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Cost Benefit Study of a Tasmanian Container Deposit System – Final Report

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Abbreviations

ABS	Australian Bureau of Statistics
C&T	Collection and Transport
C&I	Commercial and Industrial
CAGR	Compound Annual Growth Rate
CBA	Cost Benefit Analysis
CBS	Cost Benefit Study
CDL	Container Deposit Legislation
CDS	Container Deposit Scheme
COAG	Council of Australian Governments
DPIPWE	Department of Primary Industries, Parks, Water & Environment
LGA	Local Government Association
MFA	Material Flows Analysis
MRF	Materials Recovery Facility
NLI	National Litter Index
NPV	Net Present Value
OBPR	Office of Best Practice Regulation
PV	Present Value
RVM	Reverse Vending Machine
SCEW	Standing Council on Environment and Water
TFES	Tasmanian Freight Equalisation Scheme
WTP	Willingness to pay

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Executive summary

Marsden Jacob has assessed the costs and benefits of introducing a Container Deposit Scheme (CDS) in Tasmania, a scheme where empty beverage containers are returned to a redemption point for recycling with a refund provided to the redeemer. CDS is known to be an effective way to increase levels of beverage container recycling and reduce litter. CDS is currently operational in South Australia and the Northern Territory, as well as a number of European countries and some states in the USA.

Based on our assessment, a Tasmanian CDS is estimated to result in a net cost of **$86m NPV** (net present value) to the state (calculated over the 21 year period between 2014/15 and 2034/35). This is primarily because there is a high cost of diversion (due to the additional infrastructure necessary to underpin a CDS) relative to the incremental benefits of diversion (the increase in market value of recovered material and avoided existing infrastructure costs). Recognising the inherent uncertainty in projections, sensitivity testing was also undertaken resulting in an 'optimistic' or best case net cost of **$52m NPV** and 'pessimistic' or worst case net cost of **$107m NPV**. That is, under favourable assumptions a CDS is still expected to result in net cost to the state of **$52m NPV**.

In particular, Tasmanian recyclate attracts a lower market value relative to mainland Australia as there is no domestic reprocessing industry and has to be shipped to the mainland, incurring freight costs. The possibility of establishing a domestic recycling industry was investigated, but this was found to be unfeasible given the lack of scale.

One factor that has not been included in the core analysis is an incremental estimate of society's willingness to pay (WTP) for recycling and litter outcomes above the economic and environmental benefits assessed in the study. The incremental WTP value is highly uncertain. A threshold analysis was therefore undertaken to assess the incremental WTP value required for the policy to provide net benefits to society. Based on the threshold analysis, Marsden Jacob finds it unlikely that WTP would be high enough to result in CDS providing a net benefit to Tasmania.

Marsden Jacob has also assessed the financial impact on selected stakeholder groups. This assessment may not be directly compared with the whole-of-state economic assessment as the economic assessment excludes items considered 'transfers'[1]. The net cost of a CDS (cost of infrastructure provision and refunds net value of recovered material) is funded by beverage manufacturers. The beverage industry, and beverage consumers to the extent that these costs are passed on through increases in prices of beverage products, are therefore the most adversely impacted stakeholder, incurring a net cost of **$86m NPV**. Conversely, local government benefit financially by **$28m NPV** through the receipt of refunds on collected material (assuming these refunds are passed on by recyclate processors) and avoidance of some costs associated with existing kerbside recycling.

[1] Transfers are transactions between two parties that result in a change of wealth or welfare between them but do not represent a cost or benefit to the economy since the aggregate economic value of production and consumption remain unchanged. For example, the payment of a container refund at a redemption point is a transfer which does not affect the inherent market value of the container being redeemed. Broadly speaking the sum of the impact to all mutually exclusive stakeholder groups (excluding transfer items) within the Tasmanian economy would equal the net economic impact. However, it is not appropriate to offset the total economic cost of $86m NPV by the benefit to any individual stakeholder (such as the estimated positive $28m NPV impact to local government).

Key study findings

Over the period 2014/15 to 2034/35 a Tasmanian CDS would:

- Reduce beverage container litter by an estimated 6,271 tonnes (a reduction of 35% on baseline volumes);
- Not reduce other types of litter;
- Increase the rate of container recycling to 78%;
- Be likely to result in a total net cost to the state of $86m NPV with a net cost in each year of scheme operation averaging approximately $10m per year[2];
- Be unlikely to produce a net benefit to Tasmania, even when the community's 'willingness-to-pay' is taken into account;
- Not attract sufficient quantities of beverage containers to establish a domestic recycling industry; and
- Be likely to benefit local government by a total of $28m NPV, through collected container redemption and avoidance of kerbside recycling costs.

[2] Note that a net scheme cost of approximately $10m per year results in a Net Present Value (NPV) cost figure ($86m) that is lower than a figured arrived at by simply multiplying the annual cost figure by the study time horizon as the NPV also discounts future year costs/benefits to account for the time value of money.

1. Introduction and overview

1.1 Introduction

The Department of Primary Industries, Parks, Water and the Environment (DPIPWE), EPA Division has commissioned Marsden Jacob to undertake a CBS assessing the expected impact of introducing a Tasmanian CDS, a scheme where empty beverage containers are returned to a redemption point for recycling with a refund provided to the redeemer. South Australia and the Northern Territory currently operate such a scheme. The CBS follows a national study considering ten options for improving the recovery of recyclable packaging materials and reducing litter. These options include three variations of a CDS.

This study also follows a number of Tasmanian CDS studies. In particular, a feasibility study of a CDS for Tasmania **(Hyder Consulting, 2009)** and an assessment of the potential financial impacts of CDS on Local Government in Tasmania **(Equilibrium, 2013)**. In this CBS study, a CBA was undertaken to assess the net cost or benefit from implementing a CDS in Tasmania, as well as identifying major distributional impacts. A CBA systematically compares the costs associated with undertaking a policy option with the anticipated benefits, relative to the 'base case' (expected costs and benefits if that policy option is not pursued) to determine whether the policy is expected to deliver net benefits to society.

Our analysis indicates that a CDS is not expected to deliver net benefits to the state of Tasmania. Key drivers of this outcome are the market value of recovered material, which is lower in Tasmania than on mainland Australia due to freight costs, and the cost of duplicating infrastructure, as Tasmania already operates a kerbside recycling system.

A key uncertainty in this analysis is Tasmanian consumers' Willingness to Pay (WTP) for recycling and/or litter outcomes. In this study, we have considered the *incremental* WTP, as in the amount society values greater recycling and/or less litter, over and above values that can be realised through markets and the value of avoided environmental damage. While Marsden Jacob has estimated the environmental benefits of diverting waste from landfill and the cost saving from reducing litter to clean up, we have not found robust estimates of *incremental* WTP for recycling or litter reduction beyond these market and environmental values. Therefore, a 'threshold analysis' has been undertaken that estimates the incremental value of WTP required for a CDS to be expected to be of benefit to society. This 'threshold value' has then been compared to estimates derived from literature (see **Appendix B:** Community willingness to pay for recycling and litter reduction).

1.2 CDS design analysed

Relating to previous studies

The modelled option closely matches COAG Option 4b **(COAG SCEW, 2011)** of a 'Centralised container refund scheme' and the hybrid model proposed in the Feasibility Study of a Container Deposit System for Tasmania **(Hyder Consulting, 2009)**. This design was assessed as being the most suitable for Tasmania and while other variants are possible these are expected to be either more costly or financially unsustainable.

Operation

Legislation would require every beverage manufacturer and importer, corporate and non-corporate, to register with a single CDS Coordinator. The Single Coordinator could either be a designated not-for-profit business to be responsible for running the scheme or a private contractor selected through competitive tender. The entity would need to be held accountable to strong performance criteria and be overseen by a skills and industry-based Board with experience in resource recovery.

Penalties would apply to any retailer who sells to the consumer an unregistered container. Labelling of containers ('10 cent refund at collection depots') would be required as evidence of registration and penalties would apply for labelling an unregistered container.

The Single Coordinator would be required to contract with collection depots and hubs. Government would not appoint depots, nor adjudicate on what prices the Single Coordinator pays to depots. The Single Coordinator would run a 'clearing house' through which depots and hubs are paid contractually determined amounts to cover their operating costs (including reimbursement for refunds paid). Collection points would likely be a mix of RVMs and depots.

The Single Coordinator would invoice beverage importers and manufacturers for the costs of the scheme on the basis of their market share, not the volume of their containers actually returned, which ensures that depot sorting costs are minimised.

Under this model, there would be no mandated up-front collection of a deposit from the consumer. Instead, beverage importers and manufacturers will incur the costs of the scheme which they may choose to recover through increases in the prices of beverage products. Hence, the Single Coordinator does not collect a deposit and no surplus (otherwise derived from unredeemed deposits) is anticipated in early years. The Single Coordinator will pass on any savings associated with low return rates to all beverage producers in the form of lower fees (or fee rebates).

Refund

Beverage containers would be eligible for a refund of 10 cents for each container returned to an authorised collection depot. The refund is legally fixed at 10 cents regardless of the size of container (within an upper and lower limit), the material from which it is made or the location of the depot collecting it. Depots will be required to make payments to consumers for returned containers in cash or equivalent legal tender. To ensure that the incentive component of the refund is maintained over time, the refund is assumed to increase approximately in line with inflation to 15c in 2025 and to 20c in 2035.

A higher refund rate starting at 20 cents, as suggested in **Hyder Consulting (2009)**, was also considered. A higher refund rate would be more effective at promoting container returns, although it would also provide greater incentives for fraud and greater beverage price impacts and market distortion **(Hyder Consulting, 2009)**. For these reasons a refund rate of 10 cents has been analysed. The impact of a higher refund rate (20 cents) may be extrapolated from core results and therefore while this option has not been explicitly modelled, the implications of adopting a higher refund rate are discussed (see **Section 2.4.3:** Qualitative assessment of other scenarios).

Scope

The scheme would apply to all beverages in liquid or "ready to drink" form intended for human consumption between 100 and 3000 ML in volume. This includes beer, wine, soft drink, water (carbonated and non-carbonated), fruit juice and milk.

1.3 Approach to and scope of analysis

1.3.1 Approach to the analysis

The conceptual approach to the CBA is comprised of the following key elements:

- **Quantities** – The amount of recyclate that is likely to be diverted through the CDS (further segmented into the amount that would have otherwise gone to landfill, through the kerbside system or littered), measured in tonnes;
- **Composition –** The make-up of these segmented quantities in terms of source sector (i.e. municipal kerbside, public place and non-public place), material type (glass, plastics, aluminium, steel and liquid paperboard) and source region[3] (Southern, Northern and North Western Tasmania); and
- **Prices and values –** The market or non-market value of diversion expressed as a net cost or benefit from diversion.

In addition to the assessment of quantities diverted and the unit value ($ per tonne) of that diversion (referred to as 'diversion value' in this study), a number of other costs and benefits (assessed on an annual basis) were assessed, including:

- **Litter reduction –** The reduction in costs of litter as a result of diverting waste to recycling, using avoided litter clean-up costs as a proxy for litter costs;
- **Government regulation –** The costs to government to develop the scheme, appropriate legislative instruments and ongoing administration, compliance and enforcement;
- **Business compliance –** The costs to business to implement regulations, continuously administer and fulfil reporting obligations;
- **Participation** – The value of consumers' time and vehicle expenses, or businesses' expenses (e.g. cleaning cost) to participate in the CDS (collect and return containers to a redemption point); and
- **Producer surplus –** The economic cost of reduced beverage containers sold due to the effect of a price increase resulting from liable entities passing on scheme costs.

All assumptions were derived through a combination of literature review, stakeholder consultation (state government, local government and recycling industry) and Marsden Jacob knowledge of CDS.

Quantity and compositional assumptions were derived through the application of Material Flows Analysis (MFA) (see **Appendix C:** Material flows analysis), drawing primarily on data from the **COAG SCEW (2011)** and other relevant literature. The MFA was undertaken by Marsden Jacob with advice and analysis provided by Warnken ISE. Material quantities were adjusted and reconciled against Tasmanian state specific data obtained during the study **(Equilibrium 2013; Blue Environment 2011; Stakeholder consultations)**. The MFA was undertaken by first projecting waste flows under a base case or 'business as usual' (expected outcomes under current and expected policy and market settings if a CDS was not implemented). The base case is described in **1.3.2:** Assumed

[3] The regional classification adopted in this study matches the structure of regional waste groups of Southern Waste Strategy Authority (Southern), Northern Tasmanian Waste Management Group (Northern) and Cradle Coast Waste Management Group (North West).

base case. Following this, the amount that would be diverted to a CDS was estimated. There were three forms of diversion identified:

1. Material that is delivered to a redemption point that would otherwise been sent to landfill;
2. Material that is delivered to a redemption point that would have otherwise been collected for recycling; and
3. Material that remains in co-mingled recycling collection but is ultimately taken to CDS to obtain container refund.

Details relating to price and value assumptions, as well as the annual costs, are provided in **Appendix A:** Assumptions development. These assumptions incorporated important Tasmanian circumstances (such as the incorporation of freight costs in assessing net market values and relatively higher collection, transport and processing costs compared to mainland Australia).

Finally, the potential to establish a domestic recyclate reprocessing industry was also investigated and further analysis was undertaken to establish distributional impacts to local government and the domestic beverage industry. **Table 1** summarises the costs and benefits included in this study.

Table 1: Costs and benefits

Diversion Value (assessed as $ per tonne)	Other costs and benefits (assessed on annual basis)
Material that is delivered to a redemption point that would otherwise been sent to landfill - Avoided landfill operating costs - Avoided landfill environmental costs - Avoided collection and transport - Market value of material recovered - CDS infrastructure costs	**Litter reduction** **Government regulation** **Business compliance** **Participation costs** - Consumer participation - Businesses participation
For material that is delivered to a redemption point that would have otherwise been collected for recycling - Avoided collection and transport - Avoided MRF processing costs - Avoided landfill operating and environmental costs of the rejected material - The higher market value achieved through greater quantity and quality of recyclate - CDS infrastructure costs	**Producer Surplus**
Material that remains in co-mingled recycling collection but ultimately taken to CDS to obtain container refund - CDS infrastructure costs	

1.3.2 Assumed base case

Beverage container consumption growth of **0.75%** CAGR between 2011 and 2015, **0.73%** CAGR between 2016 and 2020, **0.63%** CAGR between 2020 and 2030 and **0.54%** CAGR between 2021 and 2035, consistent with **COAG SCEW (2011)** is assumed in the base case.

The base case assumes that the variety of initiatives that local government are currently pursuing to improve recycling, such as the introducing of a recycling precinct in the North, bin audits across a number of local governments and education campaigns on appropriate materials to place in kerbside bins are continued in the short term[4]. Additionally, the introduction of a state government landfill levy in Tasmania (as recommended by **Blue Environment (2011)**) is assumed. Currently, there is a voluntary landfill levy applied of between $2/tonne and $5/tonne (**stakeholder consultations**). In the base case, it is assumed that a landfill levy of approximately $10 per tonne will ultimately be adopted in Tasmania between 2015 and 2020. While there are various proposals relating to the potential levy and initiatives that levy proceeds would fund, our economic and distributional assessments of CDS do not assume a direct injection of funds into CDS infrastructure from any future waste levy proceeds.

The effect of these initiatives is expected to continue to increase beverage container recycling rates at **2%** CAGR in the medium term (up to 2020) but in the absence of any other major policy interventions, this growth tapers off after 2020 down to an average of **1%** CAGR between 2021 and 2035.

Tonnes of beverage container recycling under the base case and CDS case are provided in **Section 2.3.1** Recycling projections.

4 Stakeholder consultations revealed that local governments in Tasmania are undertaking initiatives to improve recycling and reduce litter in Tasmania. In particular, this includes bin audits and education to households on appropriate material for kerbside bins.

2. Cost benefit analysis

2.1 CBA overview

A Tasmanian CDS was assessed to be expected to result in a net cost of **$86m NPV** to the state. This is primarily because there is a high cost of diversion (the additional infrastructure necessary to underpin a CDS) relative to the incremental benefits of diversion (the increase in market value of recovered material and avoided existing infrastructure costs).

Note that the net cost of diversion is presented as a single PV figure but the underlying costs and benefits of that figure (CDS infrastructure costs minus incremental market value and minus avoided infrastructure costs) are explored in more detail in the following section. The drivers of diversion value are discussed in the next section (see **Section 2.2:** CBA drivers).

The costs and benefits of introducing a CDS in Tasmania are shown in **Figure 1** and **Table 2**.

Figure 1: Costs and benefits of a CDS in Tasmania

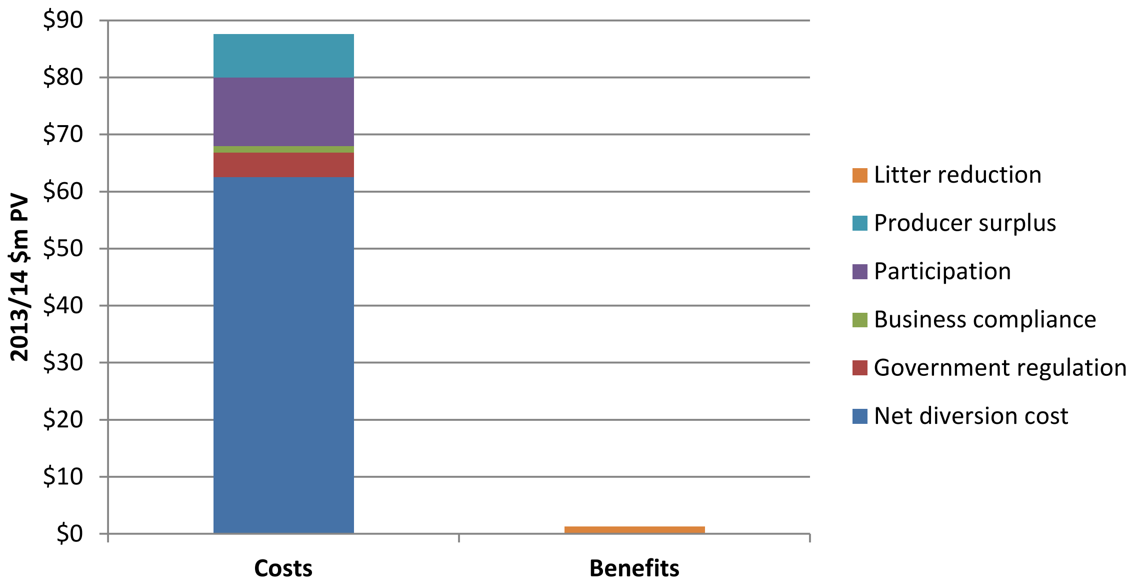


Table 2: Costs and benefits of introducing a CDS

Cost or benefit item	PV over 2014/15 to 2034/35 (2013/14 $m)	Value at scheme introduction (2016/17) (2013/14 $m)	Value in 2024/25 (2013/14$m)	Value in 2034/35 (2013/14$m)
Costs				
Diversion	$63	$5.80	$6.91	$8.68
Government regulation	$4	$0.39	$0.39	$0.39
Business compliance	$1	$0.11	$0.11	$0.11
Participation	$12	$1.08	$1.38	$1.59
Producer surplus	$8	$0.65	$0.80	$1.16
Benefits				
Litter reduction	$1	$0.00	$0.18	$0.25
Net Cost	**$86m**[5]	**$8.0**	**$9.4**	**$11.7**

Following diversion, participation (the time, vehicle travel and business expense cost for households and businesses to redeem containers) is the next highest cost item. This is followed by lost producer surplus which results as the domestic beverage industry is expected to increase the price of beverage products to offset scheme costs, resulting in lower demand and sales. Other costs include the participation (the value of time, travel cost and additional business expenditure incurred to redeem containers), business compliance (primarily labelling of containers and reporting against the scheme) and government regulation.

Avoided costs of litter clean-up are small by comparison. This reflects the relatively small volume of litter (relative to total quantities of beverage packaging consumed and recycled) and the relatively low cost of cleaning up that litter.

2.2 CBA drivers

2.2.1 Diversion value

Diversion value refers to the cost of diversion (the additional infrastructure necessary to underpin a CDS) relative to the incremental benefits of diversion (the increase in market value of recovered material and avoided existing infrastructure costs). There are three types of diversions (changes to material flows relative to the base case) that can occur:

1. Material that would have gone to landfill and is now assumed to be directly redeemed;
2. Material that would have been put in a co-mingled bin and is now assumed to be directly redeemed; and

[5] Note that the PV of costs and benefits (and net cost) is rounded to the nearest million dollars. Therefore, the sum of individual rounded figures may not equal the rounded sum.

3. Material that would have been put in a co-mingled bin and is assumed to be still retained in that bin but is ultimately dropped off[6] at a redemption point to obtain the refund.

Figure 2, **Figure 3**, **Figure 4** and **Table 3** below provide the costs and benefits resulting from this diversion.

Figure 2: Costs and benefits ($/t) resulting from diversion from landfill

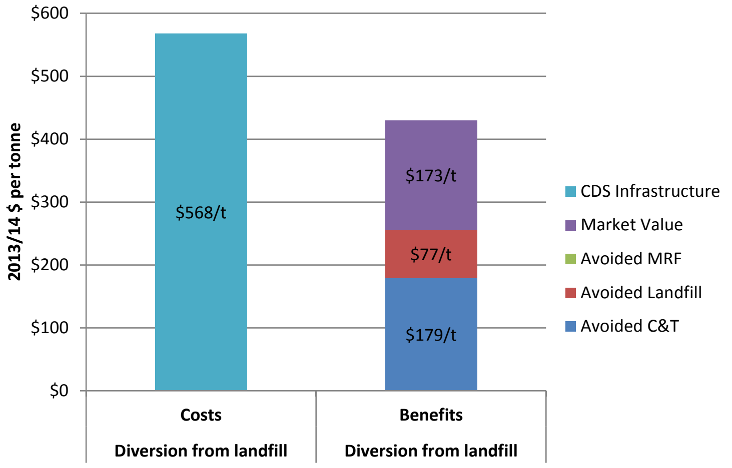
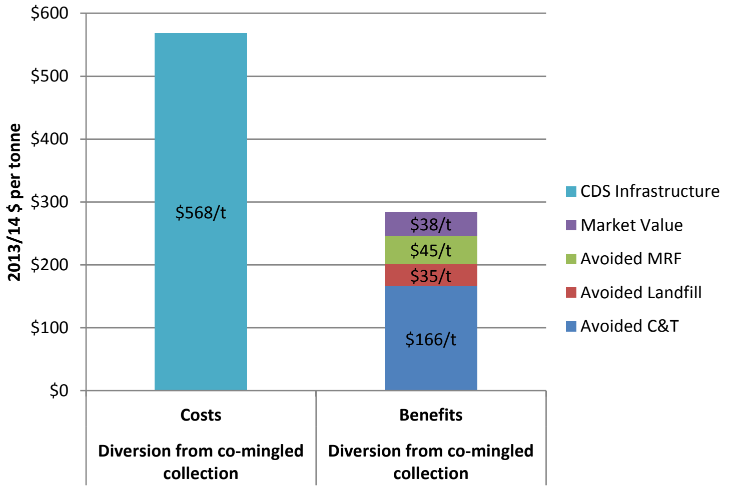


Figure 3: Costs and benefits ($/t) resulting from diversion from co-mingled collection



6 It is assumed that MRF operators would ultimately redeem containers at a redemption point and this benefit is passed on to Local Government through reduced processing fees.

Figure 4: Costs and benefits ($/t) resulting for material remaining in co-mingled collection

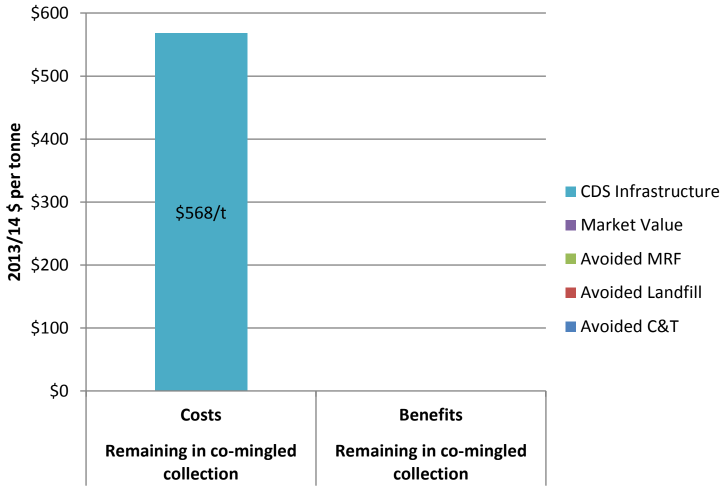


Table 3: Costs and benefits resulting from diversion

Cost or benefit item[7]	Diversion from landfill ($/tonne)	Diversion from co-mingled collection ($/tonne)	Remaining in co-mingled collection ($/tonne)
Benefits			
Avoided C&T	$179	$166	n/a
Avoided Landfill	$77	$35	n/a
Avoided MRF	n/a	$45	n/a
Market Value	$173	$38	n/a
Costs			
CDS Infrastructure	$568	$568	$568
Net Cost	**$138**	**$284**	**$568**

Diversion from landfill provides the largest gross benefit (or lowest net cost) as a relatively large increase in market value is achieved through recovering material for recycling. Diversion from co-mingled collection provides some increase market value (through increases in the quantity and quality of recyclate recovered), although this is much lower than diversion from landfill. Whereas material remaining in co-mingled bin incurs a large net cost as the material propagates through existing infrastructure (collection and processing) as well as CDS infrastructure.

[7] Figures in this table are rounded to the nearest dollar. Therefore, the sum of individual rounded figures may not equal the rounded net cost.

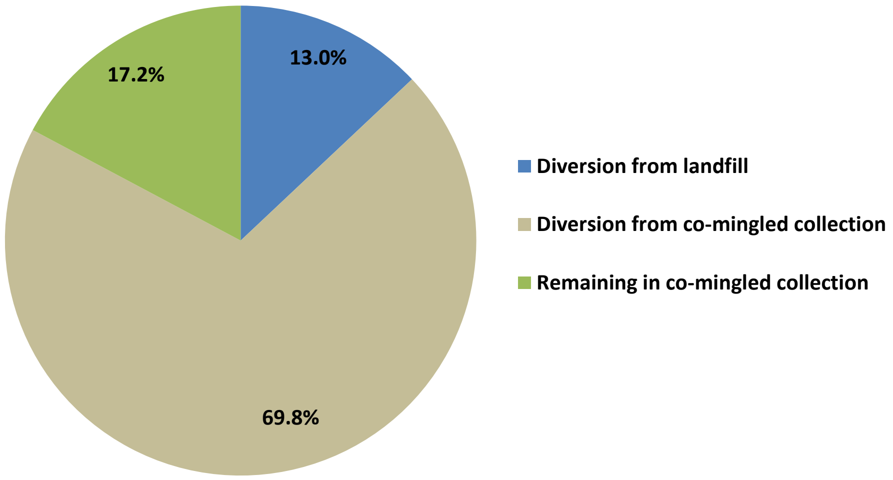
In all cases, the costs of CDS infrastructure are higher than the benefits. This is in part driven by the relatively lower market value of recyclate from the island.

2.2.2 Duplication of existing infrastructure

While there may be the ability to leverage off existing waste infrastructure (and this has been assumed in the estimation of costs) a CDS will result in the duplication of some infrastructure. With the introduction of a CDS, waste producers may return containers to a direct redemption point (such as an RVM or depot) or continue to put containers in co-mingled recycling. Thus, both sets of infrastructure need to be maintained at a higher cost than in the base case (or in an alternative case where a CDS is introduced in place of a kerbside recycling system).

Additionally, the incremental recycling outcomes are only achieved when material is redeemed through a CDS and that material would have otherwise gone to landfill. This is a relatively small proportion (shown as the blue segment in the pie chart below).

Figure 5: Disaggregation of diversion in 2024/25



There is some additional recycling through diversion from the co-mingled bin but none for material remaining in the co-mingled bin.

2.3 Recycling and litter projections

CDS provides a financial incentive to increase recycling and reduce litter. In doing so it provides a much stronger signal to recycle than in the base case. Material eligible for CDS that would otherwise have been sent to landfill is now recycled. Furthermore, some litter is avoided and there is a financial incentive to remove litter that remains.

2.3.1 Recycling projections

A maximum beverage container collection[8] rate of 85% (consistent with existing CDS schemes including South Australia) is assumed. The recovery rate is assumed to increase gradually over time with a step increase at scheme introduction and gradually increasing to 26,590 tonnes per year and a recovery rate of 78.1% (reflecting the maximum collection rate of 85%) by 2034/35 as illustrated in **Figure 6** below.

Figure 6: Increase in beverage container recycling with CDS

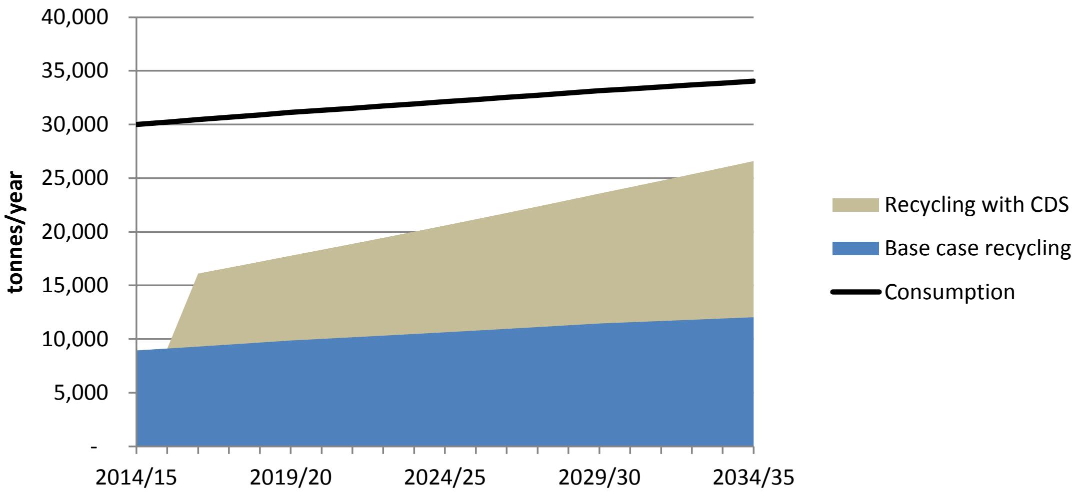


Table 4: Increase in beverage container recycling with CDS

Beverage container consumption/recycling	Cumulative from 2014/15 to 2034/35 (tonnes)	Annual at scheme introduction (2016/17) (tonnes)	Annual in 2024/25 (tonnes)	Annual in 2034/35 (tonnes)
Consumption	674,001	30,451	32,115	34,044
Base case recycling	222,585	9,299	10,631	12,037
Recycling with CDS	421,666	16,108	20,586	26,590
Increase with CDS	**199,081**	**6,809**	**9,955**	**14,553**

In the absence of a CDS total beverage container recovery rate is expected to increase from **31%** in 2016/17 to **35%** in 2034/35, whereas beverage container recovery rate is expected to be **53%** in 2016/17 and **78%** in 2034/35 under a CDS.

8 Collection refers to the amount (or rate) of material collected for recycling some of which may not be recovered due to issues such as glass breakage or contamination. Recovery refers to the amount (or rate) actually recycled.

2.3.2 Litter

Litter is reduced as there is less material 'available to be littered'[9] and a lower 'propensity to litter'. However, it is important to note that a CDS is only effective at reducing items of beverage litter and other litter (e.g. cigarette butts, take-away containers etc.) will not be affected.

Figure 7: Beverage container litter reduction with CDS

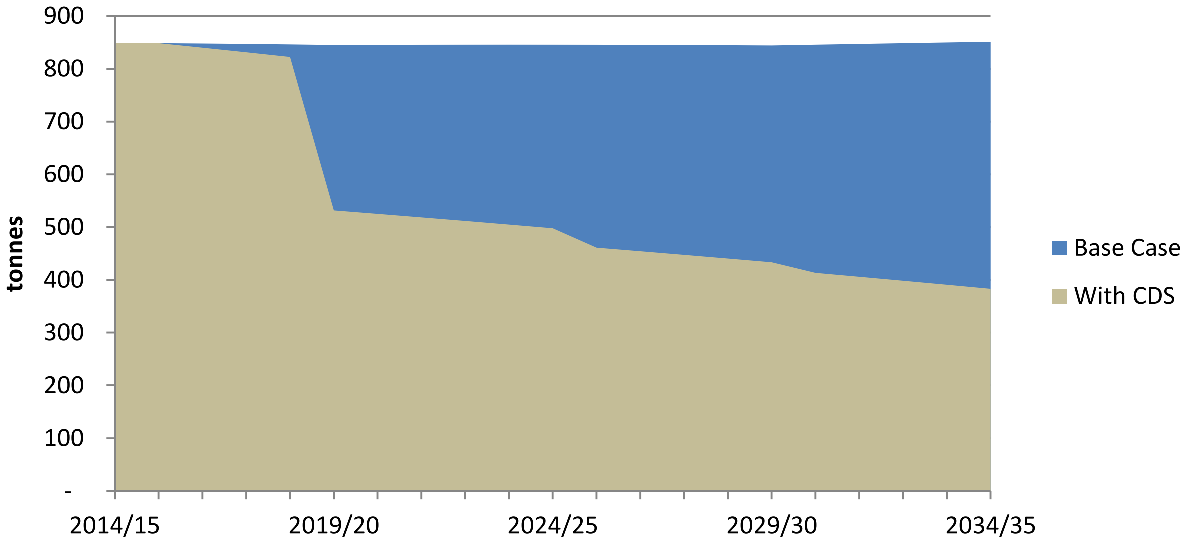


Table 5: Beverage container litter reduction with CDS

Beverage container litter	Cumulative from 2014/15 to 2034/35 (tonnes)	Annual at scheme introduction (2016/17) (tonnes)	Annual in 2024/25 (tonnes)	Annual in 2034/35 (tonnes)
Base Case	17,780	848	846	851
With CDS	11,509	840	498	383
Reduction with CDS	**6,271**	**8**	**348**	**468**

9 Litter is calculated by applying a 'propensity to litter' factor to material that is not sent for recycling and is therefore assumed to be 'available to litter'. In this way, the propensity to litter reflects the proportion of material available to be littered that is actually littered (as opposed to being sent to landfill).

2.4 Sensitivity and threshold analysis

2.4.1 Sensitivity tests performed

It is apparent from the results from the central analysis that the primary driver of expected net benefit/cost is the value of diversion. In developing data assumptions, a number of assumptions were found to be particularly uncertain and have the potential to either be higher than assumed or lower than assumed. The cumulative effect of key variables with the potential to improve the diversion value was estimated and modelled as an 'optimistic' scenario and the cumulative effect of key variables with the potential to worsen the diversion value was estimated and modelled as a pessimistic scenario. Specifically:

- The ***optimistic scenario*** assuming 50% lower net diversion costs from higher long run **commodity prices** and **market values**, lower **CDS infrastructure costs** through maximising synergy with existing infrastructure and the potential to establish some additional **reprocessing capacity** in Tasmania (providing value add to the economy); whereas
- The ***pessimistic scenario*** assuming 30% higher net diversion costs from lower avoided **collection and processing costs** (if reductions in throughput cannot be translated into the extent of cost savings assumed) and a lower current **reject rate** of material from co-mingled collection (and therefore lower improvement in salvage rate through CDS).

Variations to the social discount rate to **3%** and **10%** (whereas 7% is assumed in the central case) in accordance with the Office Best Practice Regulation guidelines **(OBPR, 2013)** have also been modelled.

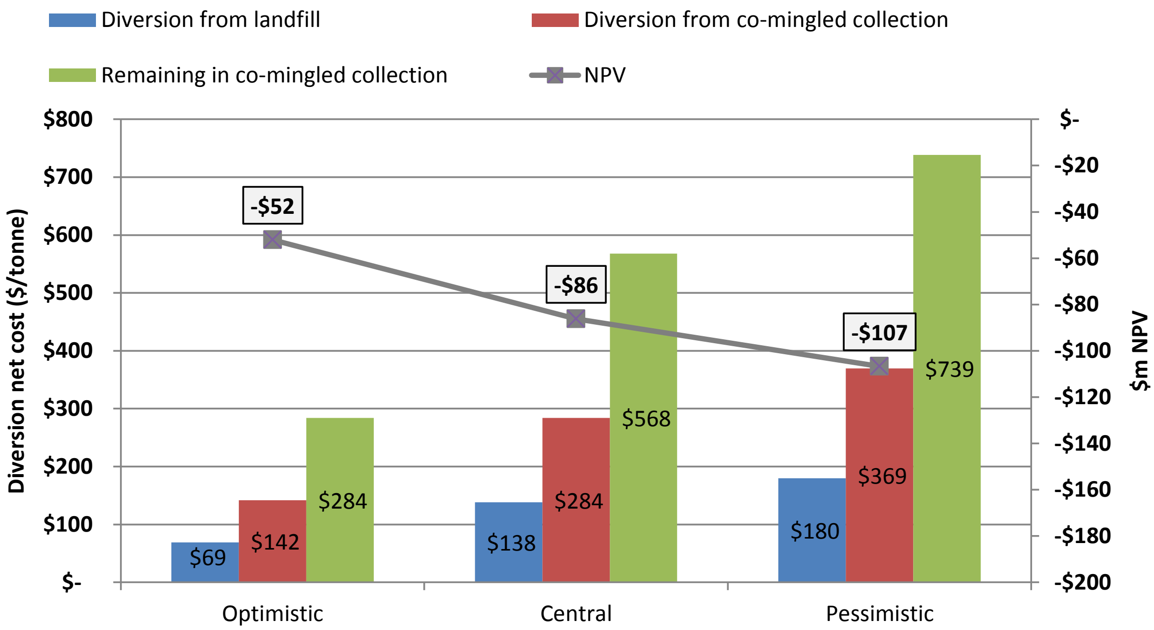
Finally, a threshold analysis was undertaken to determine the value of WTP for outcomes over and above benefits already accounted for in the analysis was undertaken.

2.4.2 Results of sensitivity analysis

Optimistic and pessimistic and scenarios

The average estimated diversion values and NPV in the pessimistic and optimistic scenarios are compared with the central scenario in **Figure 8** below.

Figure 8: Optimistic and pessimistic scenario results

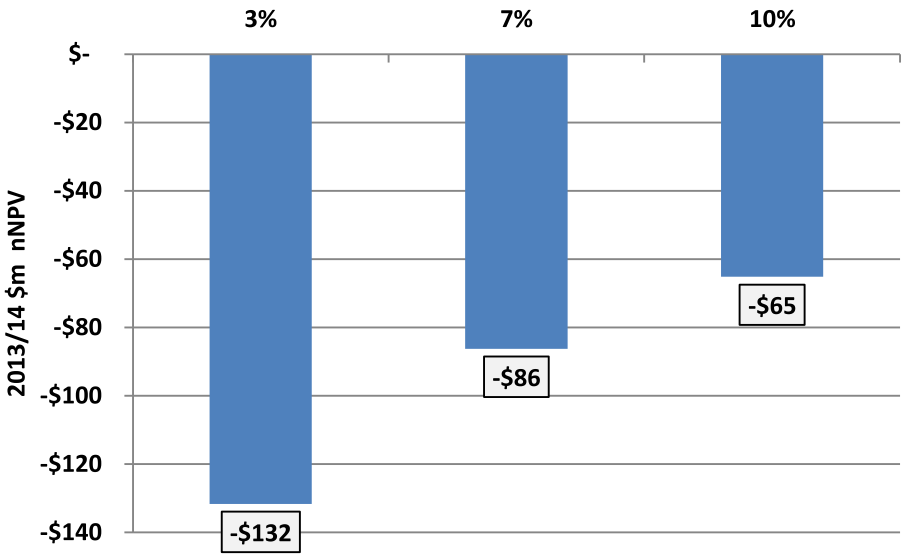


In all scenarios, implementation of a CDS is expected to result in a net cost to society.

Variation of discount rate

The NPVs from applying a 3%, 7% and 10% social discount rate are compared in **Figure 9** below.

Figure 9: Discount rate scenario results



A higher discount rate reduces the magnitude of the NPV (since future costs and benefits are more heavily discounted). In this study, a change to the discount rate[10] is not expected to change the sign of the NPV given that annual net benefit is consistently negative throughout the study period.

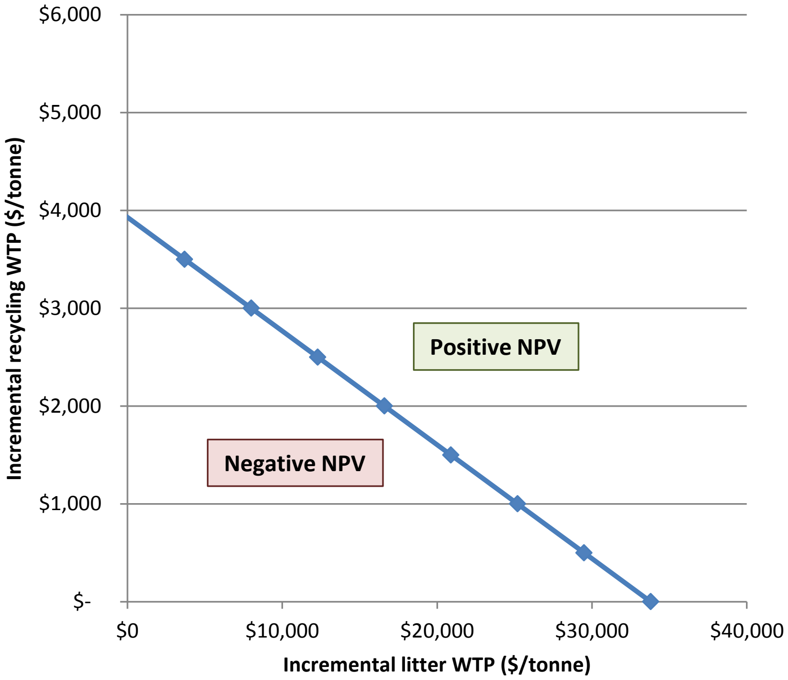
WTP threshold analysis

Breakeven values of incremental WTP for litter and recycling outcomes (above those already captured in the central scenario) were calculated using 'threshold analysis'. The results of this analysis are presented in **Figure 10** below.

The x-axis value (incremental litter WTP) and y-axis value (incremental recycling WTP) for all points above the blue line below, represent sets of incremental WTP values that would lead to a positive NPV. Conversely, the x-axis value and y-axis value for all points below the blue line below, represent sets of incremental WTP values that would lead to a negative NPV.

10 A variation to the discount rate in the CBA is more likely to affect the conclusion (positive or negative NPV) when there is a greater variation in annual positive and negative net benefits during the study period (e.g. initial large cost followed by many years of varying positive benefits etc.)

Figure 10: Threshold analysis results



Note that the origin (nil incremental WTP values) is equivalent to the central case. Breakeven values of incremental WTP lie along the blue line above. For example, the following sets of incremental WTP values would result in a zero NPV:

- $0/t for recycling and approximately $34,000/t for litter reduction;
- Approximately $4,000/t for recycling and $0/t for litter reduction; and
- Approximately $2,000/t for recycling and $17,000/t for litter.

Our assessment of these results is that WTP values are unlikely to be greater than the threshold values identified. For example, an incremental WTP for recycling of $4,000/t is over 18 times the current average market value of a composite tonne of beverage container material and over 13 times the combined sum of average market value and avoided landfill costs (both financial and environmental). Similarly, an incremental WTP for litter reduction of $34,000 is approximately 60 to 70 times the amount that is currently paid to clean-up litter.

These threshold values for incremental WTP are very unlikely and this is reinforced through our study of the relevant literature (see **Section Appendix B:** Community willingness to pay for recycling and litter reduction).

Conclusion from sensitivity analysis

The range of sensitivity test performed support the conclusions derived from central case results. That is, the implementation of a CDS is expected to result in a net cost to society. However, the net costs to society may be lower, should circumstances prove to be more favourable to the policy (particularly if commodity prices are higher than expected and scheme costs are lower than expected) or if it is assumed that society is willing to pay more for recycling and litter outcomes than already accounted for by economic and environmental values assumed in this study.

2.4.3 Qualitative assessment of other scenarios

Two additional scenarios where considered qualitatively.

Firstly, the introduction of a state government landfill levy in Tasmania has been previously recommended **(Blue Environment, 2011)**. Currently, there is a voluntary landfill levy applied of between $2/tonne and $5/tonne (**stakeholder consultations**). In the base case, it is assumed that a landfill levy of approximately $10 per tonne will ultimately be adopted in Tasmania. This is a policy consistent with a number of other Australian jurisdictions, albeit at a lower level. If the levy is not introduced, this would reduce the amount of recycling in the base case and increase the amount of recycling with a CDS. The effect of this would be to amplify the cost of CDS to Tasmania (through greater diversion costs). While it has not been a subject of this study, the introduction of a landfill levy can be expected to result in an increase in recycling without the associated additional infrastructure costs of a CDS.

Secondly, a higher refund amount (such as a 20 cent starting refund rate) could also be expected to increase diversion compared to the assumed 10 cent starting refund rate. Similar to assuming no landfill levy in the base case, increased diversion would result in an amplification of the cost of CDS to Tasmania.

3. Distributional impacts

3.1 Local government

Local government is expected to benefit through the introduction of a CDS as the value of material remaining in co-mingled bin is expected to increase (assuming this value is realised by processors passing on the benefit of refunds through to local government), the avoidance of infrastructure costs for material that is diverted from co-mingled bin (although there is some loss of market value associated with the loss of this material) and through avoidance of infrastructure costs for material that is diverted from general waste.

The diversion value from a local government perspective is provided in **Figure 11**, **Figure 12** and **Figure 13** and **Table 6**. The following assumptions have been made in estimating these benefits:

- Benefit estimates include only the kerbside service and not public place services (although these are much lower in comparison) and exclude the avoided costs of litter clean-up (estimated as a separate line item); and
- The estimation of landfill benefits also includes environmental benefits (although these would not directly accrue to local government per se).

Total benefit estimated at a PV of **$28m** and approximately **$3m** per year (starting lower but increasing over time as diversion increases). The extent to which local government would save on conventional infrastructure costs is highly contentious and Marsden Jacob has adopted a balanced position based on consideration of stakeholder comments and literature evidence (see **Sections A.3:** Avoided costs of collection and transport and **A.5:** Avoided cost of processing material at MRF).

Our conclusions are consistent with a recent study specifically focussing on local government conducted by **Equilibrium (2013)**, however our benefit estimate is higher. The following differences in study approach would have contributed to this difference:

- While **Equilibrium (2013)** noted that there is a higher reject rate in Tasmania, the effect of rejected material does not appear to have been explicitly included. Inclusion of this effect leads to a higher benefit estimate as there is a lower loss of counterfactual market value of material in the co-mingled bin;
- **Equilibrium (2013)** noted that market values in Tasmania are lower than mainland Australia, however, a national value from **COAG SCEW (2011)** was applied as a proxy. Reducing market values to account for freight costs (see **Section A.4:** Market value of recovered material), as done in this study, also has the same effect of lowering the ‘lost market value’ and therefore increasing benefit estimates
- Marsden Jacob has also included the benefit of avoided general waste collection and infrastructure costs as a result of material being diverted from landfill; and
- Marsden Jacob has included the avoided environmental costs of general waste sent to landfill as a notional benefit accruing to local government (relatively low in comparison).

Figure 11: Costs and benefits ($/t) to local government of diversion from landfill

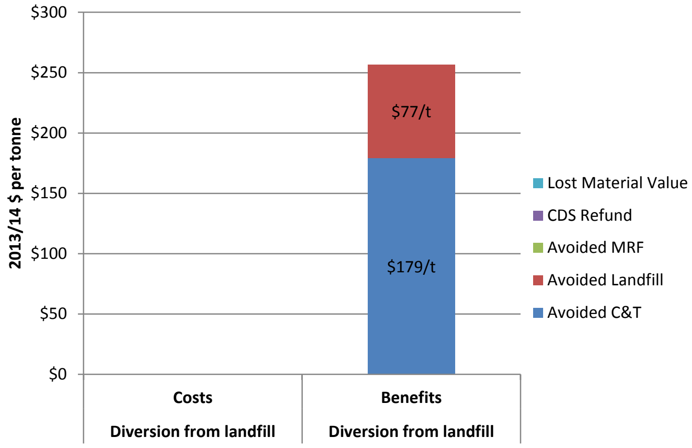


Figure 12: Costs and benefits ($/t) to local government of diversion from co-mingled collection

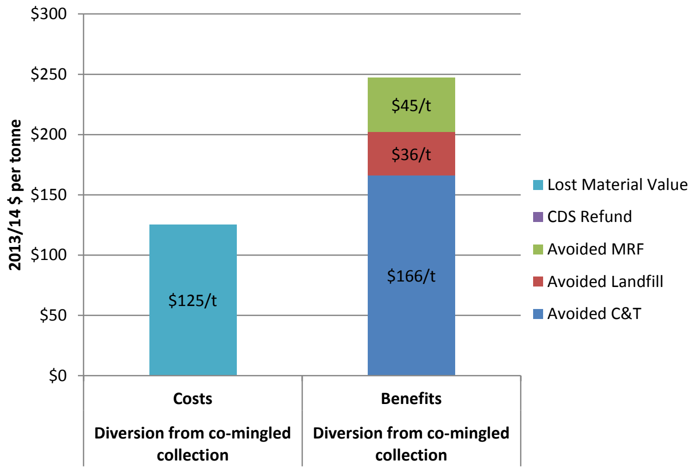


Figure 13: Costs and benefits ($/t) to local government of material remaining in co-mingled collection

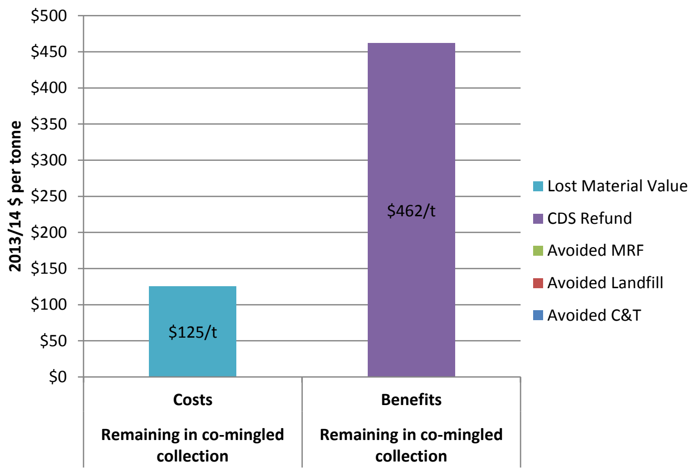


Table 6: Costs and benefits to local government

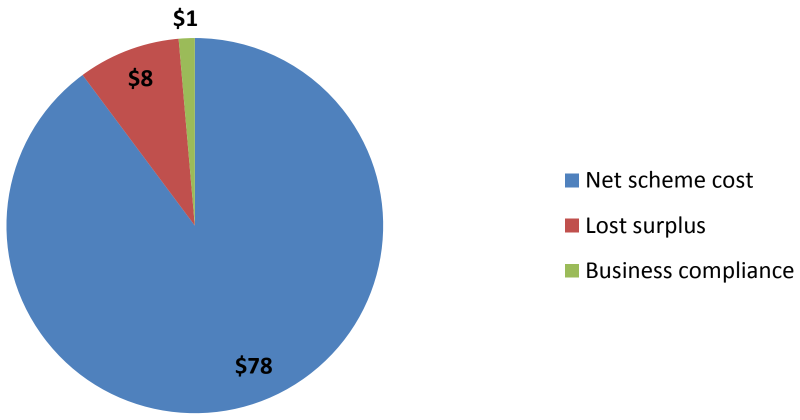
Cost or benefit item[11]	Diversion from landfill ($/tonne)	Diversion from co-mingled collection ($/tonne)	Remaining in co-mingled collection ($/tonne)
Benefits			
Avoided C&T	$179	$166	n/a
Avoided Landfill	$77	$36	n/a
Avoided MRF	n/a	$45	n/a
CDS Refund	n/a	n/a	$462
Costs			
Lost market value	n/a	$125	$125
Net Benefit	**$257**	**$122**	**$337**

3.2 Beverage industry and consumers

The net cost of a CDS (cost of infrastructure provision and refunds net value of recovered material) is funded by beverage manufacturers (or beverage consumers if this cost is passed on through higher prices of beverage products). Therefore beverage industry and consumers are expected to incur a net cost of **$86m**. This is comprised of the net cost of the scheme, lost producer surplus and costs of complying with regulation.

11 Figures in this table are rounded to the nearest dollar. Therefore, the sum of individual rounded figures may not equal the rounded net cost.

Figure 14: Costs to beverage industry and consumers[12]



The extent of loss of surplus depends primarily on net costs of the scheme (as it is these costs that are potentially passed on through higher prices, resulting in lower demand and sales). Net costs in turn are comparatively higher for a Tasmanian CDS due to lower market value (market value offsets the cost of the scheme through revenue earned from recyclate sales).

3.3 Other

Other stakeholders include state government that incur the costs of regulation (estimated at **$4m PV**). Additionally, a CDS is also expected to benefit the environment (this has been included as a benefit of avoiding landfill and notionally accruing to local government).

12 Figures in this chart are rounded to the nearest million dollars. Therefore, the sum of individual rounded figures may not equal the rounded net cost.

Appendix A. Assumptions development

A.1. Avoided costs of landfill

Beverage containers that would have been sent to landfill but are expected to be diverted through CDS if a CDS were to be implemented would result in lower landfill costs than otherwise. In this case, the full economic cost of landfill must be considered. The full economic cost includes both market costs (financial costs incurred by landfill operator) and non-market costs (environmental damage that may result from landfilling).

Market costs have been estimated through either published landfill fees or direct discussions with landfill operators. These fees have been adjusted to remove the landfill levy component as in a CBA such items are considered 'transfers' (monetary transactions between parties that do not involve employment of any economic resources such as capital or labour).

Non-market costs have been estimated based on a study by **BDA Group (2009)**, which estimates the private and non-market costs for landfill in Australia. Costs are estimated according to landfill size (small, medium and large) and landfill location (urban or rural). Costs are also provided by best controls/climate and poorest controls/climate. By size classification, Tasmanian landfills are either small (less than 10,000 tonnes per year) or medium (between 10,000 and 100,000 tonnes per year). Environmental controls are relatively sound at major landfills included Hobart City Council, Glenorchy City Council, Launceston Council and Dulverton landfills. Notably, all these landfills with the exception of Dulverton have fitted methane gas capture equipment (the largest contributor to non-market costs) whereas Dulverton expects to install gas capture by 2014/15 **(Dulverton Waste Management, 2012)**. Limited information for level of controls on smaller landfills is available. Therefore a profile based on a mix of predominantly medium sized urban landfills with strong controls and smaller rural landfills with poor controls has been assumed and the relativities of non-market costs to private costs from **BDA Group (2009)** have been applied to provide a total cost.

The assumed costs are summarised in **Table 7** below.

Table 7: Assumed avoided landfill costs

Region	Market costs ($/tonne)	Non-market costs ($/tonne)	Total cost ($/tonne)
Southern	$56.95	$6.32	$63.27
Northern	$75.00	$8.32	$83.32
North West	$86.55	$9.60	$96.14

Sources: Glenorchy Landfill website[13], Launceston Council website[14], Stakeholder consultations, Phone call to Dulverton landfill, BDA Group (2009)

13 http://www.gcc.tas.gov.au/content/Landfill_Disposal_Charges.GCC?ActiveID=1336,

14 http://www.launceston.tas.gov.au/lcc/index.php?c=371

A.2. Avoided costs of litter

There are two main benefits delivered through litter reduction. The first is that it avoids the cost of clean-up. Secondly, there is a potential willingness to pay that is additional to the cost of clean-up resulting from benefits such as improvements to visual amenity, health and ecological impacts.

The benefit of avoided litter has therefore been accounted for in two aspects of our analysis. Firstly, the estimate of diversion value, includes the avoided costs associated with reduced clean-up, whereas willingness to pay for reduced litter is captured in our analysis of willingness to pay more generally (see **Appendix B**: Community willingness to pay for recycling and litter reduction).

Avoided costs associated with reduced clean-up have been estimated through reference to national sources due to lack of availability of Tasmanian specific costs. A weighted average tonne of litter of **$526.55** has been estimated using Clean Up Australia data **(Clean Up Australia, 2010)** and Victorian Local Government data **(Sustainability Victoria, 2011)**.

A.3. Avoided costs of collection and transport

Introducing a CDS in Tasmania will lead to less volumes of material being transported through the kerbside collection system than otherwise as material is delivered directly to a depot or to an RVM. Stakeholder consultations revealed that there are divergent views on the extent to which this would reduce costs of collections and transport.

On the one hand it is argued that collections are often charged on per lift rather than on a per weight basis and that a high proportion of collections costs are fixed. Furthermore, costs savings may not be achieved immediately but possibly in the long run. On the other hand, a large proportion of collection costs are in-fact variable based on weight (e.g. cost of fuel, wear-and-tear on collection vehicles, size of fleet and number of trips required etc.).

Marsden Jacob has estimated that 70% of current collection and transport costs may be saved through reduced kerbside collection volumes, based on cost data from **DEC NSW (2004)**, **Nolan ITU et al. (2001)**, **Victorian Jurisdictional Recycling Group (2002)**. The data suggests that approximately 85% of costs may be variable. However, a lower estimate is assumed to account for uncertainty (a step change may be needed to significantly reduce costs whereas a marginal reduction may not) and potential lag in realisation of cost savings. In deriving this estimate we recognise that:

- There are a certain proportion of costs that are fixed;
- Costs savings will not be realised immediately but over time as operations adjust to lower volumes; and
- While many councils may be currently charged on a per lift basis and some contracts may be in place for many years in the future, there is a distinction between financial costs (actually transacted in the market) and true economic costs (actual costs incurred to provide the service) and for this study we are primarily interested in the latter.

This factor of 70% has been applied to estimates of total Tasmanian collection and transport costs which are estimated to range from $150 to more than $400 per tonne **(Equilibrium, 2013)**. **Equilibrium (2013)** also found that:

- The Southern region generally enjoys some of the most competitive rates in Tasmania;
- There is a wide range in the per service and per tonne costs for collection in the Northern region; and
- Collection costs for the North West region are the highest in Tasmania.

On this basis the following average total and long run average avoidable costs have been estimated:

Table 8: Assumed avoided collection and transport costs

Region	Assumed current average total cost ($/tonne)	Long run average avoidable costs ($/tonne)
Southern	$200	$140
Northern	$250	$175
North West	$350	$245

These values are applied for recycling and garbage collection, as well as both at-home and away-from-home collection.

A.4. Market value of recovered material

A CDS is expected to increase the total market value of recovered recyclate through an increase in both the quantity and quality of recyclate. The first results in higher amount of recyclate being recovered due to the financial incentives offered by a CDS. Secondly, material recovered through a CDS has a relatively lower reject rate and greater degree of sorting than that recovered through the kerbside system. Estimates for this value have been derived from **COAG SCEW (2011)**. The values provided in **COAG SCEW (2011)** have been verified and adjusted through stakeholder consultations. Stakeholders commented that:

- The values in **COAG SCEW (2011)** are broadly consistent with those in the mainland market (with the exception of glass);
- Effective values in Tasmania are lower as there is no domestic re-processing of recyclate (with the exception of glass re-use in road-base and construction applications) and additional shipping costs are incurred to export the recyclate off the island; and
- The value of glass is negligible but can be much higher for high quality glass.

In response to this feedback, Marsden Jacob has derived market value estimates based on **COAG SCEW (2011)** but adjusted these to account for shipping costs and a lower glass value. In particular, all recyclate is shipped through Melbourne (either as a final destination or on-route to final destination) following the withdrawal of a direct call international service that previously enabled shipping from Tasmania to Asia **(Veolia, 2014)**. Therefore, the effective value of recyclate in Tasmania is assumed to be the mainland value less the cost of shipping. Shipping costs from Tasmanian Ports to Melbourne are estimated at $65 per tonne based on average wharf-to-wharf freight rates on Victoria-Northern Tasmania routes **(BITRE, 2013, p. 24)**. This incorporates the effect of the Tasmanian Freight Equalisation Scheme (TFES).

A separate estimate is required for glass value as glass is either landfilled or recycled within Tasmania due to the prohibitive cost of shipping to the mainland and the inherently low value. Stakeholders expressed the view that glass is re-processed primarily to avoid cost rather than to generate revenue. Therefore a negligible (nil) value for glass has been assumed.

Finally a premium has been applied to glass and plastic material recovered through CDS. For glass, this was based on stakeholder feedback but consistent with **COAG SCEW (2011)**. A premium value to plastics was assumed based on **COAG SCEW (2011)**.

Table 9: Assumed market value of recovered material

Material	Assumed current average total cost ($/tonne)	Reduction for shipping costs ($/tonne)	Assumed effective value for Tasmania ($/tonne)	Assumed 'premium' value for material from CDS ($/tonne)
Liquid Paperboard	$150	$65	$85	$85
Glass	$-	$65 (to premium glass only)	$-	$25
Plastics	$560	$65	$495	$595
Steel Cans	$280	$65	$215	$215
Aluminium Cans	$1,560	$65	$1,495	$1,495

A.5. Avoided cost of processing material at MRF

COAG SCEW (2011) assumes a cost of processing (not including the cost of disposing of rejected material) of $45 per tonne (in 2011 dollars). Whereas **Equilibrium (2013)** notes that processing gate fees vary widely from about $50 to $180 per tonne. The former refers to the economic cost of processing material at MRFs whereas the latter refers to the financial cost paid by Local Government

In a theoretically competitive market, MRF charges (financial cost) would be equal to the processing cost, plus the cost of disposing rejected material less any value in the material remaining. Based on our modelling this theoretical financial cost would be in the order of $100 per tonne. However, the actual financial cost of processing in Tasmania (ranging from $150 to $280 per tonne) is much higher. This suggests that costs of processing in Tasmania are also much higher than $45 per tonne, assuming normal industry profits to industry.

Stakeholders also expressed the view that only a portion of processing costs may be saved since the costs of MRF operation are largely fixed (although some savings in labour and reduced wear-and-tear on equipment may be realised).

On the balance of information available, a higher total cost is likely but it assumed that a cost *saving* of $45 per tonne (consist with **COAG SCEW (2011)**) is possible. This estimate recognises that only some of the current cost of processing material could be saved through reduced volumes and even then this may take time to realise.

A.6. Loss of producer surplus

The implementation of a CDS scheme is expected to lead to fewer beverage purchases (due to higher prices faced by customers). In turn, this is expected to lead to lower production (and sales) for

Tasmanian manufacturers of beverage products. Within an economy, industries generate what is known as 'producer surplus', when items are sold at higher than their cost of production, which is assumed to be the case for beverage containers. Producer surplus contributes to overall economic welfare and the expected reduction in this surplus (assuming consumer surplus remains unchanged) has been estimated in the CBA.

Loss of producer surplus is estimated by segmenting the market in two ways and then summing the results of each of the segments to obtain a total. The first segmentation is undertaken by product category, because the responsiveness of items sold to price (price elasticity of demand) and the profit margin per item (used as a proxy for producer surplus) is estimated to vary across the categories. The product categories are:

- beer manufacturing;
- bottled water manufacturing;
- milk and cream production;
- soft drink manufacturing;
- spirit manufacturing;
- fruit juice drink manufacturing; and
- wine manufacturing.

The second segmentation is undertaken by customer segment. This is required as each of the following segments experiences a different effective price increase (depending on whether they redeem or not):

- customers who redeem their own containers; and
- customers who do not redeem (their containers are either redeemed by a third party or are not redeemed at all).

For each of the product and customer segments, the process of estimating loss of producer surplus essentially involves four steps:

1. Estimate an absolute average product price impact per container[15].
2. Determine effective price impact on each customer segment (this is the absolute average produce price impact from step 1 minus refund amount (for customers redeeming their own containers only)).
3. Determine the change in volume (applying the relevant price elasticity of demand) due to the change in price.
4. Determine the change in after tax profit, multiplying change in volume by profit margin.

Average price and profit margin by industry

The assumptions used for price and profit margins are listed in **Table 10**.

[15] This is the expected cost of refunds (which in turn depends on expectations of redemption rates) plus net costs of the scheme operation, divided by the number of containers.

Table 10: Producer surplus assumptions, Options 4a, 4b and 4c

Product Category / Industry	Average price per container ($)	Price elasticity of demand (closer to zero is more inelastic)	Industry revenue (of products produced & consumed in TAS) ($m)	Gross Margins (% of revenue)
Beer	2.72	-0.27	158	22%
Bottled water	1.28	-0.50	7	19%
Fruit juice	2.87	-0.76	19	11%
Milk	2.08	-0.79	38	6%
Soft drink	1.80	-0.79	38	20%
Spirits	30.30	-0.60	6	17%
Wine	11.50	-0.24	36	11%

Sources: Fogarty (2008); Andreyeva 2010; Nghiem 2011; ACIL Tasman, 2012; IBIS World 2014

Average prices for each product category are based on **ACIL Tasman (2012)**. Industry revenue for Beer and Wine is based on the Tasmanian Food and Beverage Industry Score Card 2010-11 **(DPIPWE, 2013)**. Industry data obtained from **IBISWorld** were used to estimate industry revenue for all other categories and gross margins (as a proxy for producer surplus[16] expressed as Earnings Before Interest and Tax (EBIT) + Depreciation + Rent) per product category.

Price elasticities of demand are used to determine the change in quantity of beverages sold and are based on a number of Australian and international studies on the demand for food and beverages. The loss of producer surplus is then estimated as the reduced volume of beverage containers sold domestically multiplied by the average surplus for each beverage container (summed for each of the product categories).

A.7. Propensity to litter

Baseline

An estimate of current annual beverage litter rates can be made by developing estimates of the quantities of litter cleaned up each year (QLC), the change in the stock of litter on land (Δ LLS) and the quantity of litter ending up in the marine environment each year (QML) – see Box 1.

Applying the equations presented in Box 1, the total beverage litter rate in Tasmania is estimated currently to be about **1,000 tonnes per year** of which about 90% is land based litter and 10% is marine litter. This total is used as the baseline figure for the purpose of estimating future *propensity* (the rate at which the amount available to be littered (not collected for recycling) is litter as opposed to be disposed of in general waste) to litter in Tasmania under the CDS.

16 Theoretically this margin should exclude normal profit. However, we assume that capital and fixed costs are not changed (scale of impacts is minimal) and therefore any change to gross margin comes off the bottom line.

With CDS

A CDS scheme (or other options) can act to reduce litter in two possible ways:

1. By reducing the amount of material available to be littered, especially in public places such as parks, parks, recreation reserves, beaches and shopping precincts, where most litter occurs **(Curnow & Spehr, 2005)**.
2. By reducing people's propensity to litter which also is likely to be relatively high in public places.

In relation to the first point, recycling infrastructure associated with the CDS scheme is assumed to have an impact on litter rates by reducing the amount of beverage containers available to be littered, especially in public places.

The impact of the CDS on people's propensity to litter is estimated to be more pronounced. The public place propensity under the baseline is derived by estimating the total amount of public place beverage container available to be littered and the proportion of this waste that is actually littered, producing a propensity to litter estimate for public place packaging consumption of **16.4%**. The litter rate used to calculate the propensity to litter estimate for non-public place is derived from the total annual litter rate, with a proportional breakdown between public place and other litter, derived from National Litter Index data **(Macgregor Tan research, 2011, 2012)**. This produces an estimate of **0.5%**.

Box 1. Litter stocks and flows

Litter can be measured in terms of litter stocks and litter flows. The change in the stock of litter from one year to the next (ΔLS) is the sum of the change in the land based stock of litter (ΔLLS) and marine based stock of litter (ΔMLS), expressed as:

$$(1) \quad \Delta LS = \Delta LLS + \Delta MLS$$

The change in land based stock of litter is in turn the sum of the quantity littered on land and remaining on land (QLL) less the quantity cleaned up on land (QLC), expressed as:

$$(2) \quad \Delta LLS = QLL - QLC$$

Similarly, the change in marine based stock of litter is the sum of the quantity littered on land and transported to the marine environment (QML(LB)) and the quantity littered at sea (QML(MB) - noting that the quantity of litter cleaned up in the marine environment is assumed to be zero since little if any marine litter is cleaned up[17]). This is expressed as:

$$(3) \quad \Delta MLS = QML(LB) + QML(MB)$$

Drawing on equations (1) to (3), the total littered in any one year (QL) can be expressed in the following three equations:

$$(4) \quad QLL = QLC + \Delta LLS$$

$$(5) \quad QML = QML(LB) + QML(MB)$$

$$(6) \quad QL = QLL + QML$$

Although there are no specific data available for QLC, Δ LLS and QML, it is possible to interpolate from available data to provide estimates for each of these variables.

Evidence from overseas indicates that the financial incentive provided by containers refunds can have a significant impact on propensity to litter under container refund schemes, with beverage container litter rates falling substantially following the introduction of deposit/ refund schemes in Germany and some states in the USA **(Albrecht et al., 2011)**.

A detailed breakdown of NLI data from two years **(Macgregor Tan Research 2011, 2012)** was undertaken for this study separating beverage container, non-beverage container packaging and non-packaging litter data for South Australia and Tasmania. That data was used to develop estimates of beverage container and other packaging litter rates in South Australia compared to Tasmania. The estimates, indicate that over the two years for which disaggregated data is available beverage container litter rates were only 38% of beverage container litter rates in Tasmania (on a weight basis) . Litter rates of other packaging though, were similar in South Australia to Tasmania (97%). This data has been used to derive adjusted propensity to litter rates under a CDS scheme. The adjusted propensity to litter rates assume that beverage container littering will approximate the littering rates in South Australia (with an adjustment for beverage container recycling rates). The adjusted rates are presented in **Table 11** below.

17 Except for litter that has been washed onto beaches, which is counted in estimates of QLC. Also, litter in freshwater environments (lakes, rivers, drains) is accounted for when it flows to marine environments or is cleaned up on land (e.g. litter traps).

Table 11: Propensity to litter under base case and with CDS

Product Category / Industry	2015	2020	2030
Propensity to litter, public place – baseline	16.41%	16.41%	16.41%
Propensity to litter, other - baseline	0.54%	0.54%	0.54%
Propensity to litter, public place - with CDS	16.41%	10.72%	9.78%
Propensity to litter, other - with CDS	0.54%	0.35%	0.32%

A.8. CDS Infrastructure costs

For this study we adopted a widely accepted approach to estimating the cost of CDS arrangements, with estimates made of the various cost elements on a per container basis. Each unit cost provided is fully inclusive of both capital and operating costs including costs associated with baling and transport of the baled containers.

An overview of the cost estimates for the main data variables is provided in the table below[18]. These estimates draw on a number of sources including **BDA and WCS (2009)**, **Boomerang Alliance (2011)** and **Boomerang Alliance (2012)**.

Table 12: CDS cost elements

Cost element	Assumption (c/container)
Capital and operating costs – Consolidation points	4.0 (metro)
Capital and operating costs – Collection depots	4.2 (non-metro)
Capital and operating costs – RVMs	4.5 (metro)
Capital and operating costs – remote collection points	5.0 (non-metro)
Baling for transport	3.9 (metro)
Transport: collection depot and RVM to consolidation depot	4.5 (non-metro)
Transport: remote collection point to consolidation depot	6

Key assumptions underpinning the estimates include:

- RVM-based collection points provide efficiencies relative to a depot-based system, with those efficiencies reflected in lower capital and operating costs.
- Capital and operating costs estimated for RVMs includes an assumed rental/ incentive payment to retailers of 0.2c/ container in metropolitan areas and 0.3c/ container in non-metropolitan areas.

18 Note for the purpose of this study, these costs have been modelled as average unit costs over the life of the project. In reality, unit costs are likely to be higher than the average in the early years of the project, when most capital costs are incurred, and lower than the average in later years when costs are confined largely to operating costs.

- Capital and operating cost differences between metropolitan and non-metropolitan areas include assumed higher operating costs in non-metropolitan areas due to smaller scale of operation.
- Transport costs are assumed to be lower in metropolitan areas than regional areas, which in turn are lower than transport costs in remote areas.

Results of applying these assumptions provide a weighted average of costs for metropolitan and non-metropolitan areas of **$568/tonne**.

A.9. Participation costs

Household participation costs

Households face participation costs due to the time it takes to accumulate packaging and transport it to collection infrastructure points. These costs can be divided into four main sub-categories:

- accumulation time;
- vehicle operating costs (VOCs);
- in-vehicle travel (IVT) time; and
- container deposit redemption time.

The estimated values are summarised in **Table 13**.

Table 13: Consumer participation cost elements

Cost element	Assumption	Source(s)
Value of time	$8.06/hour	(Bockstael et al., 1992; Feather & Shaw 1998; Lake & Ferreira 2002; Larson & Shaikh 2004)
Accumulation time	Nil	Households already involved in current waste management practices
VOCs and in-vehicle travel time	2km for urban trips, 11.6 km for rural trips, with fuel and maintenance costs being 15.4c/km	South Australia data, Nolan ITU, (2003) and ISF (2001)
Container deposit redemption time	1.6 minutes for RVMs and 10 minutes for non-RVMs	Based on assumed throughput of RVM, Harrison Research (2012)

Based on the assumptions outlined above, annual household participation costs for different periods are set out in the table below. Increasing costs over time reflect increased redemption rates and therefore increases redemption times.

Table 14: Household participation costs ($m)

2020	2025	2030	2035
$1.1m	$1.3m	$1.4m	$1.5m

Business participation costs

Business/workplace participation costs are defined as costs incurred by employees taking beverage containers to temporary storage infrastructure and cleaners/other staff consolidating this in larger storage infrastructure such as skip bins.

As with household accumulation time, time incurred by employees taking packaging to temporary storage infrastructure is assumed to be zero, as employee time spent taking containers to storage is likely to be no greater than the time that is already involved in current waste management practices.

Cleaner costs are based on the following assumptions:

- 1,139 participating businesses (over $2m turnover) threshold[19];
- an additional 1 trip every four days to transfer packaging to larger storages (averaged over all participating businesses; and
- $35/ hour cleaning costs (including salaries, on-costs and normal margins).

Drawing on assumptions business participation costs are estimated to be about **$130,000/year**.

A.10. Government regulation and business compliance costs

The cost to government to develop the scheme, implement appropriate legislative instruments, undertake ongoing administration, compliance and enforcement have been estimated as annualised costs for government regulation.

Similarly, the cost to business to comply with a CDL, including the costs to implement regulations, continuously administer and fulfil reporting obligations have been estimated as an annualised cost for business compliance.

These estimates are based on **BDA and WCS (2009)** which provides the costs of a national CDS for system administration, regulatory costs, business and education as $9.7m, $2m, $4.5m and $4.5m a year respectively. These figures have been scaled using Tasmanian proportion of national population and escalated for inflation to provide a figure of **$393,399** per year for government regulation and **$109,277** per year for business compliance.

A.11. Potential for establishing Tasmanian recycling industry

One of the main disadvantages of establishing a CDS in Tasmania (relative to other jurisdictions) is the relatively lower market value of recovered material. There is no domestic reprocessing of beverage containers (other than the use of some recovered glass in road base and construction applications) and therefore material must be shipped to other markets (and freight costs incurred) to realise its market value.

[19] Based on ABS Business Count Data, 2011.

The absence of a domestic industry is due to the lack of economies of scale. The potential benefit of establishing an industry (and the associated value added to the economy) was investigated but was found to be unlikely.

Indicative threshold base volumes for profitable plastics, glass and aluminium (comprising approximately 95% of beverage container material) reprocessing were derived from public sources. These threshold values were then compared to Tasmanian volumes to assess whether the introduction of a CDS is likely to yield sufficient volumes to establish reprocessing facilities. This assessment is summarised below.

Table 15: Estimated volumes required for profitable reprocessing

Material	Estimated threshold value (tonnes/year)	Estimated existing amount of recyclate	Approximate increase through CDS in 2034/35 (tonnes/year)
Plastics	80,000	10,000 – 15,000	2,533
Glass	40,000 – 100,000	40,000	12,213
Aluminium	40,000	4,000	796

Sources: WRAP (2009)[20], WRAP (2012)[21], Owens-Illinois (2011)[22], European Commission Joint Research Centre (2010) and Organisation of European Aluminium Refiners and Remelters (2006)[23]

Glass appears to be the only material where reprocessing may be financially viable. However, the lower bound of the above threshold value range was estimated from international data (where possible support through subsidies may be a factor) whereas the upper bound (derived from Owens-Illinois' Australian operations) is more likely to be relevant for considering the potential for establishing a new competitor in the Australian glass market. Additionally, there is currently a surplus of glass recyclate in Australia and market values are relatively low.

Therefore, on the balance of evidence investigated it appears unlikely that the introduction of a CDS in Tasmania would lead to substantial additional reprocessing industry.

20 Based on financial modelling of a mixed plastics reprocessing facility

21 Minimum scale of Scottish glass reprocessing into containers

22 As at 2011, recycled an approximate 405,000 tonnes of glass across 4 plants

23 **S**hows that the capacity of the aluminium refining industry in Europe is growing, suggested that smaller plants are no longer competitive.

Appendix B. Community willingness to pay for recycling and litter reduction

B.1. Introduction

Households and the broader community place a value on recycling that includes a range of market and non-market values. Market values have been fully captured in the main analysis. However, there is uncertainty as to what extent full non-market values have been captured.

Potential non-market values include:

- avoided environmental and social externalities associated with the operation of landfills (e.g. pollution and noise);
- avoided environmental and social externalities of litter (e.g. impacts on landscapes and general enjoyment of open spaces and other public places, ecological impacts - especially in the marine environment);
- reduced resource depletion;
- avoided environmental externalities due to reduced resource depletion; and
- a sense of 'civic duty' that accompanies recycling and waste avoidance.

Externalities associated with landfill have been estimated through data from **BDA Group (2009)**. Whereas externalities associated with resource depletion (considered as 'upstream' externalities') have not been included, noting that the Productivity Commission states that *"with the exception of a comprehensive response to greenhouse gas abatement, a host of existing policies already address directly most known upstream externalities occurring in Australia"* **(Productivity Commissions, 2006, p. xxxi)**.

That said, there is a potential that the community's willingness to pay for these non-market values is higher than the values captured in this study. These are two main types of studies[24] that provide an indication of this value, referred to as 'stated preference' and 'revealed preference' studies, both of which have limitations.

Stated preference methods rely on survey responses and in doing so aim to provide as much information as possible to the respondent. It is undoubtedly challenging to convey the complex information necessary to value recycling or litter outcomes and there is a risk that some values can be double counted (e.g. a sense of 'civic duty' may in fact be related to the desire to protect the environment and avoid resource depletion when in-fact these may already be largely 'internalised').

Revealed preference methods may underestimate the true WTP. Notably the cost of clean-up is a form of revealed preference for the WTP for litter avoidance. However, it is likely that the

24 A range of methods are utilised to value costs and benefits that are not directly valued in the market. Some of these methods (e.g. 'preventative expenditure/restoration cost', 'hedonic pricing' and 'travel cost') are referred to as 'revealed preference' or 'revealed willingness to pay' methods because their application involves revealing values (directly or indirectly) through people's market purchases or actions. 'Stated preference' methods (e.g. 'contingent valuation' and 'contingent choice/ contingent ranking') on the other hand, are used when it is not feasible to reveal values through market purchases or actions. Surveys are used instead to get information on people's stated preferences.

WTP for litter is higher and that this is not a perfect proxy (e.g. it is more difficult to clean-up litter in the marine environment whereas there are certainly environmental and social impacts associated with this litter etc.).

Nevertheless, a literature review has been undertaken to provide an indication of this value. A large qualification is placed on these estimates. In particular, it was not consistently clear to what extent market values or environmental and social externalities already captured in our analysis are included in the total WTP estimates and a disaggregation has not been attempted. Secondly, some studies were found to have deficiencies in study design.

B.2. Estimates of WTP for recycling

Removing outlying values associated with WTP for recycling of waste that clearly has no links to packaging material (e-waste at the high end and green waste at the low end, both shaded) provides values for WTP for additional recycling of domestic waste (of which packaging materials are a substantial proportion) of approximately $150 to $700/ tonne.

Table 16: Indicative estimates of WTP for recycling derived from literature

Study	Focus	Estimated WTP	Extrapolated WTP (A$ 2011/ tonne)
Australia			
PWC 2010	WTP for additional packaging recycling, above 50%	$2.77/ household/ year/ 1% increase	702
Gillespie & Bennett 2011	WTP for fortnightly kerbside recycling scheme	$131.49/ household/ year	639
URS & ERE Consulting 2009	WTP for e-waste recycling scheme (assuming current low levels)	$37-43/ household/ 5 years - 50%	1,117
		$52-60/ household/ 5 years - 70%	1,033
		$68-78/ household/ 5 years - 90%	972
Gillespie & Bennett 2011b	WTP for organics (green waste) recycling scheme	$35.23/ household/ year	87
International			
Covec 2007 (New Zealand)	Willingness to spend additional time recycling above current levels (household inorganic waste)	NZ$0.88/household/ week (all inorganics)	256
		NZ$1.68/household/ week (plastics, paper & glass)	475
Blaine et al. 2005 (USA)	WTP for kerbside recycling program , Central Western USA	US$1.72/household/ month	154
Aadland & Caplan 2006 (USA)	WTP for kerbside recycling program , Western USA	US$2.97/household/ month	258
Koford et al. 2012 (USA)	WTP for kerbside recycling program, SE USA	US$2.27/household/ month	198

B.3. Estimates of WTP for litter reduction

A review of recent Australian and overseas WTP studies has also been undertaken with reference to litter. Results of the review are presented in Table 17. The qualifiers that apply to the recycling WTP literature review also apply to the litter studies reviewed.

Table 17: Australian and international studies of WTP for litter reductions

Study	Focus	Estimated WTP
Australia		
PWC 2010	WTP for litter reductions	$4.15/ household/ year/ 1% reduction
International		
Cambridge Economics Associates 2010 (UK)	WTP for street cleanliness	£6.45/household/year/grade improvement/regionwide £18.80/household/year/grade improvement/local
Wardman et al. 2011/ Sherrington et al. 2013 (UK)	WTP for 'best' status in neighbourhood litter, Scotland	£12.54/person/month/rural £15.81/person/month/urban

Note that it was not deemed realistic or appropriate to extrapolate results of the litter WTP studies to a standard unit (e.g. $A/ tonne of litter reduced) for the purpose of comparison due to a lack of focus on packaging litter and the litter effect not being precisely defined in the studies.

Appendix C. Material flows analysis

An analysis of material of flows was required to understand expected changes to physical flows of waste as costs and benefits are driven by a change to those flows. This was undertaken through the application of Material Flows Analysis (MFA).

In MFA, the quantity and composition of waste arising at selected significant points in the supply chain is estimated. This is done by collating available data on actual measured (or estimated) quantities at specific points in the supply chain and inferring amounts at intermediate points. The MFA provides a level of robustness as a 'mass-balance' verification is undertaken to ensure that the amount of waste at a certain point in the supply chain equates to the sum of all downstream points. In particular, the sum quantity of waste recycled, sent to landfill or littered must equal the quantity of consumption (assuming beverages are consumed and containers disposed of in the same time period).

Further verification is provided by reconciling estimates of Tasmania quantity and composition inferred from national data, with available state specific estimates of quantity and composition. This is necessary as a combination of national data and Tasmanian data was used to undertake the MFA, primarily because of a limitation of available Tasmanian data (particularly relating beverage containers as a proportion of total waste). However, Tasmanian data provides a useful reference to appropriately apportion national volumes to Tasmania and to reconcile those derived estimates with state specific estimates.

C.1. Base Case

An MFA was undertaken for the base case (business as usual), estimating the expected beverage container volumes of:

- Consumption (disaggregated by domestic, public place and C&I (non-public place);
- Recycling (disaggregated in the same manner);
- Litter (by applying litter propensities analysis described in **Section A.7:** Propensity to litter); and
- Direct to landfill (inferred as the residual).

The key data sources used for undertaking these estimates is provided in **Table 18** below.

Table 18: Sources used in constructing MFA base case

Source	Use in MFA
COAG SCEW (2011)	Beverage container consumptions distributed by population for Tasmania (adjusted for higher relative glass consumption). Recycling rates for household waste. At-home and away from home consumption rates.

Equilibrium (2013)	Recycling rates for households waste in Tasmania.
Blue Environment (2011)	Landfill by Tasmanian region. Proportions of garbage and recycling collected in Southern region by local government.
NEPC (2014)	Recycling rates for household waste

The above key sources provided the initial data population of the MFA. Adjustments were made to ensure reconciliation between state estimates inferred from national estimates, and Tasmanian data, and to ensure that estimates were consistent with qualitative evidence about material flows in Tasmania gleaned through stakeholder consultations. In particular, consultations revealed that there is a high proportion of reject rates for glass collected through kerbside collections. This is due to the limited recoverability of broken glass. Glass breakage, in turn, also embeds in paper/cardboard recyclate reducing its recoverability.

C.2. Change to material flows through implementation of CDS

The diversion that may result through the implementation of CDS was estimated by assuming that a maximum collection rate of **85%** (consistent with existing CDS schemes including South Australia) is assumed. This is assumed to increase gradually over time with a step increase at scheme introduction and gradually increasing to the maximum rate by 2034/35.

Litter is reduced as there is less material 'available to be littered'[25] and a lower 'propensity to litter'. However, it is important to note that a CDS is only effective at reducing items of beverage litter and other litter (e.g. cigarette butts, take-away containers etc.) will not be affected.

25 Litter is calculated by applying a 'propensity to litter' factor to material that is not sent for recycling is assumed to be 'available to litter' (material that is not sent for recycling). In this way, the propensity to litter reflects the proportion of material available to be littered that is actually littered (as opposed to being sent to landfill).

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