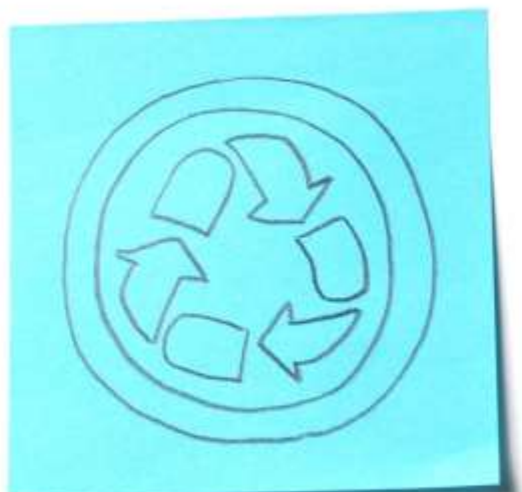

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DAE	Deloitte Access Economics
TS	Transfer station
MSW	Municipal Solid Waste
EFW	Energy from Waste
MBT	Mechanical Biological Treatment
PED	Price elasticity of demand
C&I	Commercial & Industrial
C&D	Construction & Demolition

Executive Summary

Deloitte Access Economics has been engaged by the Australian Council of Recycling (ACOR) to analyse the economic effects of increasing the solid waste levy for metropolitan Adelaide. In South Australia, the Government currently imposes a waste levy on waste depot license holders of $57 per tonne for the disposal of solid waste from metropolitan Adelaide. This level is roughly equivalent to that in place in Victoria and Western Australia. New South Wales currently has the highest levy of $133 per tonne.

Our approach to this report has been to firstly outline the pricing principles relevant to setting a landfill levy, which then guided the identification and quantification of the full costs of landfill. This is followed by an estimation of the employment effects of increases to the landfill levy in metropolitan Adelaide under several price scenarios. We then considered the policy implications of increasing the levy, including around how additional revenues could be spent.

Principles for setting the levy

The overarching objective of the landfill levy in South Australia should be to achieve the socially optimal level of waste going to landfill versus alternatives, such that the overall economic welfare of society is maximised. In short, this is achieved at the point where the landfill gate price reflects the full social costs of landfill.

The full social cost of landfill consists of three key cost categories namely:

1. 'Private costs' for landfill operation, including full life cycle costs such as site and cell establishment costs, operating costs, and post-closure cell and site management.
2. 'Direct externalities' associated with waste collection and landfill disposal, such as greenhouse gas emissions, other air emissions, leachate, disamenity, the opportunity cost of land and transport externalities.
3. 'Avoided externalities' associated with avoiding the extraction and production of virgin materials, which occur as a result of waste materials being diverted from landfill and mobilised into productive use.

In addition to the full social cost of landfill, the landfill levy should also reflect society's desire to reduce waste and encourage resource recovery. This is a more difficult concept to measure as society's desire is not homogeneous, and there are limited studies which have placed a dollar value on this. However it is an important consideration nonetheless, and needs to be considered in any decision around setting a landfill levy price.

For the most part, the *private* costs of landfill are reflected in the gate price. Therefore, in order to determine the right levy amount, the two types of externalities need to be quantified. If the landfill gate price does not reflect these externalities, they will be borne elsewhere in the economy.

The literature suggests that the *direct* externalities for metropolitan Adelaide landfills could range anywhere from a relatively low $ per tonne up to **$42 per tonne** (and possibly higher) of waste disposed. The uncertainty relates to the differences in methodologies in the studies, externalities that have not been quantified such as health risks, assumptions around different landfill practices, and end-of-life management assumptions.

In terms of *avoided* externalities there are also many uncertainties in its quantification, including how much of the value of avoided costs is reflected in the price for virgin materials and therefore already paid by society. However, it is safe to say that not all of the *avoided* externalities are currently reflected in any price adjustment mechanism.

In summary, unless there are equivalent levels of un-costed externalities associated with alternatives to landfill (i.e. from recycling facilities), the un-costed externalities for landfill will lead to a level of waste to landfill that will be higher than what is socially optimal.

Impact on employment

Irrespective of the optimal levy, changing it will have economic consequences, especially through employment. Most directly, an increase in the landfill levy will generate jobs in the recycling sector, partially offset by a loss of jobs in landfill. Currently a significant proportion of SA's waste (approximately 1 million tonnes) is disposed to landfill each year (being a mixture of household, Commercial & Industrial (C&I) and to a lesser extent Construction & Demolition (C&D) waste streams).

To illustrate the impact of increasing the levy on employment in the waste management sector, we quantified the effect of three landfill levy price scenarios using price elasticity of demand estimates and the ratio of recycling jobs to those in landfill. These scenarios were:

- An increase of the levy to $62 per tonne (representing a small increase in line with approximately 3 years of CPI)
- An increase of the levy to $133 per tonne (representing a levy that resembles the largest in Australia – being NSW)
- An increase of the levy to $100 per tonne (a mid-point scenario)

The price elasticity of demand is calculated in two ways. The first is a standard price elasticity of demand calculation that is based on the change in historical observed landfill volumes versus the change in historical landfill gate prices. The second is a point price elasticity calculation. This is an analysis of the elasticity of landfill demand between two price points (namely the current landfill gate price of $93 and a gate price of $169 per tonne, excluding transfer costs). The reason for the second approach is that the gate price for landfill is approaching a price sensitive point on the demand curve where landfill alternatives are price competitive. Therefore it is likely that the price elasticity of landfill at a higher price than the present is much higher than that suggested by the historical price elasticity calculation where prices were lower.

Using the historical price elasticity methodology, the mid-point price elasticity calculation (of -0.39) shows that the net employment effect is between 14 FTE (small levy increase) to 205 FTE (large levy increase). Under the point price elasticity calculation, the employment effect is between 38 FTE and 579 FTE.

The elasticity approach, however, is a simplistically linear way of viewing changes to landfill volumes. In reality, there are particular price thresholds of the levy whereby landfill alternatives, such as new resource recovery operations, become viable. Any new resource recovery operation would therefore result in a step change in waste diversion, rather than a linear change indicated by price elasticity. In particular, many C&I and sophisticated C&D recycling facilities are on the threshold of becoming viable under a levy rate of $62 per tonne, Mechanical Biological Treatment (MBT) at $100 per tonne and Energy from Waste (EfW) plants at $133 per tonne.

Our analysis has focussed only on direct ongoing operational employment numbers and has not considered associated indirect employment impacts, from either landfill or recycling. Nor has it considered the impact of the significant construction and related activity associated with new recycling or landfill facilities. However, by some estimates, for an EfW plant this can be up to 800 FTE during peak construction over a multi-year period and multi-hundred million dollar investment. Furthermore, if the total waste generated by South Australia follows historical trends, there will be around 2% per year increases in waste generated into the future. Therefore as volume of total waste grows so will employment in the waste management sector.

Table i Net impact on Full Time Equivalent (FTE) employment in the waste management sector at four landfill levy elasticity prices and three levy scenarios

Landfill levy ($ per tonne)	Price elasticity of -0.13	Price elasticity of -0.39	Price elasticity of -0.65	Point price elasticity -1.1
$62 (increase of $5)	5	14	23	38
$100 (increase of $38)	39	116	194	328
$133 (increase of $68)	68	205	342	579

Policy implications

Changing the landfill levy also raises a range of other policy implications that need to be considered including:

- Ensuring households and businesses receive the right ‘price signals’ to encourage behaviour changes around reducing waste (through reduction and reuse behaviours) and increased recycling through source separation of waste
- Curbing the incentive to dump waste illegally
- Preventing the perverse incentive to shift waste across state borders, between metropolitan and regional landfills, or even export to overseas destinations
- The price impact on residual waste from recycling operations
- The lack of landfill alternatives for asbestos and metal recycling floc
- Addressing the risk that waste is stockpiled at resource recovery plants to avoid paying the landfill levy
- Timing and phasing of any increase in the levy to ease businesses and households into waste management cost increases, and provide certainty for potential investors.

Allocation of levy funds

There are many possible uses of the increased revenue collected from any increase in the levy. As a general principle, the first priority for any additional levy revenues should be towards programs that will address any unintended consequences of increasing the levy, such as any increased prevalence of illegal dumping, preventing the incentive for waste shifting or stockpiling, or loss of economic activity to other jurisdictions.

As a second priority, there is a case that the additional landfill levy revenue could be directed towards efforts that maximise the effectiveness of the levy in resource recovery and other waste management initiatives, to further divert waste from landfill and develop the resource recovery sector. Increasing the competitiveness of this sector also has the effect of lessening waste management costs to households and businesses.

Wider economy impacts

There is some uncertainty over the wider economic impacts of increasing the landfill levy. On the one hand, increasing the landfill levy increases the cost of waste disposal to households and businesses of South Australia. At face value, increasing the cost of waste disposal effectively increases the cost of production, reducing production and hence jobs. At some point, the levy could be so high that this effect will begin to outweigh the in-sector employment gains.

However, quantifying these rest-of-economy employment impacts is complex, and it is not just an issue of increasing costs to the South Australian economy. The levy also drives key behaviour changes, such as waste avoidance, switching to recycling etc. meaning that costs to society in some areas will be reduced – in ways as diverse as reduced costs of mining virgin material to reduced carbon sequestration costs. Furthermore, the revenue raised by the levy could be used in a way that generates employment. As such, employment in the rest of the economy will be a function of how the South Australian economy responds to the increased cost of waste disposal, and how the revenue raised by the levy is used.

What is clear is that, from the perspective of waste industry job creation alone, any decrease in waste to landfill matched by an increase in recycling will increase in-sector demand for labour.

1 Introduction

Background

The negative environmental and economic impacts of waste are well known. With the increasing consumption of a finite amount of resources, innovation has been key in shaping and changing the way we view waste materials.

Historically, landfill has been the simplest and cheapest way of disposing of society's waste with landfill prices (per tonne of waste) typically only reflecting the private costs of their operation and not the wider cost to society and the environment. These costs include greenhouse and other air emissions, the reduction of amenity for surrounding landholders, damage to surrounding soils and water resources and a significant ongoing environmental management challenge for Government, even after landfills have ceased operation.

Therefore, in the absence of other mechanisms to address externalities, government intervention is necessary to ensure that landfill's full cost to society is reflected in the gate price. A landfill levy is a key mechanism in internalising these externalities, and has the effect of reducing volumes of waste to landfill from waste generators (households and businesses as well as the residual material from recycling facilities) while increasing volumes for recycling through making alternatives more price competitive.

Furthermore, landfill levy amounts are often set higher than that which simply covers the externalities. This is justified on the basis that they reflect society's desire for waste reduction and greater resource recovery which provides further benefits of reduced pressure on virgin materials (particularly those that are non-renewable). It also reduces the negative externalities associated with virgin material production. These costs are often not quantified (unlike landfill negative externalities), but they, nonetheless, represent a valuable benefit to society.

Most state governments have a landfill levy – for the most part this levy has been introduced (or significantly increased) in the last 10 years. In South Australia, the Government currently imposes a waste levy on waste depot licence holders of $57 per tonne for the disposal of solid waste from metropolitan Adelaide.

The project

The Australian Council of Recycling (ACOR) is seeking an analysis to assist in determining what the 'optimal' solid waste levy is for metropolitan Adelaide, and to understand the economic impacts of changing the levy.

South Australia has the potential to generate economic benefits (including job creation) through increasing the recycling and resource recovery of its waste streams. A previous Access Economics (2009)[1] report estimated that there are 9.2 jobs for every 10,000 tonnes of waste recycled, compared to 2.8 jobs for landfill. Therefore, all else being equal, the

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[1] Access Economics 2009, *Employment in waste management and recycling*, July 2009

more tonnes of waste diverted from landfill and into resource recovery activities, the more jobs will be created. Currently a significant proportion of South Australia's waste (approximately 1 million tonnes) is disposed to landfill each year (being a mixture of household, Commercial & Industrial (C&I) and to a lesser extent Construction & Demolition (C&D) waste streams).

The major challenge to achieving more waste diversion from landfill is to understand which policy levers (new or existing) should be used and/or adjusted to create net economic benefits to South Australia – i.e. creating more jobs in the waste management sector while minimising the impact of any policy changes to the rest of the economy.

The imposition of a landfill levy is considered by many to be the most effective financial lever to divert waste away from landfills and into resource recovery activities. A higher landfill levy is likely to make some of the more expensive resource recovery activities price-competitive with landfills. Because of this, a high enough levy may encourage new investment in more sophisticated resource recovery facilities such as Municipal Solid Waste (MSW) resource recovery plants (which have technologies to separate and recycle 'general waste') and Energy from Waste (EfW) plants.

The focus of this study is informing what the landfill levy should be, the employment implications of an increase in the levy, broader policy considerations and how the revenue collected from the landfill levy should be used.

Scope

The overall objective of this study is to understand the economic effects of increasing the landfill levy amount for metropolitan Adelaide in terms of job creation and positive economic outcomes. Our approach to this question consists of the following activities:

- Quantifying the direct externalities associated with landfills in South Australia by reference to other studies and using benefit transfer techniques to apply these findings to South Australia
- Quantifying the externalities associated with resource recovery – which are generally not that well quantified, but are, nonetheless, critical factors in considering what the landfill levy rate should be
- Quantifying the direct net employment effects of various landfill levy scenarios, in the waste management sector, through determining the price elasticity of demand for landfill and consideration of the price thresholds for landfill alternatives
- Discussion on the policy implications of increasing the landfill levy, and consideration of options for how these could be addressed, that will best capture the potential benefits to South Australia
- Discussion on how any additional levy revenue could be allocated that would maximise the benefits and effectiveness of waste management in South Australia.

2 Profile of South Australian Waste Management Industry

The waste management industry in metropolitan Adelaide consists of many facilities, including:

- Five urban landfills
- Three C&D recycling facilities
- One C&I recycling facility
- Eight transfer stations (TS) (including a combined TS/C&D plant)
- Numerous materials recovery facilities (MRF) including glass, metals, masonry, electronic waste, cardboard & paper, and organics.

There are also many smaller regional landfills in South Australia.

Currently there are no municipal solid waste (MSW) plants, mechanical biological treatment (MBT) facilities or energy from waste (EfW) plants in South Australia. At present, South Australia has one C&I recycling facility that is economically viable due to its local alternate fuel outlet arrangements. Any new C&I facilities, however, would not have this option and therefore are not economically viable at this stage.

The waste sector in South Australia has an annual turnover of approximately $1 billion and employs approximately 4,800 people. It is also estimated to contribute around $500m, directly and indirectly, to gross state product (GSP).[2] It is estimated that the total direct market value of resource recovered materials for SA in 2012-13 was $299 million, equal to $87 per tonne of recovered resources, on average.[3]

Chart 2.1 shows the total volume of waste generated in South Australia from 2004 to 2013, separated into recycling and landfill. In 2013, a total of 4.5 million tonnes of waste was generated in South Australia. Of this, 1 million tonnes of waste was sent to landfill and 3.45 million tonnes of waste was sent to resource recovery. The chart shows that waste generation in South Australia was reasonably constant between 2004 and 2009, with spikes in volumes occurring in 2011 and 2012 due to additional waste being generated from large construction projects including the Adelaide desalination plant, Adelaide Oval redevelopment, the South Road Superway and Royal Adelaide Hospital.[4] These projects contributed to significant increases in C&D materials (clean fill and other construction materials). Prior to these large projects, total waste volumes increased by 14% between 2004 and 2010, or an average change of around 2% per year.

Chart 2.2 indicates the percentage of waste sent to landfill and resource recovery by waste stream in 2013, showing that 23% of waste is sent to landfill. Due to the high resource

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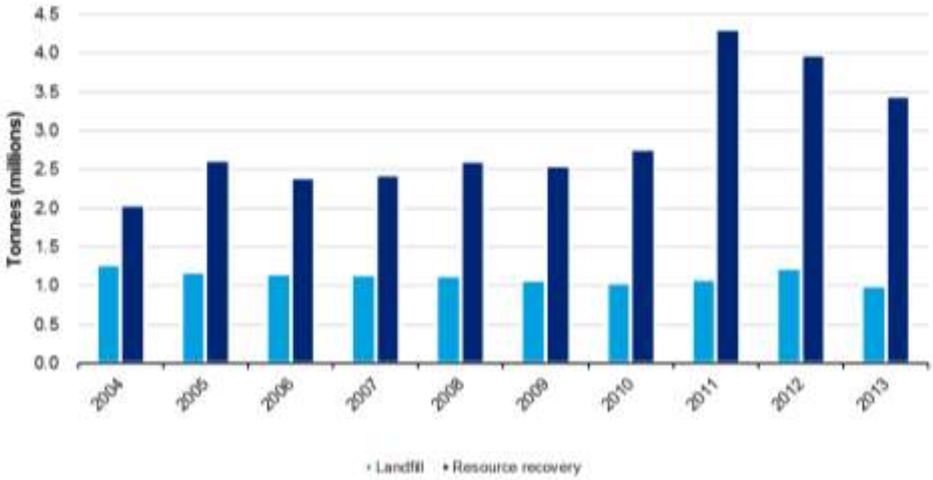
[2] Zero Waste SA 2015, *Waste Strategy 2015-2020 Consultation Draft*

[3] Zero Waste SA 2013, *South Australia's Recycling Activity Survey – 2012-13 Financial Year Report*

[4] ibid

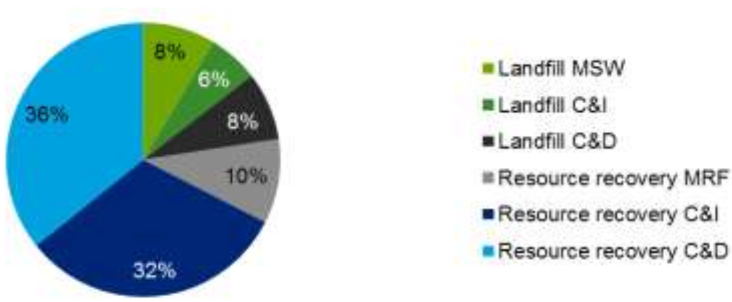
recovery of large projects, this percentage is slightly lower than usual. Landfill volumes in 2010 were around 27% of waste generated.

Chart 2.1: Landfill and resource recovery volumes FY 2004 to FY 2013



Source: Zero Waste SA 2013, *South Australia's Recycling Activity Survey – 2012-13 Financial Year Report*

Chart 2.2: Landfill and resource recovery volumes per waste stream FY 2013



Source: Zero Waste SA 2013, *South Australia's Recycling Activity Survey – 2012-13 Financial Year Report*

Note: Resource recovery MRF is identified as MSW in the reports. It is assumed MRF since there is no MSW resource recovery in South Australia.

In terms of future waste volumes, should population and economic growth continue to be positive, there are likely to be increases in overall waste being generated.

3 Costs of waste management in South Australia

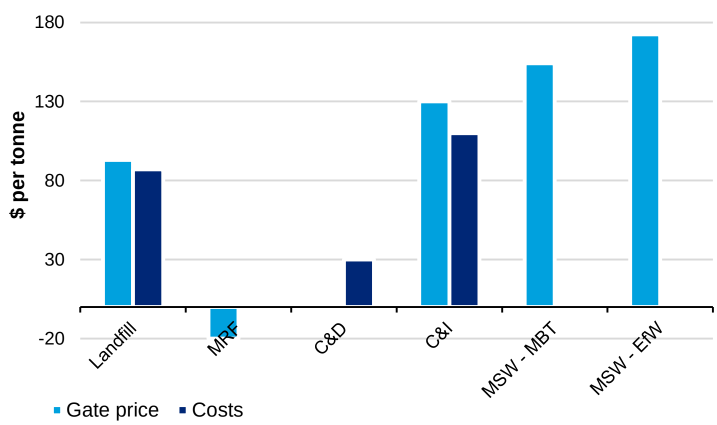
This chapter provides a review of the literature and available data sources on the overall costs per tonne to operate waste management facilities in metropolitan Adelaide. This information provides an overall picture of the competitiveness of recycling facilities in metropolitan Adelaide compared to landfill. It also forms a key input into our later discussion of waste diversion rates under different levy scenarios, and the effects on employment.

3.1 Operating cost and gate price comparison for waste management facilities

Chart 3.1 provides gate prices and estimated costs per tonne for landfills, recycling facilities and MRF facilities in metropolitan Adelaide. Operating costs include labour, materials, equipment, energy, water, administration and rent, and other costs that are required to operate a facility. There is also a cost to send any 'residual waste' on for further processing or to landfill. These costs incorporate the current landfill levy rate of $57 per tonne.

The chart compares the costs to other alternative recycling technologies that are not currently operational in South Australia, such as MSW, MBT and EfW plants. The C&I numbers are an estimate for a new plant in South Australia. As noted, the C&I facility in Adelaide has an abnormally low cost structure due to having a major buyer for its recycled product (alternate fuel outlet) which provides a revenue stream. There is no further capacity for this to occur for new C&I plants.

Chart 3.1: Waste management facility gate prices and costs ($ per tonne)



Source: Australian Council of Recyclers (ACOR) estimates 2015 for landfill, MRF, C&D and C&I. Waste & Resources Action Programme (WRAP) 2014, *Gate fees report 2013-14 Comparing the Costs of Alternative Waste Treatment Options* for MBT and EfW. These gate prices are based on a landfill levy at $57 per tonne

Key points to note from the chart above are that:

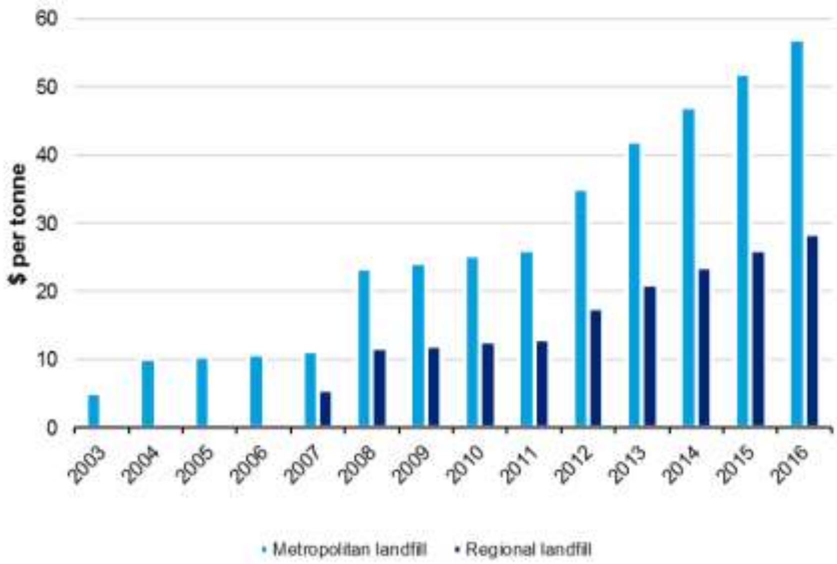
- Landfill costs are made up of private costs (of around $30 per tonne for a large landfill plus the levy of $57 per tonne). The gate price of $93 per tonne therefore reflects a profit margin as well. The landfill numbers here represent operating costs of a large facility in metropolitan Adelaide receiving greater than 300,000 tonnes per year, and includes the full lifecycle costs of landfill (i.e. from establishment and cell development, to annual operating costs, through to end of life management). Landfill costs in metropolitan Adelaide have a range of $30 to $45 per tonne depending on volumes processed at the site.
- The cost of landfill in Adelaide also needs to take into account the costs involved at the transfer station and further haulage costs to transport waste from the transfer stations to the landfills, which are not located in metropolitan areas. The costs of transfer stations is estimated at around $15 per tonne, while the costs of haulage at around $15 per tonne. Therefore the gate price of landfill plus the gate price of the transfer station results in a total landfill price of around $123 per tonne. This is referred to in this report as the 'landfill transfer station price'. This landfill transfer station price is the most appropriate price when comparing the cost of landfill to alternatives.
- C&D costs are estimated at $30 per tonne. There was no gate price estimates available for C&D except for a particular component of C&D (i.e. $15 for unclean concrete).
- Any new C&I facilities are likely to have gate prices that are not competitive with current landfill prices.
- MRF facilities pay up to $20 per tonne for the waste from municipal recycling bins – plastic, glass, paper etc. There are also other plants which recycle materials from container deposit legislation including aluminium, glass, plastic containers etc. but these are not shown.
- The estimates for MBT and EfW gate prices are based on median estimates from a UK study on gate fees for landfill alternatives[5]
- C&I, C&D, MRF and metal recycling plants have a waste residual that cannot be recycled and is therefore sent to landfill.

3.2 Landfill levies

The landfill levy was first introduced into South Australia for metropolitan landfills in 2003 and for regional landfills in 2007. Chart 3.2 shows that there has been three distinct 'blocks' in the metropolitan landfill levy rate over this time. The first is between 2003 and 2007, when the levy was around $10-11 per tonne. The second is between 2008 and 2011, where it increased to around $23-26 per tonne, following a step change in 2008. The third is between 2012 and 2015 where, after a step change in 2012, it has risen by an annual average of 14% per year to its current rate of $57 per tonne.

[5] Waste & Resources Action Programme (WRAP) 2014, *Gate fees report 2013-14 Comparing the Costs of Alternative Waste Treatment Options,* prepared by Urban Mines

Chart 3.2: Landfill levy ($ per tonne)

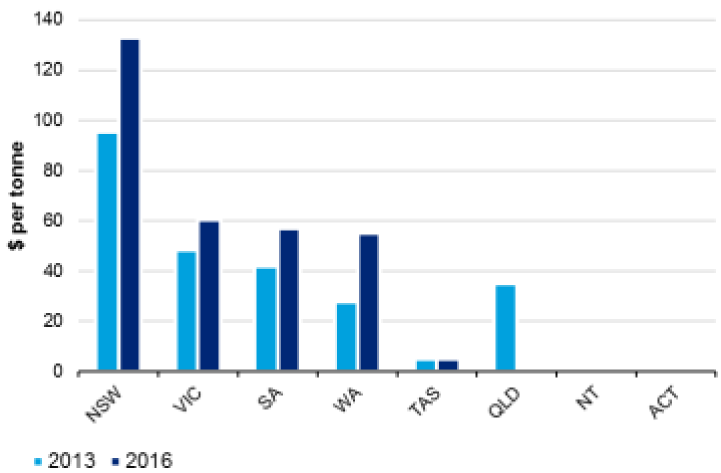


Source: Australian Council of Recyclers (ACOR)

Chart 3.3 compares the various landfill levies for different Australian states and territories. South Australia's metropolitan waste levy of $57 per tonne (for 2015-16) is comparable to Western Australia, which has a levy of $55 per tonne on putrescible waste, and Victoria which has set its metropolitan waste levy at $61 per tonne for municipal and industrial waste. NSW has the highest levy of all the states at $133 per tonne for the 2015-16 financial year.

Tasmania does not have a legislated levy but has implemented a voluntary levy of between $2 and $5 per tonne on all waste sent to landfill. Queensland, Northern Territory and Australian Capital Territory do not have a solid waste levy in place.

Chart 3.3: Comparison of metropolitan waste levies across Australian states for financial years 2013 and 2016



Source: State government websites 2015. Notes: Western Australia levy is on putrescible waste, inert waste levy is $40 per tonne; For Tasmania the upper limit of the voluntary levy is shown

The key reasons for the implementation of levies in different states include:

- **New South Wales:** The levy price in NSW has been set to achieve the objective of making alternatives to waste disposal more attractive. Economic modelling from the NSW Office of Environment & Heritage indicated that the levy will achieve this objective at a price of around $120 per tonne in 2012-13.[6] There is currently a differentiated levy amount for the Sydney metropolitan area, the extended regulated area and the regional regulated area.
- **Victoria:** The key purpose of the landfill levy in Victoria is to provide funding to support government initiatives to encourage waste generators to reduce waste.[7]
- **Western Australia**: The state government has a levy on putrescible waste of $55 and $40 for inert waste. The state government has increased the levy by almost double, effective from January 2015, and it has gazetted for a levy increase to $70 for both putrescible waste and inert waste by the financial year 2018-19. There will be an increase of $5 and $10 on putrescible and inert waste, respectively, in 2016-17 and then again in 2017-18. The purpose of the levy is to divert waste from landfill in the metropolitan area, support government initiatives to increase recycling, and encourage investment in alternative waste treatment facilities.[8]
- **Queensland:** The Queensland government introduced a waste levy on 1 December 2011. The levy applied to C&I and C&D waste sent to landfills. There was no levy on MSW sent to landfills. On 1 July 2012, the government repealed the levy,[9] therefore, a nil waste levy currently applies to all waste streams.

Landfill levies are also widely used internationally. A discussion is provided below:

- **Sweden:** A landfill levy was implemented in Sweden in 2000 and a ban on combustible waste sent to landfill was introduced in 2002.[10] Currently Sweden only disposes of 1% of all household waste to landfill with 50% of waste recycled and 49% consumed in EfW plants. In Sweden the aim is to reduce waste generation and then recycle whatever waste is generated. Sweden has become very efficient at waste management and resource recovery, resulting in a requirement to import 700,000 tonnes of waste per year from other countries as feedstock for its EfW plants.[11]
- **UK:** The UK has two landfill levy rates. The standard rate is currently set at £82.60 per tonne and the lower rate, which is charged on inactive waste, is currently set at £2.60 per tonne.[12] The levy was introduced in the UK in 1996 to internalise the externalities of landfill waste disposal. In 2002, a strategy review found that the levy did not have an

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[6] KPMG 2012, *Review of the NSW waste and environment levy – final report*, June 2012

[7] EPA VIC 2015, Landfill and prescribed waste levies, EPA Victoria, http://www.epa.vic.gov.au/your-environment/waste/landfills/landfill-and-prescribed-waste-levies

[8] DER 2015, *Landfill levy rates to rise from January 2015*, Department of Environment Regulation, Government of Western Australia, http://www.der.wa.gov.au/about-us/media-statements/112-landfill-levy-rates-to-rise-from-january-2015

[9] National Waste Reporting 2013, *Factsheet – jurisdictional waste profiles – Queensland (QLD)*

[10] ETC/ESC 2012, *Overview of the use of landfill taxes in Europe*, working paper

[11] Swedish Institute 2015, *The Swedish recycling revolution*

[12] UK Government 2015, *Environmental taxes, reliefs and schemes for business*

effect on changing behaviour away from landfill so the primary objective was shifted to changing behaviour.[13]

- **Germany:** Germany has aligned its waste management objectives with the EU objective of reducing waste generation and to reduce the attractiveness of landfills as an option for waste management. As of 2005, Germany has placed a ban on disposing of waste in landfills.
- **The Netherlands:** A landfill levy was introduced in April 2014. This levy rate was earmarked for an increase in 2015 to generate €100 million in expected revenues. Landfill and incineration are both subject to the tax.[14] There are landfill bans on recyclable waste, municipal waste and separated construction and demolition waste if it is possible to recover or incinerate.[15]
- **Italy:** Italy has legislated that landfill taxes be applied at the regional level on inert, hazardous and non-hazardous (including municipal) waste. Waste sent to landfill had decreased over the past years, however, diversion rates may not be as high as expected. This is possibly due to the levy being set too low.[16] A new waste levy was introduced in 2010 which replaced the tax on MSW for households. A landfill ban on waste above a specified calorific value has been in place since 2008.[17]

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[13] ETC/ESC 2012, *Overview of the use of landfill taxes in Europe*, working paper

[14] NVC Netherlands Packaging Centre 2015, *NL: Landfill and incineration to be taxed in 2015*

[15] ETC/ESC 2012, *Overview of the use of landfill taxes in Europe*, working paper

[16] ibid

[17] European Environment Agency 2013, *Municipal waste management in Italy*

4 Principles for efficient pricing

This chapter provides a discussion around the principles of efficient pricing for waste management, including what is considered ‘optimal’ from a social, environmental and economic perspective, for waste management in South Australia.

In short, we consider that the ‘optimal’ landfill levy is that which leads to a volume of waste going to landfill that maximises the overall economic welfare of society. This overall maximising of benefit is achieved through the following principles:

Principle 1: An ‘optimal’ landfill levy is that which ensures the gate price reflects the full private and direct external costs of landfill

The gate price ($ per tonne of waste disposed) should therefore reflect the full costs of landfill, namely:

- Landfill establishment costs such as land purchase and cell development (most likely reflected in a cost of capital)
- Annual operating costs (such as labour, energy, water, administration and depreciation of equipment and machinery)
- End of life management costs (including cost of landfill capping, ongoing monitoring and the opportunity cost of land)
- A reasonable rate of return or profit margin for those investing in the sector
- Direct externalities associated with waste disposal (environmental and social costs such as greenhouse emissions, other air emissions, pollution from leachate and disamenity such as noise and odour).

Where possible, estimates of landfill costs will be direct cost estimates for the relevant landfill sites in South Australia. However, in the absence of this information, best available studies can be used and a benefit transfer approach adopted.

Principle 2: An ‘optimal’ landfill levy needs to reflect society’s desire to reduce waste and reflect the benefits of mobilising previously wasted resources for productive use

The main alternative to sending waste to landfill is diverting it for recycling. In addition to avoiding the direct externalities of landfill, recycling has positive upstream impacts such as the reduction in demand on virgin raw materials and therefore the avoidance of the negative externalities associated with the extraction and production of raw materials. There is an argument that the landfill levy price could reflect these avoided negative externalities, if it can be established that these externalities are not being accounted for elsewhere in the economy.

The avoided upstream externalities include impacts such as mining land use impacts, greenhouse emissions, loss of native forests, erosion, salinity, water quality impacts, loss of biodiversity and lost recreational uses. In addition, the levy should also reflect the costs associated with processing those materials that would be additional to the costs of recycling equivalent materials (i.e. the net difference in resources used between processing virgin materials and recycled materials).

Principle 3: An 'optimal' landfill levy needs to balance the trade-off between targeting differential landfill operating practices and waste streams, and being simple and cheap to administer

Operating practices

The 'full costs' of landfill are likely to vary considerably across sites depending on the management and administrative practices of landfill operators. Ideally, the actual landfill levy would be applied to individual landfills depending on actual landfill costs and the proportion of costs that are being reflected in the gate price.

For example, say 'landfill x' has set its gate price to reflect best practice environmental controls for managing greenhouse emissions and leachate, the negative externalities would be lower. However, if 'landfill y' has lesser controls, there is greater pollution of the surrounding environment from inappropriate cell development or methane control. Therefore, its externalities are much more. Ideally, a landfill levy would be able to be varied depending on the level of externalities. In addition, regional landfills will have different external costs to metropolitan landfills. In regional landfills, disamenity may be reduced due to landfills being sited in less populated areas, affecting fewer residents.

Therefore, a flat landfill levy does not provide incentives for landfill operators to improve their practices as it is based on average costs. For example, there is little incentive for a landfill operator to implement methane recovery for electricity generation, and therefore lessen their greenhouse impact, if the levy is flat and does not change in response to operating practices.

Differentiated waste streams

It is also recognised that the level of external costs differ depending on the waste stream − MSW, C&I and C&D − as all have varying putrescible components. Putrescible waste (biodegradable materials) will generate GHG emissions, emit odours and present other environmental and health risks, while inert materials, such as building materials, plastics, glass etc. will contribute very little to these externalities. Therefore a levy applied uniformly across waste streams is therefore economically inefficient.[18]

Levy administration

Balancing the need for the levy to recognise the varying cost and pricing structures of landfills and various types of waste, is the need for the levy to be simple and cheap to administer. Differentiated levies can impose substantial administrative costs and create confusion and complexity for waste generators and operators alike. Variable charging can also lead to perverse incentives to waste collectors to misrepresent waste types or mix waste types to pay the lower levy rate. This is where a flat levy rate, based on the average total costs of landfill in the state, has its merits. Indeed, this has been the preferred instrument used by states that have implemented a landfill levy (except for differences between metropolitan and regional levies due to lack of alternatives to landfill in regional areas).

[18] Productivity Commission 2006, *Waste management review*

However a flat levy fee is not without its difficulties and it is recognised that it can serve to penalise best practice landfill operators who have the best management controls in place (and therefore may have limited external costs) compared to a landfill with poorer controls. These levy deficiencies are overcome through the use of other Government mechanisms such as environmental regulation and compliance.

5 Landfill levy considerations

To expand further on principles 1 and 2 in the previous chapter, this chapter provides a more detailed discussion on the three types of waste disposal costs that need to be considered in setting the landfill levy:

1. 'Private costs' for landfill site and cell establishment costs, operating costs, and post-closure cell and site management.
2. 'Direct externalities' associated with waste collection and landfill disposal, such as greenhouse gas emissions, other air emissions, leachate, disamenity, the opportunity cost of land and transport.
3. 'Avoided externalities' associated with production of virgin materials, which are avoided as a result of waste materials being diverted from landfill and mobilised into productive use.

The intent of this chapter is to understand which costs are not currently included in the gate price for landfills and are, therefore, being borne somewhere else in the economy. It is then argued that the landfill levy is a potential (but not the only) mechanism whereby these costs can be internalised.

5.1 Landfill private costs

Firstly, it is important to understand the full private costs of landfill from a full life cycle perspective, from establishment and cell development through to end of life management. These private costs need to be captured by landfill operators and therefore reflected in the landfill gate price. If these costs are not captured, the costs are borne elsewhere in the economy.

Private costs for landfill, expressed as dollars per tonne, include site and cell establishment costs, operating costs, and post-closure cell and site management. This includes:

- cost of land, equipment and other assets
- cell construction costs
- lining, leachate and gas control costs
- amenity management costs
- labour
- rent
- maintenance
- administration
- transport, plant and fuel costs
- utilities
- cell capping and remediation costs
- site remediation

- post-closure maintenance and monitoring

The BDA Group (2009)[19] estimates the breakdown of costs for a best practice landfill in Australia. These costs are presented in Table 5.1.

Table 5.1: Estimated costs for large best practice landfill in Australia in $2015

Type of cost	Cost per tonne of waste (WMAA)* $	Cost per tonne of waste (WCS)* $
Land purchase including airspace	2.30	2.30
Approvals / site development	2.30	6.91
Cell development	7.48	11.51
Operations	11.51	20.72
Capping and rehabilitation	2.88	5.75
Aftercare	2.3	9.21
Total	**28.77**	**57.54**

Source: BDA Group 2009. Notes: WMAA - Waste Management Association of Australia; Wright Corporate Strategy

In metropolitan Adelaide, it is understood that these private costs are captured by landfill operators (i.e. the $30 per tonne presented in Chart 3.1) and are therefore adequately reflected in the landfill gate price. Because of this, it is considered that there are no 'outstanding' private costs that would need to be reflected in the landfill levy.

5.2 Direct externalities

This section provides a discussion, based on the literature, on the types of direct negative externalities that can result from landfill operation and, where possible, an estimation of the costs of such externalities. Given the wealth of studies on this topic both in Australia and internationally, we have limited our discussion to the most relevant studies in Australia.

It should be noted that the extent and cost of externalities differ markedly between landfill operators, and that some landfill sites have already 'internalised' the costs of these potential externalities through management practices – i.e. use of technologies and certain regulations (e.g. landfill lining). Therefore, we have provided a cost range of externalities. Landfill externalities include:

- Greenhouse gas emissions
- Other air pollutants
- Leaching of waste leading to contamination of soils, groundwater resources and surface water
- Noise and odour impacts on local amenity (and reduction in house prices in the vicinity of landfill sites)

[19] BDA Group 2009, *The full cost of landfill disposal in Australia,* July 2009

- Opportunity cost of higher value future uses of land, after capping and rehabilitation
- There are also positive externalities of landfills in the event that renewable electricity from methane capture is generated (if used to replace energy sources with higher per unit GHG emissions).[20]

The three types of waste streams – MSW, C&I and C&D – will contribute to the external costs of landfill in different ways. Putrescible waste (biodegradable materials) will generate GHG emissions, emit odours and present other environmental and health risks, while inert materials, such as unclean concrete, will contribute very little to these biologically driven externalities.

5.2.1 Greenhouse gas (GHG) emissions

A number of papers have estimated the external costs of GHG emissions in Australian landfills (see Table 5.2). Importantly, these estimates are generally location-specific and have a number of assumptions about the controls in place at the landfill sites, such as methane gas capture, electricity generation, or no such controls.

Schollum (2010)[21] estimates the costs of GHG emissions for the Perth area and provides ranges for each waste stream. Best estimates are provided for: MSW at $33.51 per tonne ($2015), C&I at $36.86 per tonne ($2015), and C&D at $25.13 per tonne ($2015). These estimates are based on determining the methane emissions per tonne of waste, the amount of GHG that are recovered by the landfill, and the damage value (to the environment and the global economy) caused by GHG emissions.

BDA Group (2009)[22] estimates typical GHG emissions for landfills across Australia. The study derives estimates for wet temperate, dry temperate and tropical climates, and for landfills with: no gas collection, gas collection, energy recovery over its operating life, and energy recovery over its operating life and post-closure. The range has a lower bound value of -$1.15 ($2015) for landfills in dry temperate climates with energy recovery over the operating life and post-closure of the landfill and an upper bound value of $10.36 ($2015) for landfills in a dry temperate climate with no gas collection.

The Productivity Commission (2006)[23] estimates GHG emissions for two types of landfills. The base case is a landfill without any gas capture and the alternative case is a landfill with an efficient gas system (assuming 75% capture) that generates electricity and reduces its net greenhouse impact by 92%. The base case estimate ranges from $1.26 ($2015) as a low estimate for C&D waste to a high estimate for C&I waste of $26.52 ($2015). The alternative case ranges from a low of zero for all waste streams to a high of $2.53 ($2015) for C&I waste.

[20] Schollum 2010, *Evaluation of the social optimum for the landfill levy in WA*

[21] ibid

[22] BDA Group 2009, *The full cost of landfill disposal in Australia,* July 2009

[23] Productivity Commission 2006, *Waste management review*

BDA Group & Econsearch (2004)[24] use estimates from the NSW EPA in 1996 as the basis for the analysis, using an external cost of $15 per tonne of CO_2 equivalents. These estimates range from $14.69 to $18.69 per tonne ($2015) with no methane collection and $6.68-$9.35 ($2015) where 50% of landfills have gas capture. This study provides some discussion on the possibility that landfills may actually be sinks or at least emissions-neutral, though it is not considered in the estimates for NSW landfills, which indicates a range of $0-$10.28 per tonne ($2015) for metropolitan landfills and $0-$19.49 per tonne ($2015) for rural landfills.

Table 5.2: Greenhouse gas emission costs from Australian studies ($ per tonne) $2015

Study	Location	Estimate	Comments
Schollum 2010	Perth	$25.13 - $36.86	Best estimate
BDA Group 2009	Australia	-$1.15 - $10.36	Estimate for dry temperate climate based on damage cost
Productivity Commission 2006	Australia	$0 - $26.52	High value is best practice without gas capture for C&I
BDA Group & Econsearch 2006	South Australia	$7.58 - $12.63	
BDA Group & Econsearch 2004	NSW	$0 - $19.49	Based on updates made to the NSW EPA 1996 estimates.

5.2.2 Other air pollutants

Other air pollutants include pollutants that are not considered GHG such as: nitrogen dioxide, sulphur dioxide, fine particles, benzene, volatile organic compounds, hydrogen sulphide and mercury.[25]

Schollum (2010)[26] uses the benefit transfer method to estimate other air emission costs with estimates ranging from $0.76 per tonne for C&D waste and $1.10 per tonne for MSW and C&I. These estimates are for a dry temperate climate landfill with energy recovery.

BDA Group (2009)[27] estimates other air emissions external costs based on: annual average emissions over a 30-year operating life; a 50-year post closure period for landfills; and gas collection system efficiency of 60%. The study provides estimates for three gas management scenarios, being no gas collection, gas collection and flaring, and gas recovery and energy conversion. The estimates for urban landfills range from $0.62 per tonne ($2015) for a landfill with gas collection in a dry temperate climate or wet tropical climate

[24] BDA Group & Econsearch 2004, *Analysis of levies and financial instruments in relation to waste management*, October 2004

[25] BDA Group & Econsearch 2004, *Analysis of levies and financial instruments in relation to waste management*, October 2004

[26] Schollum 2010, *Evaluation of the social optimum for the landfill levy in WA*

[27] BDA Group 2009, *The full cost of landfill disposal in Australia,* July 2009

to $1.12 per tonne ($2015) for a landfill with energy recovery in a wet temperate climate. For rural landfills the range is from $0.09 to $0.28 per tonne ($2015).

The Productivity Commission (2006)[28] estimates the external costs of non-greenhouse gas pollutants to be less than $1.

BDA Group & Econsearch (2004)[29] provide a brief discussion on other air pollutants but consider the external costs associated with these pollutants to be negligible and do not include them in the analysis of landfill externalities.

Table 5.3: Other air pollution from Australian studies ($ per tonne) $2015

Study	Location	Estimates	Comments
Schollum 2010	Perth	$1.10	
BDA Group 2009	Australia	$0.09 - $0.62	
Productivity Commission 2006	Australia	<$1	
BDA Group & Econsearch 2006	South Australia	$0.38 to $0.51	
BDA Group & Econsearch 2004	NSW	N/A	Not quantified as part of landfill externalities

5.2.3 Leachate

Leachate refers to the contamination of groundwater or surface water by water leaching through permeable material, containing dissolved and suspended particles, or escaping from the top of landfills through extreme weather events. Leachate is an extremely toxic substance and can cause significant and irreparable damage to the surrounding environment if not contained. Modern landfill sites do have tight controls that prevent leachate under normal circumstances, usually through the use of clay or plastic lining. However, older landfills may not have these leachate controls in place.

The following studies have assumed quite a low cost estimate with regard to leachate assuming that, should there be best practice management controls, that leachate is well contained. However, it has also been suggested that, particularly in weather extremes such as floods, that leachate does inevitably escape and pollutes the surrounding environment. In the case that this does occur, groundwater and soils are extremely difficult and costly to remediate. Unfortunately there are no known studies on the frequency of these 'leachate spills' nor the cost of remediation. Nonetheless, we consider that the following estimates do not necessarily take this into account and therefore represent an underestimate of the externality of leachate. That said, we consider these studies still represent the best available studies on landfill externalities for Australian landfills.

Schollum (2010)[30] uses the BDA Group 2009 estimates as a basis for leachate estimates, and concludes that leachate from putrescible waste should not be included in an externality

[28] Productivity Commission 2006, *Waste management review*

[29] BDA Group & Econsearch 2004, *Analysis of levies and financial instruments in relation to waste management*, October 2004

calculation because of the tight regulations on lining requirements which eliminate any risk of leachate from landfills. Therefore the estimates for MSW and C&I waste is zero and the estimate for C&D waste is $0.01.

BDA Group (2009)[31] estimates the external cost of leachate at less than $1 for best practice landfills across all three waste streams. BDA Group uses National Pollution Inventory emission estimation techniques, accounting for different landfill classifications. This estimate assumes an annual average of water leachate over an operating life of 30 years and post-closure of 50 years for the landfills, and a leachate collection efficiency of 70% (the default value used by the National Pollution Inventory). The estimates range from $0 for a lined landfill in a dry temperate climate to $0.03 for an unlined landfill in a wet tropical climate.

The Productivity Commission (2006)[32] provides a detailed discussion on the estimates of other studies on leachate, though it does not provide any explanation on how it derived its estimate of <$1 for a best practice landfill across all waste streams.

Table 5.4: Leachate costs from Australian studies ($ per tonne) $2015

Study	Location	Estimate	Comments
Schollum 2010	Perth	$0 - $0.11	
BDA Group 2009	Australia	<$1	
Productivity Commission 2006	Australia	<$1	
BDA Group & Econsearch 2006	South Australia	$0.0004 – $0.002	High estimate for rural landfills; low estimate is for metro

5.2.4 Disamenity

Disamenity refers to impacts such as noise, pollution, litter, birds, pests and vermin, 'visual intrusion' and traffic. Previously, disamenity had a large impact on external costs, but over time, as landfill practices have improved and the industry has become more regulated, landfill operations have internalised much of the externalities.

Quantifying disamenity is a very difficult task. To arrive at an accurate estimate of the external costs of disamenity, assumptions about the size of the landfill, waste throughput and life of the landfill must be made. Many studies that quantify the disamenity external costs use the hedonic price method and derive low estimates for disamenity. However it should be noted that the hedonic price method is a proxy for disamenity, reflected in reduced property prices (either land or housing prices) around landfills, and may not account for any associated health risks associated with landfills, which are unlikely to be unknown in the property market.

[30] Schollum 2010, *Evaluation of the social optimum for the landfill levy in WA*

[31] BDA Group 2009, *The full cost of landfill disposal in Australia,* July 2009

[32] Productivity Commission 2006, *Waste management review*

Schollum (2010)[33] reviews a number of reports that quantify disamenity and uses the hedonic price method to derive estimates for Perth. Key steps in this calculation include determining the precise locations of each landfill site, housing density around these sites and median house price data. Schollum then calculates disamenity impacts by applying the study findings of Cambridge Econometrics in 2003, which estimated that property prices decreased by 7% within 0.4 km of a landfill and by 2% at a distance of 0.4 to 0.8 km. Landfill disamenity costs for Perth were then estimated to be $4.60 per tonne.

BDA Group (2009)[34] uses the Productivity Commission's (2006) estimate of $1.15 per tonne ($2015) for disamenity costs of a best practice landfill and then derives its own estimates for landfills that do not have best controls in place, differentiating between metropolitan and rural landfills. The premise for this distinction is that it is expected that rural landfills are less populated and, therefore, less people are exposed. House and land valuations are also lower in rural areas. The upper estimate for metropolitan landfills is $11.51 per tonne ($2015) from a UK study by DEFRA in 2004 and Covec's study of landfills in New Zealand in 2007. BDA Group assumes rural landfills at $5.75 per tonne ($2015) in disamenity costs, but notes that there are no studies to support this lower end assumption.

The Productivity Commission (2006)[35] cites the results of the NSW EPA 1996 report which estimates that property prices for houses located within two kilometres of a landfill are between zero and one percent lower, resulting in disamenity costs of up to $4.26 per tonne ($2015) of landfill waste. It assumed an average of 6,300 houses within a two kilometre radius of the landfill which would be affected by reduced valuations over 50 years. The Productivity Commission simply assumes an amenity cost for a properly located, best practice landfill of less than $1 per tonne.

BDA Group & Econsearch (2004)[36] estimates disamenity costs at $0-$4.94 per tonne ($2015) for metropolitan landfills and assumes costs are negligible for rural landfills. This paper also cites a study by Resources Policy and Management (2001) with estimated disamenity costs for the ACT at $5.50 per tonne ($2015). Although, in both cases, there is no further discussion on how these estimates were derived.

Table 5.5: Disamenity costs from Australian studies ($ per tonne) $2015

Study	Location	Estimate	Comments
Schollum 2010	Perth	$3.62 - $6.33	Best estimate $4.60
BDA Group 2009	Australia	$1.15 - $11.51	$1.15 for best practice
Productivity Commission 2006	Australia	<$1	
BDA Group & Econsearch 2006	South Australia	Not estimated	

[33] Schollum 2010, *Evaluation of the social optimum for the landfill levy in WA*

[34] BDA Group 2009, *The full cost of landfill disposal in Australia,* July 2009

[35] Productivity Commission 2006, *Waste management review*

[36] BDA Group & Econsearch 2004, *Analysis of levies and financial instruments in relation to waste management*, October 2004

Study	Location	Estimate	Comments
BDA Group & Econsearch 2004	NSW	$0 - $4.94	
Resources Policy and Management 2001		$5.50	Cited in BDA Group & Econsearch 2004

5.2.5 Other direct externality costs

In this section we consider other externalities that are often associated with waste disposal in landfills, though seldom quantified. These include; the externalities of transporting waste which results in additional traffic on roads increasing risk of accidents, noise and air pollution; the opportunity cost of land; and increased future costs for suitable landfill sites as sites become scarcer and more remote.

Transport

Schollum (2010)[37] provides some discussion on the external costs of transport and suggests that most Australian and international studies exclude these costs from the externality estimates because these costs have largely been internalised. Schollum cites a study by Eunomia (2009) which argues that these costs have been internalised through fuel and other transport-related taxes. Further, waste providers schedule waste collections to minimise time on the road and avoid congestion in an effort to reduce operating costs, thereby not contributing to, or having a minimal impact on, congested roads.

The Productivity Commission (2006)[38] does not provide an estimate for transport costs but suggests strict standards on vehicle emissions have increased the cost of transport which has the effect of internalising these costs.

BDA Group & Econsearch (2004)[39] estimate the transport corridor external costs for NSW to be between $3.07-$3.87 for metropolitan landfills and $1.60-$2 for rural landfills. These estimates were based on the Bureau of Transport and Communications Economics estimates of the effects of road transport per km. However, the study notes that diverting more waste away from landfill may result in negative transport impacts due to; recycling plants being at a greater distance away than landfills; greater trips required from recyclables having lower weight to volume ratios; and multiple handling of recyclable materials.[40]

In South Australia, however, there is additional handling of landfill waste compared to recycling. This is because landfill waste is firstly taken to transfer stations in metropolitan Adelaide, where it is then loaded on articulated bulk waste carrying trucks and transported to landfills outside of metropolitan Adelaide. Conversely, recycling facilities in Adelaide do not currently have this transfer aspect in the logistics chain and therefore trucks carrying

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[37] Schollum 2010, *Evaluation of the social optimum for the landfill levy in WA*

[38] Productivity Commission 2006, *Waste management review*

[39] BDA Group & Econsearch 2004, *Analysis of levies and financial instruments in relation to waste management*, October 2004

[40] Values converted to $2015

recyclable material are more direct in transporting material to recycling facilities. While we consider that the externalities associated with increased transportation (i.e. congestion, increased risk of accidents, noise pollution and air emissions) have largely been internalised through fuel excise, emissions regulations on vehicles and insurance, there is still a greenhouse emissions component associated with transportation that is not captured by these policy instruments.

Opportunity cost of land

Schollum (2010)[41] also discusses the external costs of land use. He makes the point that most studies exclude these costs in their externality estimates because this is not an externality so much as it is a cost relating to the scarcity of land, and this is already reflected in higher costs for landfill operators. That is, the costs are captured in the land acquisition costs paid by operators. The study also notes that many of the other costs associated with post-closure of landfill sites, which are related to the scarcity problem, are borne by landfill operators and not considered an externality.

5.2.6 Total direct externality costs

In summary, the key studies considered in this report provide a wide range of total direct externality costs of landfills.

At the extreme low end of the range is the Productivity Commission (2006) with estimates ranging from close to $0 per tonne (for a well-sited, best practice landfill with gas collection and energy conversion (for all waste streams) to $30.31 per tonne (for C&I waste at a best practice site without gas capture or energy conversion).

BDA Group & Econsearch (2004)[42] are around the mid-range estimates with total externalities for metropolitan landfills in NSW to be between $3.07 and $19.09 and for rural landfills between $1.60 and $21.49.

At the high end, Schollum (2010)[43] derives a best estimate for each waste stream in Perth landfills being $39.21 for MSW, $42.56 for C&I, and $30.50 for C&D. The key difference here is how GHG costs are calculated – with Schollum using a ‘damage value’ which is often a much higher estimate than a ‘market value’ for emissions trading schemes.

Table 5.6: Total external costs from Australian landfill studies ($ per tonne) $2015

Study	Location	Estimate	Comments
Schollum 2010	Perth	\$30.50 - \$42.56	Best estimates
BDA Group 2009	Australia	\$0 - \$27.62	
Productivity Commission 2006	Australia	\$0 - \$26.99	high estimate due to GHG emissions from C&I waste

[41] Schollum 2010, *Evaluation of the social optimum for the landfill levy in WA*

[42] BDA Group & Econsearch 2004, *Analysis of levies and financial instruments in relation to waste management*, October 2004

[43] Schollum 2010, *Evaluation of the social optimum for the landfill levy in WA*

Study	Location	Estimate	Comments
BDA Group & Econsearch 2006	South Australia	$6.91 - $11.51	
BDA Group & Econsearch 2004	NSW	$1.60 - $21.49	High and low estimates for metro and rural landfills

5.2.7 Direct externality estimates for Adelaide landfills

There is some difficulty in applying the estimates in these studies to Adelaide landfills as they relate to average costs. However, on balance, we consider that the cost of externalities in Adelaide landfills would range from a relatively low $ per tonne to $43 per tonne (and in some cases higher).

The uncertainty around the landfill externality estimate is due to:

- There being a wide variety of methodologies to calculate externalities.
- The many unknowns in regards to externalities particularly the effectiveness of leachate controls and other health and risk factors associated with this, which are not well quantified in the studies.
- The relatively arbitrary end of life management timeframe that is assumed for some studies (e.g. the 50 year timeframe) which affect the ongoing costs of landfill around leachate, greenhouse emissions, disamenity and the opportunity cost of land. The costs of landfill are anticipated to extend beyond this timeframe, although it is uncertain at what point in the future these landfill costs cease.
- The range of practices for Adelaide landfills from those that have best practice management controls in place such as methane capture and leachate management (i.e. these would be towards the lower bound of this range), while others have lesser controls. Therefore it is plausible that negative externality costs are in fact higher than $43 per tonne for some landfills.

Furthermore, landfill external costs also need to be balanced against any external costs of recycling, which would also have impacts like disamenity associated with recycling facilities. Recycling externalities, however, have not been quantified here.

5.3 Avoided externalities

The preceding chapter considers the direct external impact on landfill activities. This chapter considers the avoided externalities associated with diverting waste from landfill and into recycling.

These avoided externalities include:

- The avoided environmental impacts associated with extraction of virgin materials – For example, the mining of plastic and metal virgin materials have associated environmental impacts on land, water and surrounding ecosystems, while virgin paper fibres from logging can result in the loss of native forest areas and/or impacts associated with increasing plantations (biodiversity and habitat loss, erosion, weeds, and externalities associated with energy and water use etc.). If these direct impacts are not accounted for in the costs of using virgin materials, they are considered as externalities.[44] Recycling effectively substitutes the need to use these virgin materials, meaning that these negative externalities may be avoided.

- The avoided environmental impacts from the process of manufacturing virgin materials – Processing virgin materials into consumer products requires energy input and associated greenhouse gas emissions as well as other air emissions and water pollution. While recycling also has these similar impacts, for some recovered materials some processing activities are either not required or may be simplified, and so some negative environmental externalities are avoided.[45]
- The use of recovered materials instead of virgin materials also expands the production possibility frontier of society by mobilising resources that would have previously been wasted.

In this vein, the case for moving towards a more 'circular economy' as opposed to the linear model was articulated by McKinsey and Company over a series of reports between 2013 and 2014 focusing on the opportunity for the next wave productivity gains with associated benefits to employment and reduced externalities associated with resource depletion. The circular design principles are centred around the concept of resource recovery and regeneration at the end of products' service life, but also around improving end of life design at the front end to make resource recovery more cost effective.

McKinsey estimated the net material and energy savings for the European Union as being in the vicinity of $340 to $630 billion per year[46] for complex durables (such as motor vehicles, machinery and equipment, furniture, electrical appliances etc.), and in the order of $704 billion per year[47] for consumer industries (e.g. packaged and fresh food, beverages, apparel, and personal care products). Therefore, the potential economic gains from moving towards a more circular economy are significant, particularly when viewed in the light of global finite resources.

For a specific South Australian example, Zero Waste SA's recycling activity survey for 2012-13,[48] estimates that resource recovery of waste materials in 2012-13 (total of 3.45 million tonnes) resulted in the following savings from avoided resource consumption:

- Greenhouse Gas emissions of 1.23 million tonnes of CO_2-e
- Energy savings of about 15,910 Terajoules (TJ)
- Water savings of about 13,160 Megalitres (ML)

It is not clear, however, whether these are gross savings or net savings (i.e. taking into account energy and water use associated with recycling). Nevertheless, based on 2012-13

[44] Productivity Commission 2006, *Waste management review*

[45] ibid

[46] Ellen MacCarthur Foundation 2013, *Towards a Circular Economy – Economic and business rationale for an accelerated transition – Volume 1,* prepared by McKinsey & Company

[47] Ellen MacCarthur Foundation 2013, *Towards a Circular Economy – Opportunities for the consumer goods sector – Volume 2,* prepared by McKinsey & Company

[48] Zero Waste SA 2013, *South Australia's Recycling Activity Survey – 2012-13 Financial Year Report*

average AUD prices for carbon (of $12[49] per tonne CO_2-e), electricity ($59[50] per MWh), gas ($8[51] per gigajoule) and water ($50[52] per ML), these savings are quantified at around $60 for every tonne of recycled material ($62 per tonne in $2015). This calculation is stepped out further in the table below.

These dollar savings, however, do not necessarily represent avoided externalities. It is likely that some of the energy, water and greenhouse emissions costs would be reflected in the price for virgin materials and therefore already paid by society. However, it is unclear to what extent this takes place.

Table 5.7 Value of savings from avoided resource consumption ($ per tonne of material recycled) 2012-13

Saving component	Breakdown	Saving estimate	Saving per tonne recycled	Price per tonne	$ per tonne recycled
Greenhouse gas emissions		1.23 million tonnes	0.36 tonnes	$10 per tonne	$3.57
Energy	Electricity (50%)	7,955 TJ (2.2 million MwH)	0.64 MwH	$59 per MwH	$37.68
	Gas (50%)	7,955 TJ (7,955,000 GJ)	2.31 GJ	$8 per GJ	$18.45
Water		13,160 ML	0.004 ML	$45 per ML	$0.17
				Total	**$59.87**

A further, although older, study by Nolan ITU and SKM (2001)[53] assessed the overall benefits of kerbside recycling materials and, as part of this, valued the avoided impacts associated with resource extraction, refinement and manufacture for virgin materials. This particular study used a life cycle assessment (LCA) framework to calculate these impacts and valued these at a much higher level at:

- $127.46 per tonne of recycled material ($2015) for resource conservation and reduced resource extraction
- $456.24 per tonne of recycled material ($2015) for avoided air and water pollution from virgin materials processing
- $24.62 per tonne of recycled material ($2015) from reduced greenhouse gas emissions.

[49] ICE Futures Europe 2014 - based around the mid-point of prices in the European Union ETS between March 2011 and March 2014

[50] Australian Energy Market Operator (AEMO) 2015 – *Average annual prices (per financial year)* based on a simple average of NSW, Qld., Vic. Tas and SA

[51] Deloitte Access Economics 2015, unpublished best estimate of contracted gas prices

[52] National Water Commission 2014, *Australian Water Markets Report 2012-13*

[53] Nolan ITU & SKM 2001, *Independent assessment of kerbside recycling in Australia - revised final report - volume I*

While this study is now slightly dated, the estimates do provide an indication that there is potentially a high value of the upstream benefits of recycling that is not duly recognised in current prices for recycled products or landfill.

There is an argument that the landfill levy price could reflect these avoided negative externalities, if it can be established that these externalities are not being accounted for elsewhere in the economy. If these costs are reflected somehow, for example in the event there is a tax on forestry products to reflect forest rehabilitation or greenhouse emissions, then a landfill levy could not reasonably reflect these costs as it would be accounting for it twice.

In addition, it is generally considered to be more efficient for a levy (or equivalent) to be directly applied to the activity causing the externality (rather than indirectly and downstream through a landfill levy). This is because a direct levy provides incentives to change practices and manage these impacts where they occur.

Nevertheless, it would be a safe assumption to say that there would be a large proportion of externalities that would not be captured in any correction instruments like a levy. On this basis, a landfill levy to account for these can be argued for, but the level would need to be conservative to account for any associated uncertainty.

6 Levy impact on employment

Following the discussion from the previous chapter, it would appear that there is scope for an increase in the landfill levy for metropolitan Adelaide. This chapter considers what the impacts would be on employment in the waste management sector for three landfill levy price scenarios by considering the price elasticity of demand for landfill, the likely volumes of waste diverted, and the ratio of jobs gained in recycling from increased volumes compared to landfill job losses.

These scenarios are also considered in the context of the current cost structures of landfill alternatives, as these represent price thresholds where an increase in the levy makes these alternatives viable. Therefore, in reality, employment effects are likely to be much more 'lumpy' as a result of any increase in the levy than that suggested by any linear price elasticity calculation.

The three landfill levy price scenarios are:

- An increase of the levy to $62 per tonne (representing a small increase in line with approximately 3 years of CPI)
- An increase of the levy to $133 per tonne (representing a levy that resembles the largest in Australia – being NSW)
- An increase of the levy to $100 per tonne (a mid-point scenario)

6.1 Method

The following steps provide the method by which potential employment effects were calculated for the three scenarios. We have used two approaches to calculate the price elasticity of demand for landfill.

- The first is a standard price elasticity of demand calculation that is based on the change in historical observed landfill volumes versus the change in historical landfill gate prices. This is based on demand for landfill at prices lower than they are in the present.
- The second approach is a point price elasticity calculation, based on landfill prices higher than they are in the present. This is an analysis of the elasticity of demand between two points (namely the current landfill gate price of $93 and a gate price of $169 per tonne).

This reason for the second approach is that the gate price for landfill is approaching a price sensitive point on the demand curve where landfill alternatives are price competitive, especially recycling. Therefore it is likely that the price elasticity of landfill demand is much higher than that suggested by the historical price elasticity calculation.

Step 1a: Determining the price elasticity of demand for landfill

The first step for calculating a price elasticity of demand (PED) for landfill is to use the change in landfill waste volumes against the change in the landfill gate price over the period 2005 to 2013. The calculation assumes:

- Landfill volumes sourced from South Australia's recycling activity surveys from 2005 to 2013
- Landfill levy amounts were provided by ACOR from 2003 to 2015
- The 2015 landfill gate price was provided by ACOR and estimated to be around $93 per tonne for 2015-16
- The landfill gate prices from 2005 to 2013 were estimated by applying a -3% Compound Annual Growth Rate (CAGR) using the current estimated landfill price (i.e. gate price minus the levy) over the five years between 2010 to 2014 and then assumed to be constant between 2005 to 2009.
- The levy was added to the landfill price to give the gate price.

We calculated the PED using several approaches to determine a range of elasticities. One approach was to use the volume of landfill as a percentage of total waste generation. While landfill volumes appear to be relatively constant over the eight year period, the percentage of waste sent to resource recovery has increased, which could be attributed to the levy having an effect on waste diversion. However, we note that there have been some significant capital projects in the last three years, which has the effect of overstating this elasticity calculation.

A second method was to use the total volumes of waste sent to landfill, which provides the actual number of volumes being sent to landfill. However, as this a total volume, it doesn't account for changes in population and therefore volumes appear flatter than if it were measured on a per capita basis. This is therefore likely to understate elasticity. Combining these two approaches provides a reasonable range of elasticity of demand as a starting point.

For the above methods, we calculated the PED range to be between -0.31 and -0.65. That is, for every 1% increase in landfill price, landfill volumes decreased by 0.31% (lower end of the range) and 0.65% (upper end of the range) for the years 2005 to 2013.

This PED range is somewhat high compared to a study by BDA Group & Econsearch (2004)[54] which estimates the PED for disposal of waste in South Australia per waste stream. They estimate the PED of both MSW and C&I waste at -0.13 and C&D waste at -0.32. These values show that demand for landfill is relatively inelastic. The reason for this, it is argued, is that price sensitivity is lower where waste generators are not exposed to price signals (i.e. in the MSW and C&I segments). The study also cites five international studies which calculate the PED of household waste disposal and one study that calculates the PED for commercial waste disposal. All of these studies report relatively inelastic demand for waste disposal, ranging from a PED of -0.12 to -0.60 with an average of -0.27 and a midpoint of -0.36. Schollum (2010)[55] does not calculate elasticity of demand but argues that there are few substitutes for landfill and, therefore, landfill demand is relatively inelastic.

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[54] BDA Group & Econsearch 2004, *Analysis of levies and financial instruments in relation to waste management*, October 2004

[55] Schollum 2010, *Evaluation of the social optimum for the landfill levy in WA*

For the scenario analysis, we have decided to use the PED estimates of -0.13, which is the lower estimate provided by BDA Group & Econsearch (2004),[56] -0.65 which is the upper bound of our elasticity estimates, and -0.39 which is the mid-point.

Step 1b: Determining the point price elasticity of demand for landfill (between landfill gate prices of $93 and $169 per tonne)

A point price elasticity of demand (point PED) is a calculation of the elasticity of demand that occurs between two price points. The two price points are the current landfill gate fee of $93 per tonne (including the current levy of $57 per tonne) and a landfill gate fee of $169 per tonne (including the high levy scenario of $133 per tonne). These gate fees exclude any transfer station costs. At the current landfill gate fee of $93 per tonne (the low point), there is currently 1,007,000 tonnes of waste going to landfill. At a gate price of $169 per tonne (the high point), it is assumed that up to 90% of waste would be diverted from landfill (i.e. 906,300 tonnes).

The reason for this 90% waste diversion assumption is that, somewhere between the landfill transfer station price of $123 per tonne (representing the $93 landfill gate fee) and $199 per tonne (representing the $169 landfill gate fee), landfill alternatives become price competitive. This will occur at different points (see Chart 3.1), namely $133 per tonne (for new C&I and sophisticated C&D), $154 per tonne (for MBT plants) and $173 per tonne (for EfW plants). Of course these are averages across the material types. In reality, some facilities are viable at lower landfill prices than the average, others would only be viable at a higher price.

To calculate the point PED, we calculate the ratio of the percent change in gate price over the assumed percent change in volumes. The percent change in the landfill gate price is 82% (i.e. the percent change between $93 per tonne (the $57 levy) and $169 per tonne ($133 levy). Assuming that 90% of current landfill volumes are recycled, the point PED is therefore -1.1% (90% divided by 82%). This means that for every 1% increase in landfill price, landfill volumes decrease by 1.1%.

Step 2: Determining volumes diverted

Using the PED, changes in volume were measured in response to changes in price. A decrease in the landfill volumes was assumed to increase resource recovery by that amount only. That is, we did not consider that an increase in price would result in less waste being produced or waste being illegally dumped. Nor have we considered individual elasticities for various types of waste. Instead we have assumed that the full volume of waste is diverted from landfills to resource recovery in aggregate only.

Step 3: Calculating employment effects

To calculate the effects on employment in the waste management industry, we use a range of employment figures. ACOR provided landfill employment and waste volumes estimates which we used to determine the employment ratio per 10,000 tonnes of waste of 1.8 FTE

[56] BDA Group & Econsearch 2004, *Analysis of levies and financial instruments in relation to waste management*, October 2004

employees for landfill. Access Economics (2009)[57] completed qualitative and quantitative research on employment in waste minimisation, recycling and resource recovery compared to landfill. The estimated direct FTE employment per 10,000 tonnes of waste is 9.2 for recycling and 2.8 for landfill. On a national level this corresponds to an estimated direct labour force of 22,243 FTEs in recycling activities and 6,695 FTEs in landfill operations, totalling 28,938 FTEs across Australia.

The Access Economics report does not include employment related to facility construction, so any increase in the levy which encourages recycling needs to recognise this construction employment in addition to employment related to facility operation. One source estimates employment of an EfW facility to increase by 800 FTE during peak construction over a multi-year period.[58]

Although the Access Economics paper was published in 2009, it is still the most current and comprehensive report on employment in the waste management sector. Therefore, we use these employment values as the upper bound of our range, with the lower bound being 1.8.

Step 4: Sensitivity analysis

Our sensitivity analysis is based on assumptions about elasticity and employment. We use the PED that we calculated of -0.65, the PED from the BDA & Econsearch (2004)[59] study for MSW and C&I of -0.13 and a midpoint estimate of -0.39. The employment values for landfill used are 1.8 FTE and 2.8 FTE employees per 10,000 tonnes of waste.

6.2 Changes to waste sector employment

This chapter summarises the results from the scenario modelling. In this section we report the results of an increase in the waste levy under three scenarios assuming PED estimates of -0.13, -0.39, -0.65 and -1.1 and employment ratios of 2.8 FTE employees per 10,000 tonnes of landfill waste and 9.2 FTE employees per 10,000 tonnes of resource recovery, and then estimating the model again with a change in the FTE landfill employees from 2.8 to 1.8.

Scenario 1

Under this scenario, we analyse the effects of a small CPI-like increase in the levy from its current rate of $57 per tonne to $62 per tonne. Under the mid-point elasticity assumption of -0.39 and an employment ratio of 2.8 FTEs in landfill to 9.2 FTEs in recycling, there is a net increase in jobs of **14 FTEs.** Under the point PED of -1.1, there is a net increase in jobs of **38 FTE.**

In terms of key price thresholds at which landfill alternatives become viable, scenario 1 would result in a landfill transfer station price of around $128 per tonne (which is made up of $36 in private costs, $30 in transfer costs and $62 levy). This transfer station price is

[57] Access Economics 2009, *Employment in waste management and recycling*, July 2009

[58] Personal communication with Australian Council of Recyclers (ACOR), July 2015

[59] BDA Group & Econsearch 2004, *Analysis of levies and financial instruments in relation to waste management*, October 2004

almost at the point at which any new C&I facilities and more sophisticated C&D facilities become viable (with an anticipated gate price of around $130 per tonne). Scenario 1, therefore, is likely to result in a step change in volumes diverted (as new facilities are developed) rather than a linear change suggested by the elasticity calculation.

All things being equal, scenario 1 could potentially result in all C&I and C&D waste that was previously sent to landfill being diverted to new C&I and C&D recycling facilities. In reality, however, the point at which C&I recycling becomes viable is much more dynamic than simply reaching a pre-defined threshold point. There are some factors that would have a downward effect on the threshold, such as decreased volumes making landfill more expensive. This is because landfill fixed costs are spread over a reduced volume of waste such that the gate price would need to be higher. At this point, landfill sites may also consolidate to ensure volumes are sufficient to cover fixed costs and still be competitive. A factor that may have an upward effect on the threshold is that C&I recycling actually becomes slightly more expensive under an increased levy due to the unavoidable residual amount of waste (around 10%) that is sent to landfill, although this is a relatively minor effect.

The dynamics aside, assuming a landfill levy of $62 per tonne is around the point at which C&I and sophisticated C&D facilities are price competitive, it is plausible that much of the 265,000 tonnes of C&I waste and 361,000 tonnes of C&D that currently goes to landfill will be diverted. However, as this is right on the threshold, there are likely to be other factors like logistics and transport considerations that mean not all waste will be diverted. Hypothetically, if 50% of C&I and C&D waste were diverted at this point, the net gain to employment within the waste management sector would be around **200 FTE** jobs. In addition, there is likely be short term increases in employment in construction activity associated with new recycling plants.

Table 6.1: Net gains in FTE employment in the waste management sector for $62 levy

	PED of -0.13	PED of -0.39	PED of -0.65	Point price PED
1.8 FTE (landfill) & 9.2 FTE (recycling)	5	16	26	44
2.8 FTE (landfill) & 9.2 FTE (recycling)	5	14	23	38

Scenario 2

Under this scenario we analyse the effects of a medium increase in the levy from $57 per tonne to $100 per tonne. Under the mid-point elasticity assumption of -0.39 and an employment ratio of 2.8 FTEs in landfill to 9.2 FTEs in recycling, there is a net increase in jobs of **116 FTEs.** Under the point PED of -1.1, there is a net increase in jobs of **328 FTE.**

In terms of a threshold analysis the landfill transfer station price now increases to around $166 (which is made up of $36 in private costs, $30 in transfer costs and $100 levy). At this levy rate, C&I and sophisticated C&D resource recovery is very competitive with landfill and it is conceivable that much of the C&I and C&D landfill waste would be recycled.

Hypothetically, if 100% of C&I and C&D waste was recycled, it would result in an increase in employment of 401 FTE jobs.

Furthermore, the levy is also now also high enough that MBT, with an expected gate price of around $154, is competitive with landfill. This indicates that, at some point on the linear price elasticity trend between scenario 1 and 2, MBT becomes viable. It is difficult to say exactly the point at which this occurs, because of all the dynamics at play, such as increasing costs per tonne for landfill and transport and logistics considerations. However, it is likely that a step change in volumes diverted from landfill to MBT will occur. Hypothetically, if 50% of MSW total waste currently going to landfill (of 381,000 tonnes) went to MBT, there would be a net gain in employment of 122 FTE jobs.

This increased MBT recycling, combined with the 100% C&I and C&D recycling, would hypothetically see a net gain of **523 FTE** jobs under this levy scenario. In addition, there is likely be short term increases in employment in construction activity associated with new recycling plants.

Table 6.2: Net gains in employment in the waste management sector for $100 levy

	PED of -0.13	PED of -0.39	PED of -0.65	Point price PED
1.8 FTE (landfill) & 9.2 FTE (recycling)	45	134	224	379
2.8 FTE (landfill) & 9.2 FTE (recycling)	39	116	194	328

Scenario 3

Under this scenario we analyse the effects of a large increase in the levy from $57 per tonne to $133 per tonne. This higher rate reflects the current landfill levy in NSW. Under the mid-point elasticity assumption of -0.39 and an employment ratio of 2.8 FTEs in landfill to 9.2 FTEs in recycling, there is a net increase in jobs of **205 FTEs.** Under the point PED of -1.1, there is a net increase in jobs of **579 FTE.**

At this levy rate, the transfer station price for landfill rises to $199 per tonne (which is made up of $36 in private costs, $30 in transfer costs and $133 levy). The levy is also now also high enough that some EfW plants, with an expected average gate price of around $173 per tonne, are competitive with landfill. This indicates that, at some point on the linear price elasticity trend between scenario 2 and 3, EfW becomes viable. Again, a step change in volumes diverted is likely to occur at the point EfW plants come online. Hypothetically, if 100% of MSW waste is diverted to either EfW or MBT recycling there would be a net gain in employment of 244 FTE jobs.

This increase in MBT and EfW, combined with the 100% C&I and C&D recycling, would hypothetically see a net gain of **644 FTE** jobs. Again, there is also likely be short term increases in employment in construction activity associated with new recycling plants.

Table 6.3: Net gains in employment in the waste management sector for $133 levy

	PED of -0.13	PED of -0.39	PED of -0.65	Point price PED
1.8 FTE (landfill) & 9.2 FTE (recycling)	79	237	396	670
2.8 FTE (landfill) & 9.2 FTE (recycling)	68	205	342	579

6.3 Wider impacts on increasing the levy

The literature on the wider economic impacts of the landfill levy is quite thin. Reports have focussed on the direct impacts to employment in the waste management sector. A few studies that address the impacts of a waste levy on employment are described in more detail below.

The Productivity Commission (2006)[60] expressed the view that creating jobs in recycling simply means a redistribution of employment in the economy. That is, employees were simply being transferred from another sector to resource recovery rather than being created from unemployment. The Productivity Commission, however, did not in any way quantify what the wider effect would be on employment or make reference to the state of the economy, which can certainly have an impact when it comes to net gains from employment. The Productivity Commission also takes the view that claims about recycling being more labour-intensive than landfill can only infer that recycling is more expensive and not that it is necessarily a worthwhile thing to do.

BDA Group & Econsearch (2006)[61] estimate the triple bottom line (economic, social, and environmental) impacts of achieving the South Australia waste strategy goals forecast to 2030 of which the efficiency and resource allocation and future performance can be measured. This study estimates the impact that doubling the landfill levy in South Australia will have on employment and GSP. They use an input-output model of South Australia's economy to measure indirect economic effects including indirect income and employment benefits. They find that doubling the levy increases employment in South Australia by 180 FTE jobs in 2010 increasing to 262 by 2030, but GSP decreases by $1 million in 2010 and $5 million in 2030.

We consider, however, that there is some uncertainty over the wider economic impacts of increasing the landfill levy. On the one hand, increasing the landfill levy increases the cost of waste disposal to households and business of South Australia. At face value, increasing the cost of waste disposal effectively increases the cost of production, reducing production and hence jobs. At some point, the levy could be so high that this effect will begin to outweigh the in-sector employment gains.

[60] Productivity Commission 2006, *Waste management review*

[61] BDA Group & Econsearch 2006, *South Australia's waste strategy 2005-2010 ex-ante benefit cost assessment volume 2: technical report*

However, quantifying these rest-of-economy employment impacts is complex, and it is not just an issue of increasing costs to the South Australian economy. The levy also drives key behaviour changes, such as waste avoidance, switching to recycling etc. meaning that costs to society in some areas will be reduced – in ways as diverse as reduced costs of mining virgin material to reduced carbon sequestration costs. Furthermore, the revenue raised by the levy could be used in a way that generates employment. As such, employment in the rest of the economy will be a function of how the South Australian economy responds to the increased cost of waste disposal, and how the revenue raised by the levy is used.

7 Policy considerations

This chapter considers the key policy issues associated with implementing an increase in the waste levy and what options are available to the SA Government for addressing these issues. Furthermore, this chapter also includes a discussion on how the increased revenue generated from the levy could best be allocated to achieve the most optimal outcome for South Australia.

7.1 Policy implications

This section provides an analysis on any potential implications to the Government on increasing the levy.

7.1.1 Incentives for waste reduction and source separation

The success of increasing the landfill levy lies in its ability to reduce waste volumes and divert increasing volumes of waste to resource recovery facilities. In order for this to occur, waste generators (households and businesses) need to feel the effect of the levy directly and therefore receive a 'price signal' to encourage behaviour change around reducing waste (through reduction and reuse behaviours) and increased recycling through source separation of waste. The increased effectiveness of source separation of waste streams leads to higher volumes of materials sent to recyclers and less contamination. These two things ultimately increase revenues and reduce the costs of recycling and, in a competitive resource recovery sector, will lead to a reduction in recycling gate fees. This further reduces the impact of the landfill levy on households and businesses as the cost of alternatives are cheaper.

Households

Currently price signals are weak to households with a flat waste disposal fee. Because of these weak price signals, there is no financial incentive for households to separate waste materials into recycled and general waste. A recent NSW waste audit identified that 74% of the average household residual waste bin had the potential to be recycled.[62]

The landfill levy is in fact paid directly by local councils which is reflected in their waste management contracts for municipal waste collection services. Councils then pass this cost on to households (typically as a component of rates) who all receive the same service (regardless of the level or type of waste generated). Therefore there is no strong incentive for councils to reduce waste management costs (due to the pass through cost) and no incentive for households as they pay the same regardless of any behaviour modifications they may make.

[62] KPMG (2012), *Review of the NSW waste and environment levy – Final Report,* June 2012

Businesses

For the C&D sector, it is considered that many of these waste generators are adequately incentivised as they pay the levy directly at the point of waste disposal.[63]

For the C&I sector, it is considered that most medium to large businesses (those with more than 20 employees) would receive the direct price signals of differentiated waste services, and therefore are incentivised to separate their waste,[64] while others (particularly small business) would be similar to the household sector and receive one flat fee for waste management services thereby having limited incentive to source separate. Medium to large businesses account for around half the employment of the C&I sector and therefore roughly half the waste generated.

Under a higher levy, businesses that do decide to source separate (and therefore have a separated collection service) are able to save on waste management costs principally through the disposal cost. Although, the costs of doing so (staff time, training etc.) need to also be factored in, however, these costs are not well understood. For small businesses, under current regulations, even under a higher levy the financial gains would not be high enough to encourage either waste generators or collectors to source separate.[65]

For households and small businesses that receive council contracted waste services, there are certain options available to councils to improve the price signal that households receive and encourage behaviour change such as:

- Providing the option of varying bin sizes to residents. For example, opting for a smaller bin and accepting a lower fee may be a way to drive behaviour change[66]
- Varying collection frequencies

7.1.2 Illegal dumping

There is general acceptance of the principle that the higher the landfill levy is the greater the incentive is for avoiding the levy and, by extension, the greater the incentive is to dump waste illegally. In stakeholder submissions to the waste levy review in NSW, the majority felt that the increased levy led to increased illegal dumping. However, it was noted that there is a lack of available data to confirm the extent to which a marginal increase in the levy increases illegal dumping.[67]

The propensity to dump waste illegally obviously differs depending on the type of waste stream. Those that pay the gate fee directly would have the strongest incentives to dump waste. For example, there is little incentive for households to dump MSW waste as they pay the levy indirectly through a flat fee on their rates, whereas a householder would have more incentive to dump municipal ‘hard rubbish’ (that which cannot go into the bins provided) if they need to visit the landfill site and pay the gate fee directly.

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[63] Productivity Commission 2006

[64] Centre for International Economics (CIE) 2011, *Impacts of the waste levy on recyclers,* August 2011

[65] ibid

[66] KPMG 2012, *Review of the NSW waste and environment levy – Final Report,* June 2012

[67] ibid

There are many policy options for dealing with illegal dumping. These include:

- Higher penalties for illegal dumping
- Increased monitoring and surveillance – particularly targeting fringe areas and dumping 'hot spots'
- Provision of increased drop off centres for problem waste
- Increased education and awareness campaigns
- Identification of the key waste streams being dumped illegally and increase collections of these

7.1.3 Shifting waste

A differentiated levy between jurisdictions and/or between metropolitan and regional areas can create perverse incentives and lead to putrescible waste being shifted from one area to another (often long distances). This waste 'shifting' to avoid the landfill levy leads to waste traveling longer distances resulting in increased air pollution, carbon emissions and traffic congestion.[68] Furthermore, if the levy is set too high it can make it economically attractive to send waste materials offshore. The shifting of waste between states has become a particular problem around the NSW and Queensland border, where the high waste disposal costs of NSW (from the landfill levy) make shifting waste to Queensland (where no levy exists for MSW waste) highly attractive. Recent NSW Government actions however have stopped this practice.

For South Australia, the interstate transfer of waste is unlikely as the closest state border is Victoria where currently a comparable landfill levy exists (of around $60 per tonne). It is considered unlikely that, even under an increased SA landfill levy, it would be feasible for waste disposers to transport waste such a long distance.

If the levy in regional areas, however, continues to be half that of metropolitan, then it may be more cost effective (assuming the levy is high enough) to transport waste from metropolitan to regional areas. This may result in:

- Regional landfill capacity being used up, meaning that additional landfill sites would be required to be established. Additional sites would heighten landfill externalities of disamenity and opportunity cost of land
- Further greenhouse gas emissions associated with transporting longer distances[69]
- Increased externalities from generally poorer landfill controls in regional areas[70] with metropolitan landfills more likely to have better management controls than regional landfills.[71]

It is important that these perverse incentives are minimised through ensuring that waste levies between regional and metropolitan, and between states, are not different to the degree that waste ends up being transported long distances to avoid the highest levy. In

[68] KPMG (2012), *Review of the NSW waste and environment levy – Final Report,* June 2012

[69] Schollum 2010, *Evaluation of the social optimum levy in Western Australia*

[70] Schollum 2010, *Evaluation of the social optimum levy in Western Australia*

[71] KPMG (2012), *Review of the NSW waste and environment levy – Final Report,* June 2012

NSW the levy rate applied depends on the source of the waste, not where landfill is sited, however this can be difficult to enforce as it can be difficult to determine the source of waste. The NSW Government is currently addressing this issue through more accurate waste tracking mechanisms.

7.1.4 Residual waste from recycling operations

Resource recovery facilities cannot recycle 100% of the waste throughput at their sites – there is always a residual component of waste that cannot be recycled and therefore needs to be sent to landfill. For example, a typical C&I plant recycles a certain proportion of its dry waste stream, another proportion is sent on for further processing at a C&D resource recovery plant, and a further proportion is sent to landfill (the 'landfill residual'). Part of a C&I recycling facility's cost structure, therefore, is the gate fee for both the C&D waste sent for further processing and landfill (which includes the levy).

The increased cost to recyclers from a levy increase is the net effect of:

- The additional cost of disposing of landfill residual
- The increased net revenue from processing more waste (as the levy increases waste diversion from landfills)
- The ability to pass costs on to the suppliers of waste materials (either through an increased gate fee for C&I and C&D recyclers or through decreased input prices for scrap for MRF, metal or paper recyclers).

A 2011 CIE report[72] looked into the impacts of an increased levy cost to metal recyclers, paper recyclers and Advanced Waste Treatment (AWT) facilities in NSW. The study concluded that an increased waste levy to $120 per tonne would have a negative impact on metal recyclers (to around -3% of profit margin), an overall small positive impact on paper recyclers (around 0.1%) and a very positive impact on AWT facilities (around 30%). The key market dynamics affecting these impacts included whether landfill was an alternative to the waste stream and whether there were alternative options available to waste material suppliers (i.e. whether storage, interstate or export options were available).

The key reason for metal recyclers being impacted more than other recycling operations is that there are no established alternatives for the by-product of metal recycling namely shredder floc, which is the non-metal residual from recycling vehicles and white goods. Since the metal recovery industry generates a large amount of shredder floc and can only send it to landfill, an increase in the landfill levy will invariably lead to an increase in operating costs for metal recyclers.

There is a view that residual waste from recycling operations should be exempt or rebated from the levy. However, others believe that this residual should attract the full levy as otherwise recyclers will not be receiving the right price signals regarding this waste and will not be incentivised to innovate for solutions to this residual problem. This is particularly the case as more sophisticated technologies come online (because they become price competitive under the increased levy) such as MSW recycling and EfW plants. For example, shredder floc can be used as feedstock in EfW plants. A high enough levy will make it viable for the development of EfW plants.

[72] Centre for International Economics (CIE) 2011, *Impacts of the waste levy on recyclers,* August 2011

7.1.5 Asbestos

In a similar vein, there are currently no viable alternatives to landfill disposal for asbestos waste. Therefore asbestos will always attract a landfill levy and is unable to respond to price signals (i.e. it is perfectly inelastic) due to regulation prohibiting the reuse of asbestos fibres. As per other waste, some have suggested that a high landfill levy may further encourage illegal dumping and that, in the case of asbestos, this problem is particularly pronounced due to the health risks associated with asbestos.

For this reason, there is an argument that asbestos could be exempt or fall under a differentiated levy. However, this may also create perverse incentives and create a further opportunity for those seeking to avoid the landfill levy by claiming to have asbestos contaminated materials when, ordinarily, they would not be classified as asbestos contaminated.

7.1.6 Timing and phasing of increased levy

The timing and phasing of any increase in the landfill levy is important for two reasons – it allows waste generators of households and businesses (assuming they receive adequate price signals) time to adjust to the increase in waste management costs, and enables sufficient time for landfill alternatives to be developed.

Waste generators need time to develop strategies for dealing with any increase in management costs, e.g. such as changing their procurement sourcing arrangements to reduce packaging, waste minimisation strategies, introducing waste source separation activities, or time to enable the lapsing of existing waste contracts and for new waste contracts to be entered into. Also, should any increase in the landfill levy be introduced too quickly, leading to viable alternatives not being ready, it increases the costs on the waste generators due to limited alternatives to landfill.[73]

While alternatives may not be immediately viable under the early stages of phase in, there will be a point when the price threshold is reached. If resource recovery businesses have some assurance of the landfill levy increase into the future, then they can begin to plan and construct new facilities in anticipation of the waste levy making their businesses viable at some point into the future.[74]

In considering the optimal phasing in of an increased levy, consideration should be given to both the lead times to develop recycling facilities and the price thresholds at which these facilities become viable. A landfill levy trajectory could then be set which provides assurance to both waste generators and landfill alternatives to be developed.

7.1.7 Risk of stockpiling

An increase in the levy may also result in the stockpiling of waste. Stockpiling refers to the collection of recyclable materials by resource recovery facilities under the guise of recycling

[73] Schollum 2010, *Evaluation of the social optimum levy in Western Australia*

[74] Centre for International Economics (CIE) 2011, *Impacts of the waste levy on recyclers,* August 2011

it, thereby receiving the gate price, and then stockpiling the waste or even illegal disposing of it, to avoid paying the waste levy.[75]

Stockpiling of waste distorts the waste market, has a negative financial impact on legitimate operators and undermines the intent of the waste levy – to divert waste from landfill and increase recycling and resource recovery. It also presents health and environmental risks if stockpiled long-term as well as the risk of abandonment, imposing a cost on local communities to deal with it.[76]

A solution to this problem is through regulation of resource recovery sites requiring facilities to report on the waste received by their facilities. This system is used in NSW, and is understood to be under consideration for SA. Waste received by the sites incurs a liability which is then extinguished once the waste is lawfully removed from the site for recycling, reuse or disposal. Certain events then trigger when the liability is payable. These are: stockpiling of waste longer than the prescribed period of time, stockpiling of waste above the authorised limits, and unlawful disposal of waste.

7.2 Allocation of funds raised from levy increase

This section provides a discussion on how the funds raised from the levy increase could be spent to optimise waste management outcomes. There is some debate around whether the levy should or could be hypothecated for waste management initiatives.

The current situation in South Australia is that 50% of waste levy revenue is allocated to the 'Waste to Resources Fund' which is administered by Zero Waste SA. Zero Waste SA uses a proportion of that fund as provided for in the Zero Waste SA Act 2004. Additional funds are allocated through the Government's budget process.[77]

As a point of comparison, in NSW, 33% of levy funds is dedicated to establish a five-year infrastructure and recycling grants program 'Waste Less, Recycle More' worth $465.7 million,[78] while the remaining 67% is used by the NSW Government for general service delivery. The grants program has established priorities to invest in infrastructure ($250m), local government programs ($138m), and illegal dumping and littering ($78m). This program has been awarding grants since 2013 and, therefore, the fund is half way through its five year program. According to MRA Consulting Group[79] the NSW levy combined with the grant program is encouraging new recycling facilities and resulting in pockets of growth in the manufacturing sector that is otherwise not growing.

Principles of allocation

As a general principle, the first priority for any additional levy revenues should be that they be directed to programs that will address any unintended consequences of increasing the

[75] NSW EPA 2015, *Changes to the NSW waste levy for resource recovery facilities*, March 2015

[76] ibid

[77] Zero Waste SA 2015, *Waste Strategy 2015-2020 Consultation Draft*

[78] NSW EPA, *NSW Waste Avoidance and Resource Recovery Strategy 2014–21*

[79] MRA Consulting Group 2015, *The State of Waste 2015,* March 2015

levy such as those mentioned in the previous section like any increased prevalence of illegal dumping.

As a second priority, there is a case that the additional landfill levy revenue could be directed towards efforts that maximise the effectiveness of the levy in resource recovery and other waste management initiatives to further divert waste from landfill and develop the resource recovery sector. There are, however, diverging opinions on this. Some have argued that providing revenue back to promote and develop recycling activities actually serves to mitigate the cost of the levy as it lowers the cost of recycling. Indeed some have suggested that levy funds should be 100% hypothecated to environmental/waste programs as this is the source of where it is collected. The other extreme of the argument is that none of the revenue should be hypothecated, per se, but kept in consolidated revenue and allocated according to the Government's overall spending priorities and highest return on investment (which may include waste management programs).

The optimal outcome, however, is likely to be somewhere in the middle. It is considered that funding being directed to enhance the original intent of the levy which is to reduce downstream and upstream externalities is an important first consideration. This would include investment in resource recovery infrastructure to ensure price competitiveness with landfill (particularly if landfill and resource recovery prices are at the threshold). The key second consideration is ensuring the highest return on investment from the funding. The exact level of hypothecation should be dictated by these two considerations. It is estimated that around 40% is the average hypothecation of the levy across all states that have a levy.

7.2.1 Addressing possible consequences

Following on from the discussion on the policy implications of increasing the levy above, some of these perverse outcomes that the levy should seek to address include:

- Increasing resources for regulation, monitoring and enforcement to reduce illegal dumping and other non-compliance issues around getting 'past' the levy. Increased compliance reduces the incentive to dump waste and ensures waste is disposed of through appropriate channels. While there doesn't appear to be any consolidated evidence on the relationship between an increase in the landfill levy and illegal dumping, it makes intuitive sense that there will be some effect. Therefore, some amount of funding should indeed be directed to monitoring this and increasing compliance and enforcement efforts.

7.2.2 Development of the waste management sector

While this study has not looked at the relative return on investments of different funding possibilities, it would appear that the following initiatives should be considered further from a cost benefit perspective as we consider them to be the programs that best maximise the intent of the levy:

- Increasing resources available to local government to generate ways to create the right price signals to households and small businesses to encourage behaviour change and divert more waste from landfill.
- Establishing an infrastructure fund (through competitive grants process) which would be dedicated to encouraging large scale investment in new technology that would not

otherwise occur. In the case of South Australia, and depending on the levy price, this may involve encouraging more sophisticated C&D, new C&I MSW recycling and potentially even EfW plants. A small subsidy could therefore have a big impact in tipping them over the threshold. Furthermore, if there are limited recycling facilities (for example there is only one C&I facility in Adelaide) it is likely that distance to transport will be a key cost consideration.[80] Subsidies to encourage greater critical mass for C&I may, therefore, have the same effect of tipping this threshold.

[80] Centre for International Economics (CIE) 2011, *Impacts of the waste levy on recyclers,* August 2011

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