Cost Benefit Analysis of an Waste Disposal Levy in Queensland

Final Report

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VERSION 2

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Figures and Tables

1 Introduction

The Queensland Government has developed a new waste strategy - *Queensland's Waste Strategy 2010 – 2020: Waste Avoidance and Recycling* - in response to recent policy developments and challenges, including:

- *Toward Q2: Tomorrow's Queensland*[1] sets five ambitions to address current and future challenges for Queensland one of which is Green Queensland. This ambition focuses on cutting Queensland's carbon footprint by a third and protecting 50 per cent more land for nature conservation and public recreation;
  - one of the indicators to measure the reduction in Queensland's carbon footprint is emissions waste to landfill per household in Queensland;
- Queensland households and businesses generate more waste and send increasing amounts to landfill for disposal every year.
  - between 2003-04 and 2007-08 waste generated grew by 40 per cent, while population grew by 10 per cent over the same period.[2] This trend is predicted to continue;
- the possible introduction of a carbon pollution reduction scheme or similar means to reduce greenhouse gas emissions; and
- increasing community interest in stronger government intervention and leadership to encourage business and industry to take action to reduce unnecessary packaging, increase recyclability of products and provide opportunities for consumer's to recycle.[3]

To make the significant improvements necessary to address the above developments/challenges, a shift in thinking away from the present linear system of *take-make-waste* is needed. Ideally, thinking should move toward natural processes, avoiding waste generation and where waste cannot be avoided, beneficial use and resource recovery. One way to facilitate this change is to strengthen Queensland's waste and resource management legislation.

In addition to amending the *Environmental Protection Act 1994*, the waste strategy recommends the preparation of a new Act (and regulations). One of the key provisions

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1 Queensland Government. 2008. *Toward Q2: Tomorrow's Queensland*. September.

2 Queensland Department of Environment and Resource Management. 2010. *Queensland's Waste Strategy 2010-20: Waste Avoidance and Recycling Consultation* Draft. June. p 4.

3 Queensland Department of Environment and Resource Management. 2010. *Queensland's Waste Strategy 2010-20: Waste Avoidance and Recycling Consultation* Draft. June. p 3.

of the new Act will be the introduction of a Waste Disposal Levy to change the behaviour of waste generators from choosing disposal to landfill as the first option, to choosing alternatives that enable them to avoid or recycle waste.

Synergies Economic Consulting (Synergies) has been engaged by the Department of Environment and Resource Management (DERM) to undertake a cost benefit analysis to inform key stakeholders and the community of the costs and benefits associated with the proposed introduction of the Waste Disposal Levy. The Terms of Reference for the study were to investigate the detailed costs and benefits to industry, government and the community under three scenarios:

- the first scenario (the base scenario) is a business as usual approach where a Waste Disposal Levy is not introduced on 1 July 2011;
- the second scenario (the option currently under consultation) is the introduction of a Waste Disposal Levy on commercial and industrial (C&I), construction and demolition (C&D) (including Acid Sulphate Soils and Contaminated Soils) and regulated wastes (but excludes Municipal Solid Waste (MSW)); and
- the third scenario is the introduction of a Waste Disposal Levy on all waste streams.

The findings of this cost benefit analysis will support the Regulatory Assessment Statement (RAS) on the proposed levy.

The structure of this report is as follows:

- section 2 outlines the policy objectives for government intervention and options to be evaluated by the cost benefit analysis;
- section 3 provides details of the cost benefit analysis and modelling approach;
- section 4 identifies the sectoral impacts of imposing Waste Disposal Levy;
- section 5 summarises the cost and benefits of the proposed options; and
- section 6 provides a summary of the report.

2 Background

2.1 Policy objectives

The primary objective of Government intervention into the disposal of waste at landfill is to ensure a strong policy/price signal is provided to consumers and industry which reflects all costs to society of waste disposal. The outcomes sought from the introduction of the levy include encouraging behavioural change, bringing about waste avoidance, greater recycling of resources and disposal of the residual that is not economic or feasible to effectively avoid or recover. Achieving these objectives will facilitate a reduction in Queensland's carbon footprint from waste to landfill. Change to the existing policy arrangements surrounding the disposal of waste at landfill is considered necessary to ensure these policy objectives are achieved.

The Waste Disposal Levy will address a market failure[4] which arises because businesses and consumers do not face the social cost of the disposal of waste (i.e. negative externalities associated with the disposal of waste to landfill, such as environmental and amenity impacts). Government intervention is required as there is no available market solution.

The imposition of a general tax by a government will usually result in a less efficient use of resources because it changes production and consumption decisions that would have otherwise resulted in businesses and consumers making the best possible use of resources from their – and society's – perspective. These efficiency impacts of a tax are normally included as a cost in a cost benefit analysis. The Waste Disposal Levy is an exception to this rule because it is intended to adjust production and consumption decisions to align to the best possible use of resources. The adjustment to business and consumer resource use is a benefit to society and has been estimated as such in this Report.

[4] Markets 'fail' when the market outcome is inefficient. As a result market intervention, such as regulation, can lead to improved efficiency outcomes.

2.2 Options for achieving policy objectives

This section describes each of the options including the do-nothing case, which forms the baseline for the analysis.

2.2.1 Do-nothing

The current legislative framework for waste management in Queensland consists of primary legislation in the form of the *Environmental Protection Act 1994* and subordinate legislation:

- Environmental Protection Regulation 2009
- Environmental Protection (Waste Management) Policy 2000
- Environmental Protection (Waste Management) Regulation 2000.

The *Environmental Protection Act 1994* provides DERM with the statutory authority to manage the environmental impacts of waste in Queensland and to minimise adverse effects on human health and the environment. Various aspects of waste management, such as licensing of specified waste management activities, tracking of regulated wastes and design rules for waste equipment are subject to regulations made under the *Environmental Protection Act 1994*.

Waste disposal services are provided by local governments and private waste management operators who are largely reliant on landfill as the primary technology.

Household waste and recycling collection is one of the key services provided by local government authorities and in many cases represents the only involvement households have with waste management. Local councils either directly or through the engagement of contractors provide for the collection, transport and disposal of municipal solid waste (MSW). MSW includes household kerbside-collected and self-haul waste, as well as local government wastes from street sweeping, maintenance of litter bins and public parks and gardens, and water and sewerage treatment plants.[5] Some local governments also own and operate facilities such as transfer stations and landfills which accept in addition to MSW, waste from the commercial and industrial (C&I) [6] and construction and demolition (C&D) sectors.[7]

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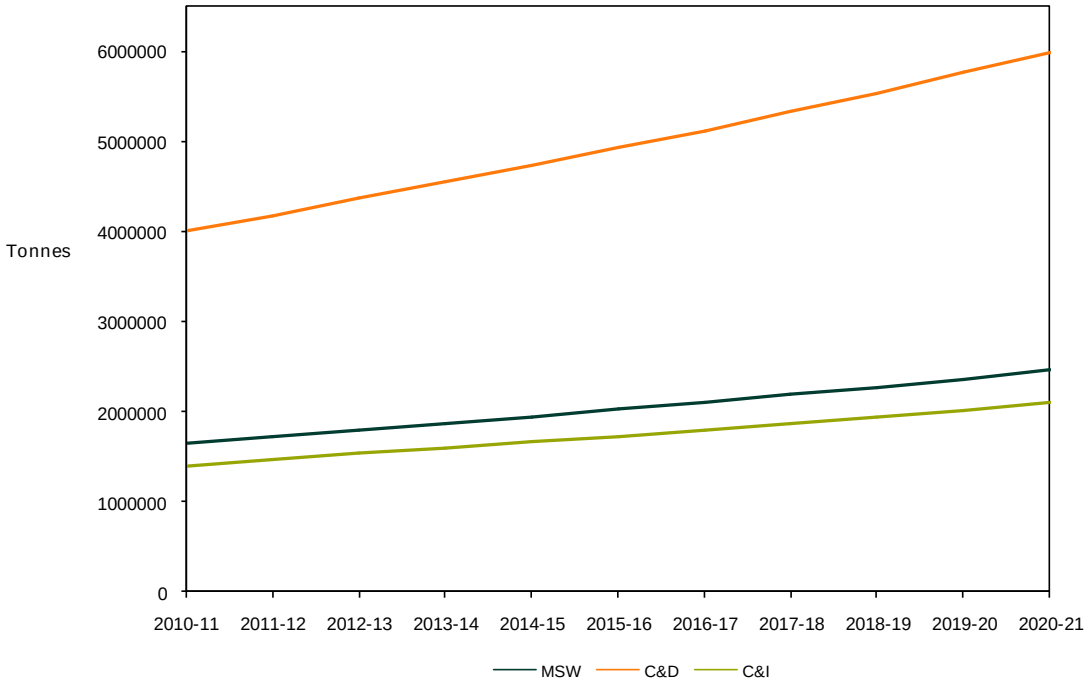
[5] Department of Environment and Resource Management (2010). Queensland's Waste Strategy 2010 – 2020: Waste Avoidance and Recycling Consultation Draft, p 26.

[6] Waste that is produced by business and commerce, it includes waste from schools, restaurants, offices, retail and wholesale businesses, hospitals, primary production and manufacturing industries.

The private waste management sector provides waste collection, transport, processing, and treatment and disposal services to the commercial sector and contracts to local government for the collection of MSW. Most waste management companies provide an integrated service for their customers, i.e. collection, transportation and disposal.

The current and forecast levels of waste disposed at landfill for the whole of Queensland for the MSW, C&D and C&I waste streams are shown in Figure 1.

Figure 1 Current and forecast levels of waste disposed at landfill (MSW, C&D and C&I) – whole of Queensland

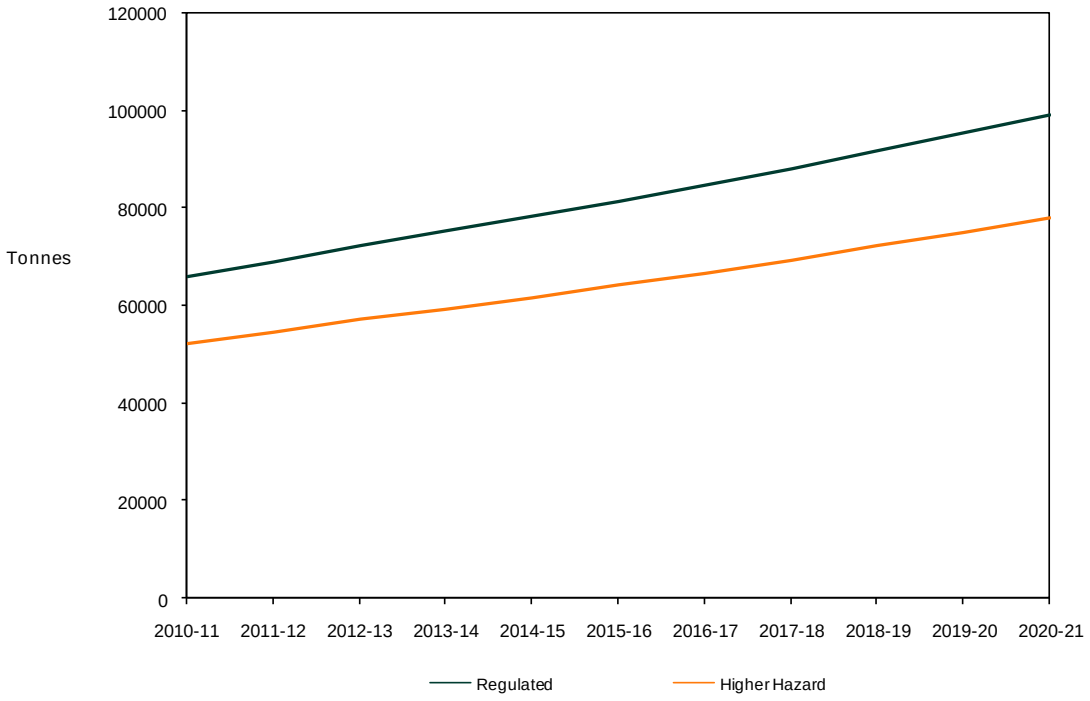


Data source: DERM

Figure 2 shows the current and forecast levels of waste disposed at landfill for the whole of Queensland for the Regulated and Higher Hazard waste streams.

[7] Inert waste that is produced by construction, renovation or remodelling or demolition activities and has the potential for resource recovery, C&D material may include plastic and cardboard packaging, material off-cuts, timber, steel, concrete and recovered appliances, doors and windows, taps, roofing iron and tiles and pipe work.

Figure 2 Current and forecast levels of waste disposed at landfill (Regulated and Higher Hazard) – whole of Queensland



Data source: DERM

Currently the disposal prices quoted by local councils and private operators typically take account of the running costs of the landfill but do not include the full environmental costs of disposal. Furthermore, disposal prices are not based on the long term costs of disposal, that is the cost of the next landfill that is required or the post-closure care and maintenance requirements of old landfills.[8]

Landfill disposal prices vary significantly across local governments in Queensland due to the following factors:

- differences in landfill fees and charges policy across local government;
- operational costs of its waste collection facilities (e.g. the types of technology utilised at each facility, benchmarks/standards applied to operational processes);
- differences in waste policy objectives of local government, for example increasing the level of waste materials recycled;

[8] Environmental Protection Agency. 2008. Let's Not Waste our Future: *Queensland's Waste Strategy Discussion Paper for Comment*. October p 16.

- existing capacity of landfill facilities and the availability of new landfill sites; and
- proximity of landfill facilities (and alternative sites) to dwellings and associated transportation corridors.

Examples of current local government waste fees and charges are provided in Attachment A.

Unlike the other mainland Australia states, waste disposed of at landfills located in Queensland are not subject to a State levy. Therefore the cost of disposal is the normal waste disposal gate fee applicable to the facility according to waste type.

2.2.2 Waste Disposal Levy on C&I, C&D and regulated wastes (option 1)

Under this option the Queensland Government would introduce on 1 July 2011 a differential Waste Disposal Levy (the levy) on C&I, C&D and regulated wastes (lower and higher hazard).[9] The levy will not apply to MSW. The differential levy amount for lower and higher hazard regulated waste reflects the requirements for additional controls around this type of waste and the increased risk associated with appropriate management.

The proposed disposal levy for each waste stream is shown in the table below.

Table 1 Proposed levy amounts (option 1)

Waste stream	Disposal levy amount
Commercial and industrial waste	$35 per tonne
Construction and demolition waste	$35 per tonne
Contaminated and acid sulphate soils	$35 per tonne
Lower hazard regulated waste	$50 per tonne
Higher hazard regulated waste	$150 per tonne
Municipal solid waste	$0

Source: Queensland Department of Environment and Resource Management. 2010. *Queensland's Waste Strategy 2010-2020: Proposed Waste Disposal Levy Consultation Draft*. June. p 2.

The levy amounts will be indexed annually by the consumer price index (CPI). The goods and services tax (GST) will not apply to the levy.

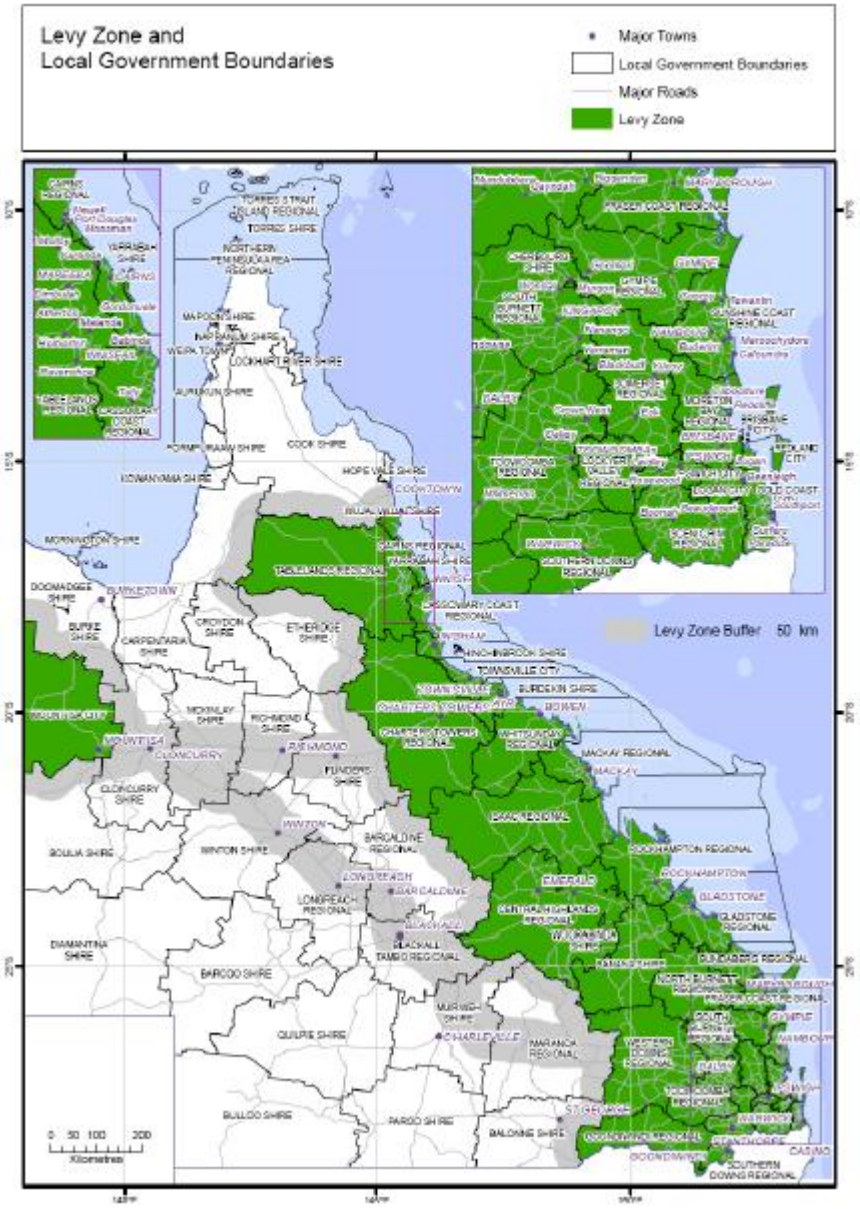
Private and public sector waste disposal facilities, located in the levy collection zones[10] and disposing of waste to which the levy applies (refer to Figure 3) will be required to

[9] The lower and higher hazard regulated waste classifications are based on Queensland's landfill waste acceptance guidelines.

[10] The levy collection zone covers disposal facilities located in 34 local government areas.

collect the levy and remit the levy collected to the Queensland Government. Waste that is generated in a levy collection zone and disposed of in a non-levy collection zone will also attract the levy. This is to avoid the transfer of waste out of a levy collection zone in order to avoid paying the levy. The levy will also apply to those waste streams that attract the levy and have been generated outside the levy zone if they are disposed of at a waste disposal site within the levy zone.

Figure 3 Proposed levy zone map



Source: Queensland Department of Environment and Resource Management. 2010. *Queensland's Waste Strategy 2010-2020: Proposed Waste Disposal Levy Consultation Draft*. June. p 8.

The levy is a price charged in addition to the normal waste disposal gate fee (even if no existing gate fee applies) at a waste disposal facility on each tonne of waste disposed. If the disposal facility does not have a weighbridge (typically facilities located outside the designated levy zone), volume to weight conversions will be deemed in regulation. The levy will only apply at the point of disposal.

Exemptions to application of the levy are proposed. The forms of waste, other than MSW, that will be exempt from the levy, include:

- waste resulting from a declared natural disaster, such as cyclone, bushfire or flood;
- waste generated as a result of a biosecurity outbreak;
- waste where disposal is required by regulation, such as appropriately managed asbestos and fire-ant waste;
- Community Service waste such as litter or illegally dumped waste collected by a local government, community group or other organised event, such as Clean Up Australia Day and waste that has been received by charities as part of donations; and
- materials that are segregated for recovery (not disposal) at the waste disposal facility.

Some of the above exemptions will be conditional. For example charities may be required to apply for a levy exemption certificate, with a limit set on the number of exemption certificates that may be issued to any particular organisation. The same may apply to community groups organising clean-up events.

Penalties will apply to operators (public and private) of waste disposal facilities, to ensure the levy is paid at the waste disposal facility at the point of disposal and to ensure the facility operator pays the appropriate amount of levy within the specified time.

2.2.3 Waste Disposal Levy on all waste streams (option 2)

This option is similar to option 1 however the levy will also apply to the MSW waste stream. The levy amount for MSW will be $35 per tonne (see Table 2) and a differential levy amount will apply to lower and higher hazard regulated waste. Reflecting the requirements for additional controls around this type of waste and the increased risk associated with appropriate management.

The levy amounts will be indexed annually by CPI. The GST will not apply to the levy.

Similar to option 1 the levy will apply to waste generated in the levy collection zone and disposed of to a waste disposal facility located either within or outside the levy zone. Levy will not apply to waste generated outside the levy collection zone and disposed of to a facility outside the levy zone.

Table 2 Proposed levy amounts (option 2)

Waste stream	Disposal levy amount
Commercial and industrial waste	$35 per tonne
Construction and demolition waste	$35 per tonne
Contaminated and acid sulphate soils	$35 per tonne
Lower hazard regulated waste	$50 per tonne
Higher hazard regulated waste	$150 per tonne
Municipal solid waste	$35 per tonne

3 Description of Benefits and costs

Cost-benefit analysis (CBA) involves first identifying and evaluating both the costs and benefits of a proposed option and alternatives to the proposed option, and then deciding whether the option should be implemented according to a particular decision rule. CBA supports selecting an option when the gains (benefits) resulting from the change exceed the losses (costs); that is, when there is a 'positive net benefit'. In this case, the option is said to improve the overall level of economic welfare of the affected population.

3.1 Benefits

The following sections assess the quantitative and qualitative benefits assessed in this analysis, including a description of the parameters and assumptions used in estimating the benefits and how the benefits were quantified.

3.1.1 Quantitative

Resource savings

Box 1 Summary of quantification of resource savings benefits

- Value of diverted waste
  - Estimate of $70/tonne for lost commodity value from landfill waste
- Volume of diverted waste
  - Increased diversion rates assumed for each waste stream under Waste Disposal Levy (see Table 3)
  - Applied to base tonnage projections to calculate additional diverted volumes of landfill waste
- Value estimate applied to diverted tonnages to estimate resource savings benefits

The resource savings resulting from the diversion of landfill waste is an important benefit of the Waste Disposal Levy. Two variables are required to quantify this benefit:

- the additional volume of waste to be diverted to recycling
- an estimate for the value of the diverted waste.

Volumes of diverted waste

DERM's baseline modelling has been used to form the business as usual scenario (base case, i.e. no waste levy) in terms of the tonnages of waste to be landfilled and recovered.[11] These estimates related to all waste streams generated throughout

[11] 10% of the base tonnage estimate for clean fill C&D waste was excluded from the base case scenario based on advice provided by DERM that this waste would be exempt from the levy. This is consistent with the approach adopted by

Queensland. As the waste levy is only to be applied to 95 per cent of the Queensland population, the tonnage estimates have been adjusted accordingly.[12] The estimates were then escalated using projected annual growth rates for the Queensland Gross State Product, as provided by DERM.[13]

Waste recovery rates were assumed for the different waste streams to account for the additional waste to be diverted from landfill to recycling under the levy. The table below presents the assumed proportions for the additional diversion of landfill waste to recycling with the levy.[14] It should be noted that while the Waste Strategy aims for diversion of 50% of the waste stream, this includes the effect of an integrated approach which includes legislation, programs and the levy price signal. The diversion rates presented in Table 3 are those attributable to the the levy.

Table 3 Assumed landfill to recycling diversion rates under levy

Waste stream	2011/12 & 2012/13	2013/14 to 2015/16	2016/17 to 2020/21
MSW (levy option 2 only)	2%	3%	4%
C&D	2%	3%	4%
C&I	3%	4%	5%
Regulated	1%	1%	1%
Higher Hazard	0%	0%	0%

Note: The diversion rates included in this table relate only to the expected impact of the Waste Disposal Levy, not the entire Waste Strategy (i.e. the components of the strategy other than the Waste Disposal Levy have not been taken into consideration in the selection of these diversion rates).

The recovery rates for the MSW, C&D and C&I waste streams are based on the increases in recycling rates achieved in New South Wales under its Waste and Environment Levy. Estimates for the current annual growth rates of recycling in New South Wales are as follows:

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the NSW Government in the implementation of its Waste and Environment Levy, with certain types of waste being made exempt from paying the levy.

[12] While the waste levy is to apply to 95% of the Queensland population, a percentage of 94% has been applied to Queensland's base waste and recovery tonnages to estimate the tonnages of waste and recovered material generated within the levy area. 1% of the population was excluded on the basis of advice provided by DERM, that 1% of the waste generated within the levy area would also be exempt from paying the levy.

[13] Forecast annual growth rates for GSP were 4.5% for 2011/12, 4.75% in 2012/13 and 4% for the remainder of the study period.

[14] Option 2 involves the implementation of the Waste Disposal Levy on MSW. Under the current arrangements, householders are charged by local government for waste removal services. These charges are typically collected on rates notices. This method of charging does not provide a direct price signal to households on the cost of disposing of MSW because the charge is fixed and not related to volume. Households also have access to kerbside pick-up programs or through the use of landfill vouchers provided by local councils. The implementation of a levy on MSW will add to the costs of local government services, which will presumably be passed onto households. However, the levy may not result in a direct price signal related to the volume of waste. Despite the price signal being indirect, experience in other jurisdictions has shown an increase in recycling after the introduction of waste levies. The major benefit of imposing the waste levy is the benefits from reducing waste to landfill.

- 2% for MSW
- 2.25% for C&I
- 0.75% for C&D.[15]

In applying these recovery growth rates to the CBA it is important to recognise the following with regard to the proposed waste levy:

- the recycling rates currently being achieved in New South Wales, in relation to C&I and C&D, are significantly higher than those achieved in Queensland (44% and 67% compared to 17% and 22%), indicating the potential for growth in recycling rates for these waste streams; and
- the waste levy was first implemented in New South Wales in 1993, meaning that waste and recycling practices have had a long period of time to adjust to the provision of a waste pricing signal, while Queensland is yet to have a waste levy.

It is considered that using the current New South Wales recycling growth rates would underestimate the likely growth in recycling in Queensland after the introduction of the waste levy, particularly in relation to the C&D and C&I waste streams. Consequently higher landfill to recycling diversion rates have been assumed in this study. The rates assumed under each levy option are broadly consistent with the recovery growth rates observed in Victoria and the Australian Capital Territory, which both operate waste levy schemes.[16]

Progressive increases have been applied to the recovery rates, after two years and five years to account for increases in recycling rates as a result of changing behaviour from a higher price for disposing of waste (i.e. businesses and households will adjust their behaviours over time to increase the scope for recycling waste in order to avoid the levy).

Data collected by or reported to DERM on regulated waste stream (either lower or higher hazard) is limited. Accordingly, conservative recovery rates have been assumed for regulated (lower hazard) and higher hazard streams.

A constant recovery rate of 1% has been applied to the regulated waste stream (lower hazard). The rationale for applying such a low recovery rate, with no growth over the study period, is based on limited data which indicates that over 90% of the regulated

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[15] *Recycling: The Shameful Facts - NSW Is behind on 8 out of 9 Targeted*. Catherine Cusak, 25 Mar. 2009. Web. 28 Sept. 2010. <http://www.catherinecusack.com.au/index.php?option=com_content&view=article&id=428:recycling-the-shameful-facts--nsw-is-behind-on-8-out-of-9-targets&catid=1&Itemid=100079>.

[16] Productivity Commission (2006). Waste Management in Australia. Inquiry Report, p 23.

waste reported in Queensland is already recovered. This suggests that there is relatively minimal scope for increasing the recovery rate. However, DERM expects that future data collection and reporting will reveal more scope for recovery in the regulated waste sector.

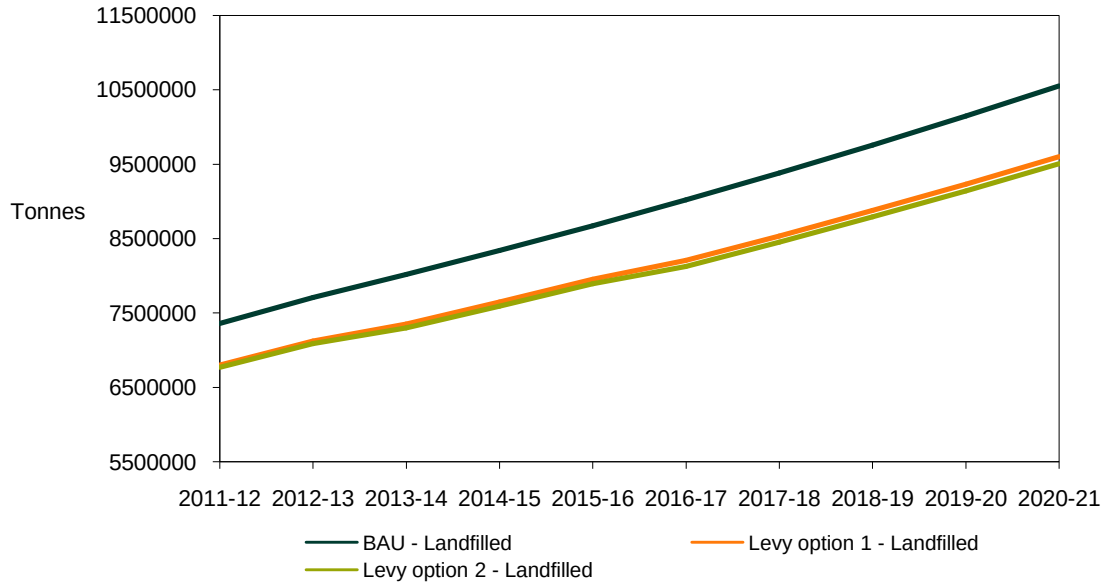
There is insufficient data on the amount of the Higher Hazard waste currently generated that is diverted to recycling. Accordingly, it was not considered appropriate to assume an increased recovery rate for this stream under the Waste Disposal Levy. However, it is noted that future data collection and reporting may affect such figures.

Further, the provision of a price signal under the levy may also in the long term, provide sufficient incentive to increase the avoidance of the creation of Higher Hazard regulated waste at the source, or in a reduction in the toxicity of the waste that is created . As the tonnage projections have not incorporated an allowance for avoidance at the source, this has not been factored into the analysis over the 10 year study period.

The forecast landfill disposal rates applied in this analysis (assuming the application of the levy alone) are shown in Figure 4.

Given the importance of this impact to the CBA and the uncertainty associated with the future growth in recovery rates under the waste levy a sensitivity analysis has been performed on the landfill diversion rates for the MSW, C&D and C&I waste streams (see section 4.1.5).

Figure 4 Forecast landfill disposal rates



Source: Department of Environment and Resource Management, Synergies

Value of diverted waste

An analysis of publicly available information was undertaken to obtain an estimate for the lost commodity value attributable to landfill waste.[17] Table 4 presents an overview of estimates calculated for the lost commodity value from landfill waste in Queensland, Victoria and Western Australia.

Table 4 Estimates for lost commodity value from landfills

State	Year	Lost commodity value ($)	Landfill waste (t)	$/tonne
Queensland	2005	351.9 million	6,025,000	58.4
Victoria	2005/06	283.8 million	4,080,000	69.6
Western Australia	2004	252.6 million	3,797,000	66.5

Source: The data and cost estimates presented in this table have been obtained from reports prepared by the Total Environment Centre based on analysis conducted by Warnken ISE for the TEC's 'State of Waste Series' reports.

The inflation of the estimate for Queensland produces an estimate as at 2011 of approximately $70/tonne.[18] The equivalent inflated values for Victoria and Western Australia are $83/tonne and $81/tonne, respectively. An estimate of $70/tonne has been applied as it is based on Queensland data and is broadly comparable with the estimates based on data from other States.

Economic benefits of reduced landfill waste

Box 2 Summary of quantification of economic benefits of reduced landfill waste

- Economic cost of landfill waste
  - Estimate of $60/tonne assumed for economic cost of landfill waste (BDA Group, 2009)
- Applied to estimated volumes of diverted landfill waste to calculate economic benefits from reduced landfill waste

The economic costs avoided as a result of the diversion of waste from landfill constitutes a key benefit from the introduction of a waste levy. These costs include the cost of land, lining, on-site gas recovery and flaring, fencing, capping and landscaping, operational costs such as labour, fuel and materials, and the cost of rehabilitation and aftercare.

The quantification of this benefit requires a value for the economic costs of landfill waste to be applied to the estimate for diverted landfill waste as a result of the levy. The parameter values applied and methodology followed in determining the estimates for diverted landfill waste under the levy have been detailed above.

[17] The lost commodity value represents the potential benefits that can be obtained from diverting waste away from landfills.

[18] The 2005 estimate of $58.4/tonne was inflated at 3% over a six year period.

A study conducted by the BDA Group in 2009 on the full cost of landfill disposal in Australia has been used as the basis for estimating the environmental cost of landfill waste. This study provided an overview of previous estimates of the private costs of landfills in Australia as well as developing its own cost estimates.

There is a high level of variation in the estimates reported in the previous studies, with estimates ranging from $25/tonne to $150/tonne. The majority of the estimates were concentrated between $25/tonne and $50/tonne.

The BDA Group estimated the private cost of landfills for small, medium and large landfills in Australia. The following table presents a breakdown of the cost estimates.

Table 5 BDA Group estimates of private cost of landfilling ($/tonne)

Cost	Small (<10,000t)	Medium (10,000-100,000t)	Large (>100,000t)
Land	5	3	2
Approvals/site development	10	6	4
Best practice liner	13	8	5
Leachate collection	6	4	3
Gas recovery	6	4	3
Amenity management	1	1	1
Operations	34	20	14
Capping and remediation	10	6	4
Post-closure maintenance	15	9	6
Total	100	60	40

Notes: The assumed annual disposal levels on which the cost estimates were based were 5,000 tonnes for small landfills, 35,000 tonnes for medium landfills and 230,000 tonnes for large landfills.

Operational differences mean that the economic (or private) costs of landfilling are likely to vary across licensed landfills. For example, where gas recovery or leachate collection is not performed at a landfill, the economic cost of landfilling will be lower at this site than is suggested by the estimates provided in this table. The economic benefits associated with diverted landfill waste will therefore also be lower. As information is not available on the operating characteristics of all licensed landfills, it is considered appropriate to adopt the estimate for medium landfills as reasonable for this analysis.

Source: BDA Group (2009). The full cost of landfill disposal in Australia. Department of Environment, Water, Heritage and the Arts.

DERM has indicated that there is significant variance in terms of the size and operating characteristics (e.g. gas recovery facilities) of landfills across Queensland.

Queensland has 428 landfill sites. 18 sites have greater than 100,000 tonnes capacity. Based on this fact it was considered appropriate to adopt the estimate for medium-sized landfills ($60/tonne) to model the economic benefits of diverted landfill waste.

Environmental benefits of reduced landfill waste

Box 3 Summary of quantification of environmental benefits of reduced landfill waste

- Avoided emissions from reduced landfill waste
  - AGO factors applied to estimates for diverted landfill waste to estimate avoided emissions
  - Garnaut price of $25/tonne applied to obtain estimate for value of avoided emissions
- Other environmental benefits from reduced landfill waste
  - Estimate of $1/tonne applied to diverted tonnages to account for other environmental benefits (i.e. leachate and amenity impacts)

As well as the economic costs of maintaining landfills, there are also environmental costs attributable to disposing waste to landfills. This avoided cost is an additional benefit of the waste levy. As with the economic benefits of reduced landfill waste, the quantification of this benefit requires an estimate for the environmental cost of landfill waste to be applied to the estimates for diverted landfill waste under the levy.

The environmental cost of landfill can be broken down into the following:

- greenhouse gas emissions
- other gas emissions
- leachate leakage
- amenity damage.

The two most recent comprehensive studies conducted on the environmental (or external) cost of landfills were by the Productivity Commission in 2006 and the previously mentioned 2009 BDA Group study. The table below presents the estimates obtained by the Productivity Commission.

Table 6 PC estimates of environmental costs of landfill waste at a Best Practice landfill ($/tonne)

Cost category	MSW	C&I	C&D
Leachate	<1	<1	<1
Greenhouse gas emissions	4-15	5-21	1-4
Other gas emissions	<1	<1	<1
Amenity	<1	<1	<1
Total	4-18	5-24	1-7

Source: Productivity Commission. 2006. *Waste Management*. No 38. October. p 76.

The BDA Group's study estimated the external costs of landfills at $1-$24/tonne in urban areas and $1-$19/tonne in rural areas.[19] According to both studies, greenhouse gas emissions account for a significant proportion of the environmental cost of landfills.

As DERM's baseline modelling includes estimates for the environmental benefits associated with avoided greenhouse gas emissions from diverted landfill waste, it was considered appropriate to distinguish between the benefits associated with avoided greenhouse gas emissions and those attributable to other environmental impacts (i.e. leachate leakage, amenity and other gas emissions).

In accordance with DERM's baseline modelling, Australian Greenhouse Office (AGO) emission factors were used to calculate the tonnes of greenhouse gas emissions avoided as a result of the estimated reductions in landfill waste.[20] The AGO factors used in the analysis are as follows:

- MSW – 1,000kg CO2-e/kg
- C&I – 1,100kg CO2-e/kg
- C&D – 300kg CO2-e/kg
- Regulated – 1,100kg CO2-e/kg
- Higher Hazard – 1,100kg CO2-e/kg.

The application of these rates to the tonnes of landfill waste to be diverted under the levy produces estimates for the volume of avoided greenhouse gas emissions. The quantification of the benefits associated with these avoided emissions requires the application of a value for greenhouse gas emissions. A rate of $25/tonne of CO2-e was applied to quantify these benefits. This rate was based on the initial carbon price assumed in the Federal Government's Carbon Pollution Reduction Scheme White Paper.

Due to the uncertainty associated with the value of greenhouse gas emissions, sensitivity analysis was performed on this variable (see section 4.1.5). It was only considered appropriate to conduct sensitivity analysis on a higher value of $40/tonne of CO2-e. The rationale for this was as follows:

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[19] The reason for the significant range in estimates was the range of environmental controls implemented at landfills (i.e. landfills with the best controls had an environmental cost of $1/tonne while landfills with the poorest controls had environmental costs near the upper end of the range).

[20] National Greenhouse Accounts (NGA) Factors November 2008 (refer Page 63 table 42)

- $25/tonne of CO2-e is considered a likely minimum carbon price; and
- a lower value (say $10/tonne) would not be consistent with Australia's greenhouse gas reduction commitments.

A rate of $1/tonne was also applied to quantify the other environmental benefits from the diversion of landfill waste (amenity, leachate leakage and other gas emissions). This estimate is based on the values reported in the Productivity Commission and BDA Group studies on the environmental cost of landfill waste. This value was added to the estimated benefits relating to avoided greenhouse gas emissions to produce an overall estimate for the environmental benefits attributable to diverted landfill waste under the levy.

3.1.2 Qualitative

Avoided emissions from production

In addition to the benefits attributable to reduced emissions from diverted landfill waste, the Waste Disposal Levy is also likely to result in a further reduction in emissions though the replacement of virgin materials with recycled materials in production processes.

Emissions resulting from production processes are reduced where recycled materials are used instead of virgin materials. The United States Environmental Protection Agency (EPA) recently published a report titled 'Solid Waste Management and Greenhouse Gases: A Life-Cycle Assessment of Emissions and Sinks'. This report provides estimates of the greenhouse gas reductions from using recycled instead of virgin materials in manufacturing processes. The table below includes the greenhouse gas emission factors provided by the US EPA.

Table 7 Greenhouse gas reductions from recycling

Materials	GHG reductions (t carbon equiv./t material recovered)
Aluminium cans	3.70
Steel cans	0.49
Copper wire	1.34
Glass	0.08
HDPE, LDPE, PET	0.38-0.46
Corrugated cardboard, magazines, newspaper, office paper, phonebooks, textbooks	0.72-0.85
Dimensional lumber and MDF	0.67
Mixed paper	0.93-0.96
Carpet	1.96
Personal computers	0.62
Fly ash	0.24
Tyres	1.75

Source: United States Environmental Protection Agency (2010). Solid Waste Management and Greenhouse Gases: A Life-Cycle Assessment of Emissions and Sinks.

However, while recognising the potential benefits in relation to the avoidance of emissions, it is also important to note that the increased recovery and reprocessing of waste also produces additional greenhouse gas emissions. This increase in emissions is attributable to the following:

- increase in transport emissions as the transport task associated with transferring material to recovery and reprocessing facilities normally exceeds the task associated with transporting waste to landfill and other waste disposal facilities; and
- reprocessing activities involve process heating and the consumption of electricity and are therefore normally more emissions-intensive than the practice of disposing of waste at landfills.

Estimating the emissions avoided as a result of the substitution of virgin materials for recycled materials in production processes is a difficult process and requires information on the mixture of waste that is to be recovered and reprocessed, as different materials will result in different reductions in greenhouse gas emissions.

Estimating the additional emissions resulting from the increased recovery of material requires the following information:

- the magnitude of the transport task associated with the recovery and reprocessing of material as opposed to disposing of waste at landfills; and
- the volume of emissions resulting from recovery and reprocessing activities.

As this information is not available, the impacts of the waste levy on greenhouse gas emissions cannot be quantified within the scope of this assessment. However, despite the inability to measure the impacts it is considered reasonable to conclude that the waste levy is likely to produce some additional benefits in terms of avoided greenhouse gas emissions. This is based on the conclusion that the avoided emissions resulting from the substitution of virgin materials for recovered materials in production processes are likely to outweigh the additional emissions incurred in the recovery and reprocessing of materials.

Reduced packing from process innovation

The benefit relates to change and innovation in the design, manufacture, purchase or use of materials before they become waste. This benefit differs from the recovery of waste as rather than waste being diverted from landfills to recovery facilities, the waste is not produced at all (i.e. increased recovery results in the diversion of waste from landfills to recycling while source reduction results in a reduction in the size of the total waste stream). Examples include altering the type of packaging used in manufacturing or producing low-waste products.

The implementation of a Waste Disposal Levy will provide households and businesses with an incentive to reduce the amount of waste they produce. Due to the high level of uncertainty associated with the magnitude of any source reduction activities that are likely to occur, the impact of source reduction on tonnages of waste and recovered material over the study period were not factored into this analysis.

To the extent that source reduction is likely to occur under the Waste Disposal Levy, it is likely to be more prominent in the medium to long term as businesses and households adjust their waste and production practices in response to the price signal. It is therefore anticipated that the proportion of diverted landfill waste that is accounted for by source reduction will increase over time.

The quantification of the benefit would require information on both:

- expected areas of innovation
- the cost of innovation
- the extent of waste reduction.

The areas of innovation, the timeframes over which new processes might be introduced and potential benefit are too uncertain to quantify. Nevertheless, the introduction of the levy provides and economic incentive for new methods of waste reduction to be investigated.

3.2 Costs

The following sections assess the quantitative and qualitative costs assessed in this analysis, including a description of the parameters and assumptions used in estimating the costs and how the quantified costs were calculated.

3.2.1 Quantitative

Illegal dumping

Box 4 Summary of quantification of illegal dumping costs

- Tonnages of illegally dumped waste under Do Nothing scenario
  - Use estimates from other jurisdictions to obtain an estimate for illegal dumping costs in Queensland
  - Use cost per tonne estimate from SA waste strategy BCA to obtain estimate for illegally dumped tonnages
- Estimate of increased tonnages under Waste Disposal Levy scenarios
  - Assumptions adopted for increases in illegal dumping rates under the levy scenarios
  - Proportions applied to base tonnage estimates of illegally dumped waste to estimate increase in illegally dumped waste under levy options
  - Per tonnage cost estimate applied to additional tonnages of illegally dumped waste to quantify costs

The increase in illegal dumping, resulting from the increase in the cost of disposing waste at landfills, is a cost associated with the implementation of the Waste Disposal Levy. Three variables are required to quantify the costs associated with an increase in illegal dumping:

- the current volume of illegal dumping
- the cost of illegally dumped waste
- expected increase in illegal dumping under the levy.[21]

No information is available on the volume of illegally dumped waste in Queensland or the cost associated with cleaning up illegally dumped waste. Publicly available information on illegal dumping expenditure in other jurisdictions was used to develop an estimate.

The Table 8 provides estimates of illegal dumping costs for three jurisdictions and the respective population. Based on these values the cost of illegal dumping, per person, has been determined.

[21] It is acknowledged that illegal waste collected by a local council will be exempt from the levy. Technically forecast payments and revenues should be adjusted to reflect the exclusion of illegal waste. However as the level of tonnes collected under the base case are not known, payments and revenues associated with the dumping of illegal waste have not been excluded from the analysis. This will not impact on the NPV results as payments and revenues associated with the levy are transfers. Gross revenues will be slightly overstated due to this assumption.

The average cost estimate for the three jurisdictions is $1.37/person. This estimate is considered to be conservative based on the National Litter Index for 2009/10, which indicates that Queensland is above the national average in terms of the number of litter items per 1,000m^2.

Table 8 Illegal dumping costs across jurisdictions

Jurisdiction	Annual cost of illegal dumping ($)	Population	Cost/person ($)
South Australia	1,600,000[a]	1,633,900	0.98
New South Wales	10,000,000	7,191,500	1.39
Victoria	9,600,000[b]	5,496,400	1.75

a The estimate provided was $1.5 million for 2006/07. This estimate was inflated for 3 years at 3% to provide an estimate of $1.6 million.
b The estimate provided was $8.5 million for 2006. This estimate was inflated for 3 years at 3% to provide an estimate of $9.6 million.
Note: Population estimates are based on data provided by the ABS for the end of the December quarter 2009.
Source: Various.

When this estimate is applied to the Queensland population (4,473,000[22]), the estimated annual expenditure on illegal dumping in Queensland is $6.2 million. Using the cost estimate for illegally dumped waste of $300/tonne used in the Benefit Cost Assessment for the South Australian waste strategy, this equates to approximately 20,666 tonnes, or 0.31% of waste deposited at landfills (using base tonnage estimates of landfilled waste for 2010/11). It is important to note that this is also likely to represent a conservative estimate as it does not take into account external costs associated with illegal dumping (i.e. environmental and amenity impacts).

This proportion of landfill waste under the Do Nothing scenario (0.31%) was held constant over the study period to provide an estimate for the volume of illegally dumped waste in the absence of the Waste Disposal Levy. In order to quantify the costs associated with the increase in illegal dumping under the Waste Disposal Levy, it was necessary to apply an increased rate of illegal dumping. Table 9 details the increases applied in the analysis.

Table 9 Assumed increases in illegal dumping (as % of total waste deposited at landfills)

Years	Levy option 1 (no MSW)	Levy option 2 (MSW incl.)
2011/12 & 2012/13	0.335% p.a.	0.403% p.a.
2013/14 to 2015/16	0.329% p.a.	0.388% p.a.
2016/17 to 2020/21	0.322% p.a.	0.372% p.a.

The basis for the difference in the rates assumed under the two levy options is the dominance of MSW in terms of the make-up of illegally dumped waste. The Benefit

[22] At the end of the December quarter 2009.

Cost Assessment of the South Australian waste strategy in 2007 included an assessment of illegal dumping incidents in South Australia in 2004/05. This assessment showed that almost 80% of illegal dumping incidents related to municipal waste. Based on this information, it was considered appropriate to apply higher rates under levy option 2, in which MSW is included.

Although there is expected to be an increase in illegal dumping, the proportion of the waste stream illegally dumped remains small under both options. Illegal dumping costs have a minimal impact on the costs of the levy.

The basis for applying a downward trend to the rate of illegal dumping under each of the options is that, according to anecdotal evidence (such as the 2004 OECD report titled 'Addressing the Economics of Waste'), the increase in illegal dumping rates observed in the initial period following the implementation of a waste levy are greater than the longer term impacts. As businesses and households adjust to the price signal, the increase in illegal dumping progressively falls.

Material recovery and reprocessing

Box 5 Summary of quantification of cost of material recovery and reprocessing

- Cost of recovery and reprocessing activities
  - Estimate of $100/tonne based on available information
- Apply cost estimate to estimates for volume of diverted landfill waste (increase in recovered volumes)

Two variables are required to quantify the costs associated with the recovery and reprocessing of the additional tonnages of waste to be diverted from landfill to recycling under the levy:

- volumes of waste to be diverted to recycling
- cost of recovering and reprocessing these additional volumes.

The methodology for estimating the volumes of waste to be diverted from landfill to recycling is outlined in section 3.1.1.

As no information is available regarding the cost of reprocessing material in Queensland, publicly available information from other jurisdictions was used to develop an estimate.

In its 2006 Inquiry Report into Waste Management, the Productivity Commission estimated the average sorting costs incurred by material recovery facilities associated

with kerbside recycling. The range of estimates produced for a comingled container of recycling were $95/tonne for large facilities to $143/tonne for small facilities.[23]

The New York City Independent Budget Office reported that, in 2008, its recycling budget was approximately US$28.1 million. This budget was based on 610,748 tonnes of recycled metal, glass, plastic and paper. This equates to a tonnage estimate of US$46. Indexing the estimate to $2010 and converting to Australian dollars produces an estimate of approximately $50/tonne.[24]

These estimates are consistent with the statement made by Michael Shapiro, the Director of the United States Environmental Protection Agency's Office of Solid Waste, that a well run kerbside recycling program should cost $50 to $150 per tonne.[25] Based on these estimates, a recovery and reprocessing cost of $100/tonne has been applied to all waste streams.

Given the uncertainty associated with this estimate and the importance of the impact to the analysis, sensitivity analysis has been performed on this parameter (see section 4.1.5).

[23] Productivity Commission. (2006. *Waste Management*. No 38. October.

[24] New York City Independent Budget Office (2007). Inside the Budget – May 1 2007, Number 150.

[25] *Do the Benefits of Recycling Outweigh the Costs?* Earthtalk. Web. 28 Sept. 2010. <http://environment.about.com/od/recycling/a/benefit_vs_cost.htm>.

Levy implementation, administration and business compliance costs

Box 6 Summary of quantification of levy implementation, administration and business compliance costs

- Cost estimates provided by DERM
  - Government levy implementation costs - $5,360,000 (year 1) (including $1.26 million in IT system costs)
  - Ongoing administration and compliance monitoring costs for government - $2,293,253 in year 1 and $1,490,231 in years 2 – 10
  - Set-up costs to be incurred by business - $2,292,460 (year 1)
  - Ongoing business compliance costs - $1,727,564 per annum (years 1 – 10)
- Annual business compliance costs and administration and compliance monitoring costs indexed at an inflation rate of 2.5% over the study period

The implementation and administration of the Waste Disposal Levy will impose additional costs on government. The implementation costs that will be incurred in year 1 of the study period have been estimated at $5,360,000 (including IT costs), while the ongoing administration and compliance monitoring costs have been estimated at $2,293,253 in year 1 and $1,490,231 for years 2 through to 10.

In terms of the cost to business, it has been estimated that the initial start-up costs will total $2,292,460 (to be incurred in year 1), with ongoing compliance costs estimated at $1,727,564 per annum. These cost estimates were provided by DERM and do not vary under the two levy options. The ongoing costs of the Waste Disposal Levy, including business compliance and government administration and compliance costs have been indexed at a rate of 2.5% p.a. over the study period.

3.2.2 Qualitative impacts

Impact on skip industry

The implementation of a levy can result in disruptions in related markets and costs associated with industry restructuring. In relation to the Waste Disposal Levy this is most likely to occur under option 1, in which MSW is exempt from the levy.

In addition to local government waste services, households can also pay commercial waste removal services or self-haul waste. Under option 2, the Waste Disposal Levy will increase the price of both these services.

Participants in the waste industry have raised concerns that skip bin operators will lose a significant proportion of their market share in the household sector if MSW is exempt from the levy. The basis for this argument is that skip bin operators, whose waste will be classified as C&I and therefore captured by the levy under both options, will be

forced to pass on the cost of the levy to customers.[26] In the event that MSW is excluded under the levy, householders will be provided with an incentive to self-haul their waste to landfills in order to avoid having to pay the levy (which will be included in the price of a skip bin).

Based on this information, it is considered likely that the implementation of levy option 1 will have an adverse impact on the competitiveness of the skip industry compared to free council kerbside collection or self-haul. The magnitude of this impact is dependent upon two factors. The first of these is the proportion of skip operators' revenues that are attributable to the residential sector. The greater this proportion, the greater the impact of the Waste Disposal Levy (under option 1) on skip bin operators' profitability. According to information provided by the Waste Contractors and Recyclers Association of Queensland (WCRAQ), and individual skip bin operators, this can be between 35 and 80 per cent but can be up to 100 per cent for small skip operators.

The second factor is the propensity of the residential sector to respond to an increase in skip prices by using council kerbside services or self-hauling (i.e. the price elasticity of demand for skip bin services in the residential sector). The greater the elasticity of demand for skip bin services in this sector (i.e. the higher the responsiveness of demand to price increases), the greater the impact of the Waste Disposal Levy on skip bin operators' profitability.

As there is no information available regarding the responsiveness of demand from the residential sector to changes in skip bin prices, it is not possible to quantify the magnitude of the impact of levy option 1 on the profitability of the skip bin industry. However, despite this inability to quantify this impact, it is important to recognise that the implementation of levy option 1 may result in significant decrease in demand for skip bins by households. This potential impact needs to be taken into account when assessing option 1.

[26] In its submission on the Queensland Waste Strategy 2010-2020, Green Bins estimated that the implementation of a waste levy would increase the charge to householders by approximately $70 per skip.

4 Results

To assess the benefits and costs of the proposed options, their impacts are assessed 'with' and 'without' the proposed policy. The 'without' case is called the base case; it provides a baseline against which all direct impacts of the project can be measured.

The impacts of the Waste Disposal Levy were modelled over a 10 year period. The CBA model uses nominal values with benefits and costs discounted at a social discount rate of 6%. A summary of the assumptions and parameter values used in the CBA model is provided in Attachment B.

The selection of the discount rate is a key component in a CBA. The discount rate is intended to represent the opportunity cost of the funds being used for the project or program for which the analysis is being conducted. Where an analysis is to be conducted from the perspective of society, the correct discount rate should represent the social opportunity cost of capital. This represents the return on capital that could have been achieved if the funds were allocated to another project or program.

As the Waste Disposal Levy is a government policy that is being assessed from the perspective of society (i.e. impacts on businesses, households and the community) it is considered that a social discount rate is appropriate for this analysis. A rate of 6% is commonly used as it represents the long-term bond rate which is used as a proxy for the social opportunity cost of capital.

The impacts of moving from the base case (Do Nothing) to each levy option are described below. This analysis includes the benefits and costs for each waste stream and the overall net impacts under each levy option. A sensitivity analysis has also been performed on several key variables and parameters.

4.1.1 Benefits

Table 10 presents an overview of the Present Value (PV)[27] of the quantified benefits for the two levy options.

Table 10 PV of benefits by levy option and waste stream ($2010)

Benefit	Levy option 1	Levy option 2
Resource savings		
MSW	-	32,148,984
C&D	75,980,088	75,980,088
C&I	35,854,253	35,854,253
Regulated	396,761	396,761
Higher Hazard	-	-
TOTAL	**112,231,102**	**144,380,086**
Reduced landfill (economic)		
MSW	-	27,556,272
C&D	65,125,790	65,125,790
C&I	30,732,217	30,732,217
Regulated	340,081	340,081
Higher Hazard	-	-
TOTAL	**96,198,088**	**123,754,359**
Reduced landfill (environmental)		
MSW	-	11,941,051
C&D	9,226,154	9,226,154
C&I	14,597,803	14,597,803
Regulated	161,538	161,538
Higher Hazard	-	-
TOTAL	**23,985,495**	**35,926,546**
Levy revenues		
MSW	-	531,823,700
C&D	1,256,898,572	1,256,898,572
C&I	449,248,027	449,248,027
Regulated	31,313,810	31,313,810
Higher Hazard	74,845,284	74,845,284
TOTAL	**1,812,305,693**	**2,344,129,394**
Totals	**2,044,720,378**	**2,648,190,385**

The PV of the benefits of levy option 1 (which excludes MSW) is estimated at $2.04 billion, while the PV of the benefits of levy option 2 (all waste streams) is estimated at $2.65 billion.

[27] The Present Values in this report have been calculated by estimating the benefits and costs of the Waste Disposal Levy over the 10 year study period and discounting these estimates at a social discount rate of 6% to convert the estimates to 2010 dollars.

In assessing these benefits it is important to acknowledge that the levy revenues do not constitute a net impact under the levy as they represent a transfer from businesses and households to government. Of the net benefits of the levy, resource savings are estimated as being the most significant, with the PV of the benefit across all waste streams totalling approximately $144.4 million. The economic benefits of reduced landfill waste is the second most significant net benefit, with a PV of $123.8 million, while the PV of the environmental benefits of reduced landfill waste is estimated at $35.9 million (across all waste streams).

4.1.2 Costs

The table below presents an overview of the PV of the costs associated with the implementation of a waste levy.

Table 11 PV of costs of waste levy in 2010 dollars ($)

Cost	Levy option 1	Levy option 2
Illegal dumping	3,272,276	14,155,637
Material recovery and reprocessing		
MSW	-	45,927,119
C&D	108,542,983	108,542,983
C&I	51,220,362	51,220,362
Regulated	566,801	566,801
Higher Hazard	-	-
TOTAL	**160,330,146**	**206,257,265**
Levy implementation	5,056,604	5,056,604
Levy administration and compliance	12,901,140	12,901,140
Start-up costs for business	2,162,698	2,162,698
Business operating and compliance	14,077,548	14,077,548
Levy payments		
MSW	-	531,823,700
C&D	1,256,898,572	1,256,898,572
C&I	449,248,027	449,248,027
Regulated	31,313,810	31,313,810
Higher Hazard	74,845,284	74,845,284
TOTAL	**1,812,305,693**	**2,344,129,394**
Totals	2,010,106,105	2,598,740,286

Note: The figures in this table represent the present values (in 2010 dollars) for the cost estimates provided in Box 6.

a Levy implementation costs, which are to be incurred in 2011-12, have been discounted back to 2010 dollars. (i.e. The estimate for levy implementation costs of $4,226,000 to be incurred in 2010-11 have been discounted at the social discount rate of 6% to provide the PV estimate of $3,986,792).

As was the case in relation to the benefits, it is important to note that the levy payments, which in PV terms account for $1.81billion under levy option 1 and $2.34 billion under levy option 2, represent transfers from businesses and households to government rather than net costs under the levy. Of the net costs under the levy,

material recovery and reprocessing accounts for a significant majority of the total costs (81.1 per cent under levy option 1 and 81.0 per cent under levy option 2).

4.1.3 Net impacts

To assess the impact of the levy two decision rules are used:

- a Net Present Value (NPV) rule which shows the discounted net annual impact (that is benefits and costs) of the levy. A positive NPV means, as a whole, society is better off with a policy than without the policy; and
- a Benefit Cost Ratio (BCR) which measures the ratio of discounted benefits and costs. A policy with a BCR of above 1 is beneficial to a community.[28]

Table 12 shows that both levy options produce positive NPVs of $34.6 million and $49.5 million respectively and BCRs greater than 1. Moreover, extending the levy to include MSW increases the net present value. The small change in the BCR between Option 1 and Option 2 is simply reflecting that present value of the benefits have increased slightly more than the present value of the costs as a result of the inclusion of MSW.

Table 12 Summary of impacts of waste levy ($)

	Levy option 1	Levy option 2
NPV	34,614,273	49,450,099
BCR [a]	1.175	1.194

a Excludes levy revenues and payments.

It is also important to note that the benefits and costs that could not be quantified in the analysis:

- reduced use of virgin materials (benefit)
- reduced waste through process innovation (benefit)
- the impact of the levy on operators in the skip bin industry (cost).

These benefits and costs were discussed in Section 3.

[28] The BCR rule does not replace the net present value rule. It is used mostly in situations where a number of options are being assessed and more than one option can be implemented. I can be used to select the options to be implemented. It has been included in this Report for completeness. The Department of Finance and Administration. (2006). Handbook of Cost Benefit Analysis, p 59.

While these impacts could not be quantified in the CBA model it is still important that they are taken into consideration when assessing the economic efficiency of the two levy options.

4.1.4 Other impacts

Employment

The imposition of a Waste Disposal Levy is a corrective policy instrument designed to reduce the volume of waste that is disposed of in landfills by increasing recycling rates and in the long term the deferral of waste. The CBA measures the resource costs and benefits of the levy at an aggregate level. For example, the benefits of reduced landfill will include the labour that would have been employed in providing future landfill services.

A positive NPV in the CBA can be interpreted as an overall gain to society from the policy even though employment in existing sectors may not grow or perhaps fall. It should be stressed that the community is better off with a Waste Disposal Levy even though it is likely to result in changes in employment. Nevertheless, employment is an economic variable of interest to policy makers and the community.

The impact of a Waste Disposal Levy will directly impact employment in the waste management industry. These impacts are as follows:

- reduced employment in the development of landfills as a result of a reduction in the volume of waste disposed of in landfills;
- reduced employment in the collection and disposal of waste; and
- increased employment in recovery and reprocessing activities as a result of the levy.

According to an Access Economics Report it is estimated that direct FTE employment per 10,000 tonnes of waste is 9.2 for recycling and 2.8 for landfill. The higher FTE for recycling is due to the higher number of activities associated with the recycling process, and in particular the sorting, transfer and transformation of materials into new products, and the labour intensive nature of some of these processes compared with landfill-related employment.[29]

Based on these estimates the levy will result in an increase in employment growth in the industry. This is attributable to an increase in the waste material to be diverted to

[29] Access Economics. (2009). Employment in Waste Management and Recycling, p 2.

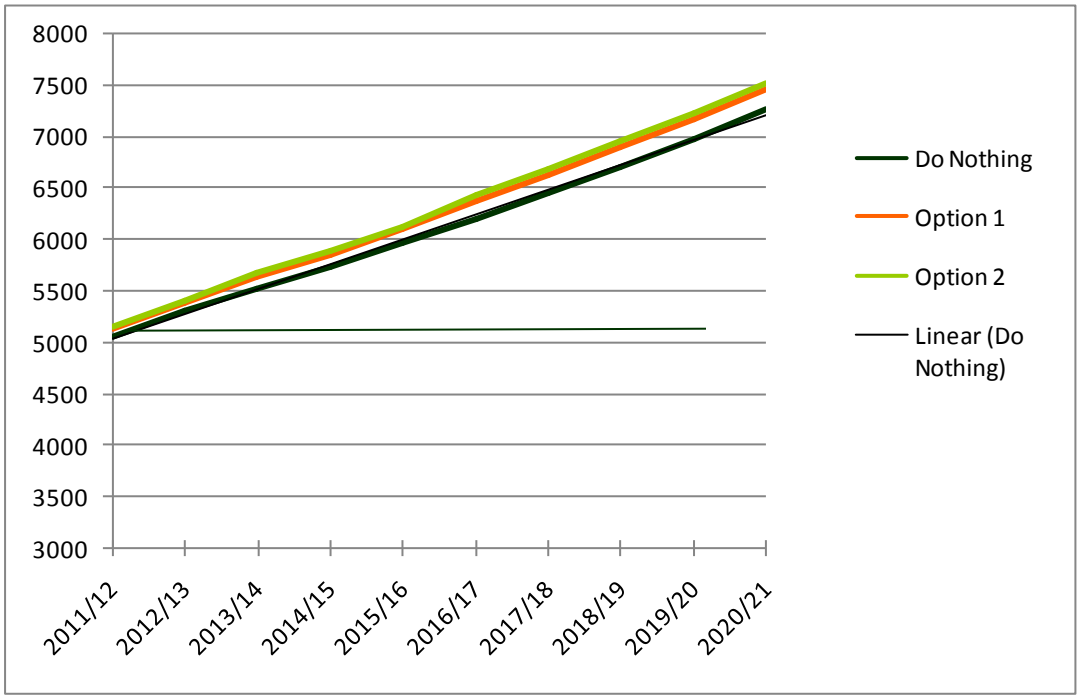
the labour intensive recycling sector. Table 13 shows the growth in employment in the industry over the study period.

Table 13 Employment impacts of the Waste Disposal Levy (# FTEs)

Scenario	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21
Do Nothing	5,064	5,304	5,517	5,737	5,967	6,205	6,454	6,712	6,980	7,259
Levy option 1	5,139	5,384	5,635	5,861	6,095	6,379	6,635	6,900	7,176	7,463
Levy option 2	5,160	5,405	5,669	5,896	6,131	6,430	6,687	6,955	7,233	7,522

Figure 5 provides a graphical representation of the data included in the above table.

Figure 5 Impact of the Waste Disposal Levy on employment



Indirectly, the levy affects employment throughout the economy by increasing the costs of disposing of waste. Indirect employment effects are likely to be more pronounced in waste intensive industries because these industries will face the largest increase in costs. Case studies prepared on several types of businesses show that the expected impact on business costs is small. However, when aggregated across the industry is will have some impact on business output and therefore employment. Given the size of the cost impacts significant employment impacts would only be expected if employment was very sensitive to tax changes. Indirect employment affects

also arise to the extent that households must now pay higher charges for waste disposal and as a result will adjust their demand for other goods and services.

4.1.5 Sensitivity analysis

The purpose of sensitivity analysis is to identify the criticality of the variables, parameters and assumptions used in an analysis to the results modelled. While the primary purpose of sensitivity analysis is to determine whether a change in any key parameter results in a negative NPV, it is also important to assess the impact of different parameters on the magnitude of the NPV that is achieved. This provides policy makers with an indication of the level of certainty associated with the modelled results in addition to identifying the critical parameters and assumptions in terms of the impact on the net benefit of the policy or program.

The sensitivity analysis was undertaken in relation to the following factors:

- discount rate (+/- 2% in absolute terms)
- increased rate of recovery (landfill diversion) (+/- 1% for MSW, C&D and C&I in absolute terms)
- cost of recovery and reprocessing (+/- 20%)
- cost of greenhouse gas emissions (+ 60%)[30]
- economic cost of landfill waste (+/- 20%)
- value of resources saved (+/- 20%).

Sensitivity analysis was performed on these variables and parameters on the basis that they were the most significant in terms of their effect on the overall magnitude of the NPV calculated under the two levy options.

Table 14 presents an overview of the results of this sensitivity analysis for the two levy options. These results are also shown in Figure 6.

[30] An upper estimate of 60% was preferred for this parameter (rather than the 20% used for the other parameters) on the basis that $40/tonne CO2-e was considered to represent a more appropriate upper estimate for the cost of greenhouse gas emissions. It was not considered appropriate to conduct sensitivity analysis based on a value lower than $25/tonne CO2-e as this was considered to represent a conservative estimate for the value of emissions.

Table 14 Summary of sensitivity analysis

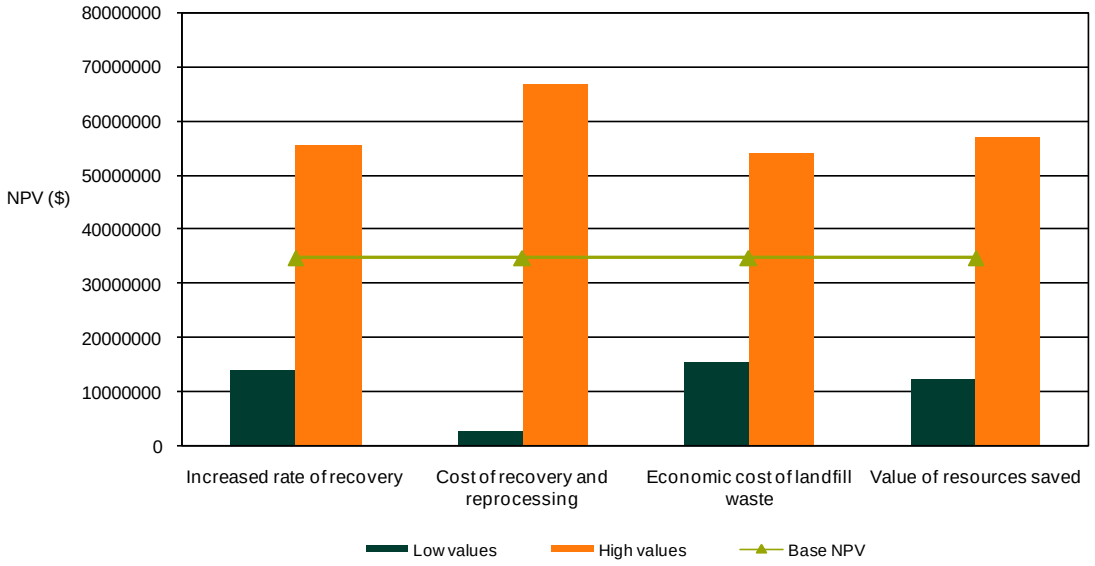
Parameter	NPV levy option 1	NPV levy option 2
Base results	$34,614,273	$49,450,099
	NPV levy option 1 (% change from base results)	**NPV levy option 2** (% change from base results)
Discount rate		
Low (-2% absolute)	$40,081,258 (+15.8%)	$56,953,434 (+15.2%)
High (+2% absolute)	$29,969,841 (-13.4%)	$43,072,472 (-12.9%)
Increased rate of recovery (landfill diversion)		
Low (-1% absolute)	$13,730,899 (-60.3%)	$20,681,441 (-58.2%)
High (+1% absolute)	$55,497,647 (+60.3%)	$78,218,757 (+58.2%)
Cost of recovery and reprocessing		
Low (-20%)	$66,680,302 (+92.6%)	$90,701,552 (+83.4%)
High (+20%)	$2,548,244 (-92.6%)	$8,198,646 (-83.4%)
Cost of tCO2-e		
High (+60%)	$48,043,589 (+38.8%)	$69,768,483 (+41.1%)
Economic cost of landfill waste		
Low (-20%)	$15,374,656 (-55.6%)	$24,699,227 (-50.1%)
High (+20%)	$53,853,891 (+55.6%)	$74,200,971 (+50.1%)
Value of resources saved		
Low (-20%)	$12,168,053 (-64.8%)	$20,574,082 (-58.4%)
High (+20%)	$57,060,494 (+64.8%)	$78,326,116 (+58.4%)

None of the scenarios tested in the sensitivity analysis result in a negative NPV. The lowest NPV result from the analysis was $2.5 million for levy option 1 under the high scenario (+20%) for the cost of recovery and reprocessing variable.

The cost of recovery and reprocessing was the most sensitive variable in terms of the variance observed in the NPV results (±92.6% and ±83.4% for the two levy options respectively). This is consistent with the observation that these costs account for over 81% of the total net costs under both levy options.

The sensitivity analysis also found that varying several other parameter values had a significant impact on the NPVs for the two levy options. For example, varying the estimate used for the value of resources saved resulted in changes to the NPV of the two levy options of ±64.8% and ±58.4% respectively. The other variables which produced significant changes in the NPV estimates were the increased rate of recovery (or landfill diversion) and the economic cost of landfill waste. Figure 6 presents an overview of the results of the sensitivity analysis.

Figure 6 Summary of sensitivity analysis (levy option 1)



5 Case studies

The following case studies outline the impact of the waste levy on the following industries/businesses according to location (South East Queensland (SEQ) or regional Queensland):

- small-medium sized cafe
- a large manufacturing business
- medium-large sized office building
- residential housing affordability.[31]

The case studies are based on information provided by Master Builders and the Chamber of Commerce and Industry Queensland.

5.1 Small-medium sized cafe

Based on the type of waste generated by a small to medium sized cafe the levy will increase business costs by $315.00 or $385.00 per annum for cafes located in SEQ and regional Queensland, respectively. It is expected that competition in the industry will see industry bear most of the impact of the levy.

Table 15 Impact of a waste levy on a small-medium sized cafe

Location	Types of waste	Ave volume of waste (tonnes p.a.)	Additional waste disposal costs ($, p.a.)	Additional waste disposal cost - % of current operating expenditure
South East Queensland	C&I	9	315.00	0.25
Regional	C&I	10.5	385.00	0.3

Note: Levy has been calculated on each tonne or part thereof. The impact of the levy assumes there is no change in operational practices such as increased recycling or the deferral of waste.

Source: Chamber of Commerce and Industry Queensland

Cafes located in SEQ can access alternatives to landfill such as recycling if they are located in a shopping centre; however these alternatives are not available to businesses located in regional Queensland. The scope for recycling in the long term is limited to cardboard.

[31] This case study is based on data provided by project builders. That is a builder who constructs 5 or more homes per annum.

5.2 Large manufacturing business

Large manufacturing businesses typically generate C&I and regulated (lower and higher hazard) wastes. The financial impact of the waste levy under each of the options, according to location is shown in table below. Due to market factors the full impact of the levy will be incurred by the business and not passed on to consumers.

Table 16 Impact of a waste levy on a large manufacturing business

Location	Types of waste	Ave volume of waste (tonnes p.a.)	Total additional waste disposal costs ($, p.a.)	Additional waste disposal cost - % of current operating expenditure
South East Queensland				
	C&I	280		
	Regulated [a] (lower & higher)	0.75		
			9,900.00	**1.1**
Regional				
	C&I	375		
	Regulated [a] (lower & higher)	1.5		
			13,325.00	**1.6**

a Regulated waste data was not spilt according to type. An average levy amount of $100 per tonne has been applied.

Note: Levy has been calculated on each tonne or part thereof. The impact of the levy assumes there is no change in operational practices such as increased recycling or the avoidance of waste.

Source: Chamber of Commerce and Industry Queensland

Manufacturing businesses located in SEQ can access alternatives to landfill and in the long term should be able to recycle cardboard, plastics, metals, expandable foams and organics. However the scope for recycling is limited to cardboard, metals and some plastics for regional manufacturing businesses.

5.3 Medium-large sized office building

Medium to large sized office buildings typically generate C&I waste. Table 17 shows the financial impact of the waste levy under each option according to location. According to the Chamber of Commerce and Industry Queensland the full impact of the levy will be incurred by owners/operators of office buildings located in SEQ. However there is scope for owners/operators of office buildings located in regional Queensland to pass some of this cost onto tenants.

Table 17 Impact of a waste levy on a medium-large office building

Location	Types of waste	Ave volume of waste (tonnes p.a.)	Total additional waste disposal costs ($, p.a.)	Additional waste disposal cost - % of current operating expenditure
South East Queensland				
	C&I	30	**1,050.00**	**0.2**
Rural				
	C&I	25	**875.00**	**0.5**

Note: Levy has been calculated on each tonne or part thereof. The impact of the levy assumes there is no change in operational practices such as increased recycling or the l avoidance of waste.

Source: Chamber of Commerce and Industry Queensland

Office buildings located in SEQ can access alternatives to landfill such as recycling however these alternatives are not available to office buildings located in regional Queensland. In the long term office buildings in SEQ will be able to recycle paper, cardboard, toner and e-waste.

5.4 Residential housing affordability

During the construction of an average home approximately 27 tonnes and 17 tonnes of C&D waste is generated at sites located in SEQ and regional Queensland, respectively. Based on the type of waste generated[32] the waste levy will increase the cost of residential house construction (per home) in SEQ by $945.00 and $595.00 in regional Queensland – see Table 18. Irrespective of location, the full impact of the levy plus a margin (determined by the builder) will be passed on to the consumer.

[32] It is acknowledged that at some sites hazardous materials or contaminated/acid sulphate soils may be disposed of. Due to the nature of this waste and the associated levy amount, the financial impact per home will be higher.

Table 18 Impact of a waste levy on housing affordability

Location	Types of waste	Ave volume of waste (tonnes per dwelling)	Total additional waste disposal costs ($, per dwelling.)
South East Queensland			
	C&D	27	**945.00**
Regional			
	C&D (total from the specific waste streams below)	17	**595.00**
	Topsoil and spoil from plumbing trenches	14	
	Plasterboard [a]	0.35	
	Blocks, timber, roofing, iron off cuts, strapping, damaged nails & screws, tiles, packaging, carpet off-cuts, FC sheeting off cuts, paint tins [a]	1.77	

a Ave volume of waste was reported on a cubic metre basis. Waste values have been converted to tonnes on the basis of 1 cubic meter equals 0.35 tonnes (approximately).

Note: Levy has been calculated on each tonne or part thereof. The impact of the levy assumes there is no change in operational practices such as increased recycling or the avoidance of waste.

Source: Master Builders Queensland.

As shown in the table above, the most significant proportion of waste for housing developments in regional Queensland is topsoil and spoil from trenches. If this waste is not contaminated it could be used as clean fill or for other purposes rather than being sent to landfill for disposal. If the total amount of topsoil and spoil from trenches reported in Table 18 could be diverted to an alternative use, the waste levy would increase the cost of residential house construction (per home) in regional Queensland by $105. A breakdown of the specific waste streams for South East Queensland was not provided. However, it is assumed that soil would also be a significant proportion of the 27 tonnes of waste reported and that the levy cost indicated above could be reduced significantly if this material was not sent to landfill for disposal.

The building sector has access to recycling facilities. However it is difficult for operators to ensure its recycling waste does not become contaminated. It was also acknowledged by industry respondents that the scope for increased recycling may be restricted due to site logistics and storage, as sites are becoming smaller and access is limited.

6 Summary

One of the key components of the Queensland Government's new waste strategy is the introduction of a Waste Disposal Levy, which will be an additional charge above the normal gate fee for waste delivered to a disposal facility.

The benefits and costs of two options for the implementation of the levy (one including all waste streams and the other excluding MSW) were modelled over a 10 year period using a social discount rate of 6%.

The costs and benefits associated with the introduction of the levy, in particular the costs and benefits to industry, government and the community under each of the scenarios (options) are summarised in the table below.

Table 19 Summary of impacts of waste levy ($)

	Levy option 1	Levy option 2
PV of benefits	2,044,720,378	2,648,190,385
PV of costs	2,010,106,105	2,598,740,286
NPV	34,614,273	49,450,099
CBR (net impacts)[a]	1.175	1.194

a Excludes levy revenues and payments.

The Present Value of the benefits and costs reported in the above table include levy revenues and payments. These represent transfers from consumers and businesses to government and are therefore not net impacts of the Waste Disposal Levy.

Of the net impacts of the levy, the key benefits were the resource savings resulting from the increased recovery of landfill waste and the economic benefits (avoided costs) associated with the diversion of landfill waste. The PVs of these two benefits across all waste streams (levy option 2) were $144.4 million and $123.8 million respectively.

There are also likely to be additional benefits and costs resulting from the avoidance of greenhouse gas emissions as a result of the substitution of recycled products for virgin materials in manufacturing processes and waste reduction innovations. While these benefits are considered likely to materialise, data limitations prevented them from being quantified. It is still important, however, that they are included in the overall assessment of the Waste Disposal Levy.

In terms of the quantified costs of the Waste Disposal Levy, the net impacts are dominated by the costs associated with the recovery and reprocessing of diverted landfill waste, which accounts for 81.1% and 81.0% of net costs under levy options 1 and 2 respectively. In addition to the costs included in the CBA model, there are likely to be impacts on the skip industry under option 1 which could not be quantified.

Sensitivity analysis was conducted on all of the key parameters and assumptions used in the CBA model to test the robustness of the results. Under none of the scenarios modelled in the analysis did the NPV of either of the levy options fall below zero. The cost of the recovery and reprocessing of diverted landfill waste was the most significant parameter in terms of its impact on the NPV estimates, resulting in variations of ±92.6% and ±83.4% for the two levy options respectively.

The implementation of a Waste Disposal Levy is likely to result in a modest increase in employment levels in the waste industry. As of year 10 of the study period, overall employment in the industry was projected at 2.8% and 3.6% higher than the base case under levy options 1 and 2 respectively. This increase in employment is attributable to recovery and reprocessing activities being more labour intensive than waste disposal activities.

In addition to modelling the benefits and costs of the Waste Disposal Levy, several case studies were also conducted to gauge the impact of the levy on participants in various industries.

Based on information provided by industry associations the financial impact of the levy on a small-medium sized café, a large manufacturing business, medium-large sized office building and residential housing affordability are summarised in Table 20.

Table 20 Impact of a waste levy (various businesses)

Business type	Location	Additional waste disposal cost ($ p.a.)
Small-medium sized café	SEQ	315.00
	Regional	385.00
Large manufacturing business	SEQ	9,900.00
	Regional	13,325.00
Medium-large sized office building	SEQ	1,050.00
	Regional	875.00
Residential housing affordability	SEQ	945.00 [a]
	Regional	595.00 [a]

a Average increase in the cost of a new home due to the introduction of a levy on C&D waste.

Sources: Chamber of Commerce and Industry Queensland; Master Builders.

A Examples of current local government waste disposal fees and charges

Table A.1 Current local government waste fees and charges (selected local governments)

Council	Vehicle Type	Waste type	Fees and charges
Brisbane City Council	Cars and station wagons	General waste	$8.65 per car
		Green waste	
	Vehicle or trailer combinations with a Registered Gross Vehicle (RGVM) of 4.5 tonnes or less	General waste	$8.65 up to 100 kg
		Mixed general	$17.90 for >100 kg but ≤ 500 kg
		Green waste	$93 per tonne above 500 kg
	Vehicle or trailer combinations with a Registered Gross Vehicle (RGVM) of 4.5 tonnes or less	Uncontaminated green waste[a]	$8.65 up to 100 kg
			$14.60 for >100 kg but ≤ 500 kg
			$71.50 per tonne above 500 kg
	Vehicles with a RGVM greater than 4.5 tonnes	General waste	$93 per tonne
		Uncontaminated green waste	$71.50 per tonne
Gold Coast City Council	Residential waste carried in passenger type cars, station sedans and vans, utilities or trailers	Mixed loads (21mx1.5mx600mm)	Nil charge
		Clean green waste (21mx1.5mx 1 m)	
		Mixed loads & Clean green waste (exceeding above size limits)	See cost per tonne below
	Commercial	Mixed waste	$16.00 min charge
			$69.30 per tonne
		Green waste	$10.00 min charge
			$37.00 per tonne
		Asbestos/contaminated soils	$44.00 min charge
			$176.00 per tonne
		Special/supervised burial	$16.00 min charge
			$120.00 per tonne
		Concrete disposal	$15.40 mini charge
			$30.00 per tonne
Mt Isa City Council	All vehicles under 2 tonne[b]	All waste types	$3.00
	2 tonne - under 5 tonne[b]	All waste types	$18.00
	5 tonne – under 10 tonne[b]	All waste types	$34.00
	Semi-trailer	All waste types	$70.00
		Vehicle wreck	$55.00
		Burial trench	$82.00 (per linear mtr)
		Regulated waste	By appointment only
Townsville City Council [c]	Domestic car and station wagon	General solid waste (inc green material that cannot be mulched for reuse)	$4.00

Council	Vehicle Type	Waste type	Fees and charges
	Domestic car and station wagon with trailer		$8.00
	Domestic any vehicle (large load)		$14.50 m^3
	Commercial any vehicle and/or trailer combination		$15.50 min charge (<250kg) $57.00 per tonne
	Domestic car and station wagon	General green waste (only material that can be mulched for reuse)	$4.00
	Domestic car and station wagon with trailer		$8.00
	Domestic any vehicle (large load)		$14.50 m^3
	Commercial any vehicle and/or trailer combination		$15.50 min charge (<250kg) $46.50 per tonne
		Construction and demolition – clean concrete, brick, pavers	$13.00 per tonne
		Construction and demolition – other	$15.50 min charge (<250kg) $57.00 per tonne
		Treated clinical related wastes	$15.50 min charge (<250kg) $57.00 per tonne $85.00 preparation fee (each)
		Asbestos, contaminated soils	$15.50 min charge (<250kg) $57.00 per tonne $85.00 preparation fee (each)
		Regulated wastes or any other	$15.50 min charge (<250kg) $57.00 per tonne $85.00 preparation fee (each)
		Disposal of documents, drugs, tobacco, alcohol, food products AQIS etc for which a certificate is requested	$15.50 min charge (<250kg) $57.00 per tonne $85.00 preparation fee (each)

a Uncontaminated green waste includes branches, leaves and grass clippings but no pots, pavers, sleepers and soil. **B.** A surcharge of $16.00 will apply to each additional trailer; **c** Waste disposal fees for landfills with weighbridge facilities.

Source: Brisbane City Council – Waste vouchers, fees and charges (http://www.brisbane.qld.gov.au/environment-waste/rubbish-tips-collections/vouchers-fees-and-charges/index.htm); Gold Coast City Council – Council Waste Disposal and Recycling Facilities (http://www.greengc.com.au/find-a-service/council-waste-disposal-and-recycling-facilities); Townsville City Council – Townsville Water Services Fees and Charges 2010-11 (http://www.townsville.qld.gov.au/resources/6793.pdf).

B Assumptions and parameter values

Table B.1 Assumptions and parameter values used in CBA model

Parameter	Unit	Value
Business as Usual tonnage projections (2010/11)		
2010/11 landfill tonnage projections	tonnes	
MSW		1,642,424
C&D		3,881,663
C&I		1,401,906
Regulated		66,113
Higher Hazard		52,147
2010/11 recovered tonnage projections	tonnes	
MSW		1,327,227
C&D		1,099,070
C&I		287,386
Regulated		745,760
Higher Hazard		0
Increased rate of recovery (landfill diversion)		
2011/12 – 2012/13	%	
MSW (levy option 2 only)		2
C&D		2
C&I		3
Regulated		1
Higher Hazard		0
2013/14 – 2015/16	%	
MSW (levy option 2 only)		3
C&D		3
C&I		4
Regulated		1
Higher Hazard		0
2016/17 – 2020/21	%	
MSW (levy option 2 only)		4
C&D		4
C&I		5
Regulated		1
Higher Hazard		0
Cost of landfill waste		
Economic cost of landfill waste	$/tonne	60
Environmental cost of landfill waste (excluding GHG emissions)	$/tonne	1
Cost of illegal dumping	$/tonne	300
Proportion of landfilled waste illegally dumped under base case	%	0.31
Increases in illegal dumping rates		
Levy option 1 (excluding MSW)	%	
2011/12 – 2012/13		8
2013/14 – 2015/16		6
2016/17 – 2020/21		4
Levy option 2 (including MSW)	%	

2011/12 – 2012/13		30
2013/14 – 2015/16		25
2016/17 – 2020/21		20
Cost of material recovery and reprocessing (all waste streams)	$/tonne	100
Lost commodity value of landfill waste	$/tonne	70
GHG emission factors (AGO)		
MSW	CO2-e/kg	1000
C&I	CO2-e/kg	1100
C&D	CO2-e/kg	300
Regulated	CO2-e/kg	1100
Higher Hazard	CO2-e/kg	1100
Cost of tCO2-e	$/tonne	25
Population breakdowns		
Inside the levy area	%	94[a]
Outside the levy area	%	5
Gross State Product growth rates		
2011/12	%	4.5
2012/13	%	4.75
2013/14 – 2020/21	%	4.0
Inflation rate	%	2.5
Discount rate	%	6.0
Costs of the waste levy		
Levy implementation costs	$	5,360,000
Ongoing levy administration and compliance costs (year 1)	$	2,293,253
Ongoing levy administration and compliance costs (years 2-10)	$ p.a.	1,490,231
Business start-up costs	$	2,292,460
Business ongoing operating and compliance costs	$ p.a.	1,727,564

a Although 95% of Queensland's population is to be captured under the waste levy, DERM has estimated that 1% of the waste generated by the included population will be exempt from the levy. A proportion of 94% has therefore been applied to the tonnage projections for the whole of Queensland.

C Summary of costs and benefits by year and waste stream

Table C.1 Benefits and costs by year ($)

	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21
Benefits										
Resource savings										
MSW	2,258,694	2,365,982	3,690,932	3,838,570	3,992,112	5,535,729	5,757,158	5,987,445	6,226,943	6,476,020
C&D	5,338,141	5,591,702	8,723,056	9,071,978	9,434,857	13,083,002	13,606,322	14,150,574	14,716,597	15,305,261
C&I	2,891,894	3,029,259	4,200,572	4,368,595	4,543,339	5,906,340	6,142,594	6,388,298	6,643,830	6,909,583
Regulated	45,460	47,619	49,524	51,505	53,565	55,708	57,936	60,254	62,664	65,170
Higher Hazard	-	-	-	-	-	-	-	-	-	-
Reduced landfill waste (economic)										
MSW	1,936,024	2,027,985	3,163,656	3,290,203	3,421,811	4,744,911	4,934,707	5,132,096	5,337,379	5,550,875
C&D	4,575,549	4,792,888	7,476,905	7,775,981	8,087,020	11,214,001	11,662,561	12,129,064	12,614,226	13,118,795
C&I	2,478,766	2,596,507	3,600,490	3,744,510	3,894,290	5,062,577	5,265,081	5,475,684	5,694,711	5,922,500
Regulated	38,966	40,817	42,449	44,147	45,913	47,750	49,660	51,646	53,712	55,860
Higher Hazard	-	-	-	-	-	-	-	-	-	-
Reduced landfill waste (environmental)										
MSW	838,944	878,793	1,370,918	1,425,754	1,482,785	2,056,128	2,138,373	2,223,908	2,312,864	2,405,379
C&D	648,203	678,992	1,059,228	1,101,597	1,145,661	1,588,650	1,652,196	1,718,284	1,787,015	1,858,496
C&I	1,177,414	1,233,341	1,710,233	1,778,642	1,849,788	2,404,724	2,500,913	2,600,950	2,704,988	2,813,187
Regulated	18,509	19,388	20,163	20,970	21,809	22,681	23,588	24,532	25,513	26,534
Higher Hazard	-	-	-	-	-	-	-	-	-	-
Levy revenues										
MSW	55,338,011	59,415,731	62,690,871	66,828,469	71,239,148	75,158,035	80,118,466	85,406,285	91,043,099	97,051,944
C&D	130,784,444	140,421,623	148,162,007	157,940,699	168,364,786	177,626,585	189,349,939	201,847,035	215,168,939	229,370,089
C&I	46,752,282	50,197,341	52,958,712	56,453,987	60,179,951	63,483,579	67,673,495	72,139,946	76,901,183	81,976,661
Regulated	3,214,669	3,451,549	3,679,352	3,922,189	4,181,053	4,457,003	4,751,165	5,064,742	5,399,015	5,755,350
Higher Hazard	7,683,600	8,249,785	8,794,271	9,374,693	9,993,422	10,652,988	11,356,085	12,105,587	12,904,556	13,756,257
Total benefits – Levy option 1	205,647,897	220,350,811	240,476,962	255,649,493	271,795,454	295,605,588	314,091,535	333,756,596	354,676,949	376,933,743
Total benefits – Levy option 2	266,019,570	285,039,302	311,393,339	331,032,489	351,931,310	383,100,391	407,040,239	432,506,330	459,597,234	488,417,961

Costs										
Illegal dumping – levy option 1	547,677	573,691	447,479	465,378	483,993	335,569	348,992	362,951	377,469	392,568
Illegal dumping – levy option 2	2,053,787	2,151,342	1,864,496	1,939,076	2,016,639	1,677,844	1,744,958	1,814,756	1,887,346	1,962,840
Material recovery and reprocessing										
MSW	3,226,706	3,379,975	5,272,761	5,483,671	5,703,018	7,908,185	8,224,512	8,553,493	8,895,632	9,251,458
C&D	7,625,915	7,988,146	12,461,508	12,959,968	13,478,367	18,690,002	19,437,602	20,215,106	21,023,711	21,864,659
C&I	4,131,277	4,327,512	6,000,817	6,240,850	6,490,484	8,437,629	8,775,134	9,126,140	9,491,185	9,870,833
Regulated	64,943	68,028	70,749	73,579	76,522	79,583	82,766	86,077	89,520	93,100
Higher Hazard	-	-	-	-	-	-	-	-	-	-
Levy implementation costs	5,360,000	-	-	-	-	-	-	-	-	-
Levy administration and compliance costs	2,293,253	1,527,487	1,565,674	1,604,816	1,644,936	1,686,060	1,728,211	1,771,416	1,815,702	1,861,094
Business start-up costs	2,292,460	-	-	-	-	-	-	-	-	-
Business operating and compliance costs	1,727,564	1,770,753	1,815,022	1,860,397	1,906,907	1,954,580	2,003,445	2,053,531	2,104,869	2,157,491
Levy payments										
MSW	55,338,011	59,415,731	62,690,871	66,828,469	71,239,148	75,158,035	80,118,466	85,406,285	91,043,099	97,051,944
C&D	130,784,444	140,421,623	148,162,007	157,940,699	168,364,786	177,626,585	189,349,939	201,847,035	215,168,939	229,370,089
C&I	46,752,282	50,197,341	52,958,712	56,453,987	60,179,951	63,483,579	67,673,495	72,139,946	76,901,183	81,976,661
Regulated	3,214,669	3,451,549	3,679,352	3,922,189	4,181,053	4,457,003	4,751,165	5,064,742	5,399,015	5,755,350
Higher Hazard	7,683,600	8,249,785	8,794,271	9,374,693	9,993,422	10,652,988	11,356,085	12,105,587	12,904,556	13,756,257
Total costs – Levy option 1	212,478,083	218,575,916	235,955,591	250,896,557	266,800,422	287,403,577	305,506,835	324,772,531	345,276,148	367,098,102
Total costs – Levy option 2	272,548,911	282,949,273	305,336,240	324,682,395	345,275,233	371,812,073	395,245,779	420,184,113	446,724,757	474,971,775
Net benefits – Levy option 1	**-6,830,186**	**1,774,896**	**4,521,372**	**4,752,937**	**4,995,033**	**8,202,011**	**8,584,701**	**8,984,064**	**9,400,801**	**9,835,642**
Net benefits – Levy option 2	**-6,529,341**	**2,090,031**	**6,057,100**	**6,350,095**	**6,656,077**	**11,288,320**	**11,794,462**	**12,322,215**	**12,872,478**	**13,446,186**