Report for the Auckland Council

Cost-benefit analysis of a Container Deposit Scheme

Preston Davies

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About Sapere Research Group Limited

Sapere Research Group is one of the largest expert consulting firms in Australasia and a leader in provision of independent economic, forensic accounting and public policy services. Sapere provides independent expert testimony, strategic advisory services, data analytics and other advice to Australasia’s private sector corporate clients, major law firms, government agencies, and regulatory bodies.

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Executive summary

The Auckland Council is interested in the likely economic costs and benefits of a proposed Container Deposit Scheme (CDS). The basic design features of the proposed CDS are as follows:

- beverage containers would attract a 10 cent deposit, refundable on the return of the beverage container;
- the CDS would operate alongside existing kerbside recycling activities;
- all ‘ready to drink’ beverage containers (including those containing milk) over 300ml and under 3 litres would carry a deposit;
- containers would be returned to public depots with manual collection; and
- central government would have responsibility for initial set-up and subsequent oversight and regulatory control of the system, while administration and management of the system (including performance) would be undertaken by a managing agency with representation from a range of parties.

A CDS is expected to raise rates of recycling, reduce litter and improve the value of some existing material that is recycled. A CDS would also be expected to involve costs for collection infrastructure and participation by individuals and organisations in the redemption of beverage containers.

We use previously published figures from the Packaging Forum and Envision Limited to determine a range within which existing and predicted return rates lie. We conservatively estimate that a CDS would result in container return rates between 79%-82%, from an existing rate between 45%-58% (for numbers of containers) and between 58%-69% (for tonnes of containers). This translates to additional recycling of between 369 million and 857 million containers or between 21,415 tonnes and 61,549 tonnes (see Table 1).

Table 1 Estimated additional recycling following CDS

<table>
<thead>
<tr>
<th></th>
<th>Upper bound</th>
<th>Lower bound</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>Tonnes</td>
</tr>
<tr>
<td></td>
<td>(millions)</td>
<td></td>
</tr>
<tr>
<td>Glass</td>
<td>226</td>
<td>47,114</td>
</tr>
<tr>
<td>Aluminium</td>
<td>327</td>
<td>4,721</td>
</tr>
<tr>
<td>Plastic</td>
<td>207</td>
<td>7,726</td>
</tr>
<tr>
<td>Liquid paper board</td>
<td>97</td>
<td>1,988</td>
</tr>
</tbody>
</table>
Over a ten-year study period and applying a 6% discount rate, we estimate a CDS would result in society being better off (i.e. benefits exceed costs) by between $184 million and $645 million. Benefits are at least three times the costs (lower bound) and may be over six times the estimated cost (upper bound), see Table 2. The relatively wide range reflects the array of assumptions needed to conduct an *ex ante* cost benefit analysis. It is appropriate that as more information emerges, assumptions are validated and actual design is confirmed the analysis should be updated before a final decision is made on possible implementation of a CDS in New Zealand.

**Table 2 Summary CBA Results ($m, net present value)**

<table>
<thead>
<tr>
<th></th>
<th>Upper bound</th>
<th>Lower bound</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total benefits</td>
<td>$762.5</td>
<td>$261.9</td>
</tr>
<tr>
<td>Total costs</td>
<td>$117.5</td>
<td>$77.9</td>
</tr>
<tr>
<td>Net benefits</td>
<td>$645.0</td>
<td>$184.0</td>
</tr>
<tr>
<td>Benefit-cost ratio</td>
<td>6.49</td>
<td>3.36</td>
</tr>
</tbody>
</table>

Over half the total benefits (almost 59%) relate to welfare gains to households from litter reduction, followed by the increase in the value of materials recovered. On the costs side, the major contributors were household participation costs and collection infrastructure and operating costs respectively, although the latter is largely offset by reductions in costs to existing kerbside recycling collections.

These net benefit findings are robust to changes in parameters such as a longer time period and higher discount rate. Moreover, in a worst-case scenario (of low benefits and high costs) society is still better off with a CDS than without one. Benefits are over twice the costs (i.e. the benefit-cost ratio is 2.22, with net benefits to society of around $144.4 million in present value terms).

A number of other impacts are possible from a CDS, but are not included in the formal analysis, either because they are non-quantifiable or are not relevant to an economic cost-benefit analysis. These include:

- Job creation
- Support for charitable organisations
- Greenhouse gas emissions and other potential environmental impacts
• Increases in non-container recycling
• Potential changes to charges and revenues associated with processing
Introduction

1. Auckland Council (the Council) commissioned us to “…test the robustness of economic modelling for a Container Deposit Scheme (CDS) as proposed by Envision New Zealand in their 2015 report The Incentive to Recycle: the case for a container deposit system in New Zealand.” In particular, the Council has asked us to complete an independent economic analysis of the impacts of a container deposit system in two stages:

   **Stage 1**
   - To provide an outline of the methodology/approach that will be used to test the Envision model (Scoping Stage)
   - To provide a completed economic analysis of the Envision model to determine if the modelling is sound and identify potential deficiencies (Stage 1)

   **Stage 2 (contingent upon the findings of Stage 1)**
   - Development and provision of a methodology for assessing how the proposed Envision model would impact on Auckland Council, as well as residents, and the community, recycling and business sectors
   - Provide a methodology template that can be adapted for use by other local authorities to assess the impacts of a Container Deposit Scheme on their jurisdiction
   - Attend progress meetings and, following the completion of each stage, present the findings.

2. This report covers the stage 2 requirements, particularly dot point one above. It draws on the work undertaken as part of the Envision report, but uses an economic cost-benefit analysis (CBA) framework. This framework differs from the financial/commercial perspective taken in the Envision report. The crucial difference is that an economic CBA takes a “whole of society” perspective.

3. This report is structured as follows:
   - Section 2 describes the CDS proposal in more detail.
   - Section 3 outlines the nature of costs and benefits relevant to this analysis.
   - Section 4 details the estimated effects of the CDS proposal and explains the basis of those estimates, including the base case, caveats and assumptions.
   - Section 5 discusses the likely net effect of the proposal.
   - Section 6 concludes with summary comments and reflections.

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1 Auckland Council Services Agreement ACPN 19992 Sapere Research Group Container deposit Scheme Assessment, p.2.
The proposal

4. While relatively simple in concept, CDSs can be designed and implemented in a number of different ways, depending on the issues they are intended to address and the legal, economic and social context in which they operate. In this section we outline the basic structure of the proposed CDS and consider the key objectives of a CDS, with reference to the main problem/s that a CDS would address.

Components

5. The CDS model examined in this report is based on that proposed in the Envision report. A stylised representation of a CDS works is shown below (see Figure 1). It shows the main players and the monetary and materials flows involved. A more detailed version is contained in an appendix.

Figure 1 How a CDS works

Source: Envision (2015)

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3 While we introduce and briefly discuss the respective design elements, it is important to note that our task is not one of design. In essence, we take design as a given and assess the effects of that design on economic welfare.
6. In general, material flows are “one-way” in nature, with a single exit point to end users/markets where the relevant material is sold for re-manufacture into new containers or for other uses.

7. On the other hand, monetary flows mostly involve “multilateral exchanges” of the deposit among parties, though not necessarily contemporaneously. For instance, a consumer pays the deposit amount to a retailer upon purchase. The retailer had previously paid the deposit amount attached to that container to the beverage (or container) producer, who in turn had previously passed the deposit amount to a Managing Agency.\(^4\)

8. Thus, while essentially cost-neutral between the parties involved, a period of time may have lapsed between the payment and the receipt of the deposit amount, for a particular container.

9. In terms of the underlying design features which drive the respective flows of material and money, we set out below the most relevant considerations, drawing from the discussions underpinning recent decision in New South Wales (NSW) to introduce a CDS.\(^5\)

10. While the model described by Envision is influenced by the arrangements in South Australia, it is not necessarily the case that the final design of any CDS in New Zealand would mimic the South Australian model. Further, more detailed design work is needed to determine the optimal model for New Zealand. It may be that a hybrid model is ultimately chosen (i.e. a model that draws from more established models such as that in South Australia while also being cognisant of more contemporaneous developments, such as in NSW).

**Incentives**

11. At its core, a CDS is an incentive to encourage people to return empty drink containers to specified collection points. The discussion document for the NSW CDS decision stated:\(^6\)

   “By providing a reward, CDSs create a disincentive to litter and an incentive to pick up littered items. In doing so, in most cases they also shift waste management and litter collection costs away from local councils and land managers, and on to drink manufacturers and consumers.”

12. The incentive could be financial or non-financial. In general, financial incentives have proven both more popular and more effective (in terms of drink container

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\(^4\) Note that there is a proposed handling fee payable to collection points to cover their costs. This handling fee is more visible in the detailed diagram in the appendix. Along with the flow of deposits, this component is not economically relevant and thus is not included in the analysis that follows.


recovery rate). Overseas evidence suggests that container return rates generally increase with the size of the financial incentive, but the relationship is non-linear (i.e. past a certain point, higher-value incentives generate smaller increases in return rates).

13. The Envision model proposes a financial incentive of 10 cents per container. In addition, a ‘handling fee’ of three cents per container would be payable. This handling fee is intended to cover the costs of receiving and sorting containers as well as system management costs. Unlike some overseas jurisdictions, the handling fee is not intended to be passed through into the product price faced by consumers.

14. No adjustment for inflation is proposed, but could be introduced. Probably better done in discrete rather than continuous time - more effective.

**Interaction with kerbside recycling**

15. A CDS could compete with, or complement existing kerbside recycling activities. Where an existing kerbside recycling scheme is in place, a CDS could divert containers from the kerbside system into the new scheme. There are both benefits and costs associated with removing containers from the kerbside system, and some diversion is inevitable, given the incentives underlying CDSs.

16. The model proposed is of a CDS that complements kerbside collections systems, to the extent they exist. The model assumes, based on overseas experience, that 20 per cent of containers recycled under a CDS will be recovered via existing schemes.

**Scope of containers**

17. The scope of containers (i.e. the size, type and material composition of drink contained included in the scheme) should largely be driven by the objectives of the scheme. In the NSW case, the primary objective was litter reduction. The scope therefore should reflect the types and sizes of containers consumed away from home and found in the litter stream. Consideration should also be given to the interaction with any existing kerbside collection system in place, particularly if the intention is to complement the existing system (i.e. minimise diversion away from the kerbside collection system).

18. The proposition contained in the Envision model is that all ‘ready to drink’ beverage containers (including milk) over 300ml and under 3 litres are required to carry a deposit. Importantly, the scheme encompasses containers that are not currently recycled such a Tetra-Pak, pouches and tubed beverages. It also includes refillable bottles such as those that are currently included in the “Swappa Crate” arrangements.

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Infrastructure requirements

19. The location and type of infrastructure and its relationship to the particular incentive is integral to the success or otherwise of a CDS, both in terms of effectiveness and cost. There is a balance to be struck in terms of the size of the (financial) incentive and the proximity and convenience of collection infrastructure. All else equal, a lower incentive would need to be ‘offset’ by the availability and ease of use of infrastructure, while a larger incentive would encourage participation and people would be more willing to go out of their way as a result.

20. There are also important choices around the mechanism used to generate infrastructure provision. This in turn determines what particular approach would best meet the aims of the CDS. Some overseas schemes have used legislation to oblige major stakeholders to provide collection infrastructure at particular sites. Others have relied on incentives or left it to market forces to provide the necessary infrastructure.10

21. Two major infrastructure-related return approaches are possible: return-to-retail, and return-to-depot. Again, there are trade-offs between accessibility and convenience and cost. Retail outlets, particularly supermarkets, have a large network of stores in most locations and offer the ability to combine container return with other everyday activities. However, they potentially involve significant costs as valuable floor space is given up or expensive machines are installed. Return-to-retail has most often been associated with legislated obligations to establish collection infrastructure.11

22. On the other hand, return-to-depot involves a smaller number of larger drop-off locations which can utilise existing infrastructure as well as take advantage of scale economies in the aggregation of container returns for transport and logistics. The location of the depot could be mandated as part of the CDS, or left to the market to decide, with incentives in place to encourage establishment—usually through a handling fee arrangement which is payable on each container recovered.

23. A final factor in the choice of infrastructure is whether collection is automated or manual in nature. Many schemes use both options. Manual options involve collection sites that may be permanent or temporary/mobile structures, and usually involve staff or volunteers who undertake the necessary sorting activity. The most popular example of automated collection involves reverse vending machines, which accept containers and in return issue deposit refunds (either in-cash or in-kind, through for example, redeemable vouchers or tokens).

24. Again there are trade-offs between cost, convenience and scale. Manual collection allows for larger volumes, are relatively cheap to establish and can readily take advantage of existing facilities. However, there may be issues with more limited opening/operating hours, waiting times and locality/space requirements. Automated collection can result in less space requirements, lower staffing needs and more convenience (i.e. able to be located in close proximity to complementary activities,

11 Ibid, p.41.
such as shopping centres). On the other hand, automated collection can come at significant upfront or establishment costs, be more limited in terms of the volume of material able to be handled and may give rise to vandalism and/or security concerns as well as convenience if cash is not involved.

25. The proposal outlined in the Envision report is for return-to-depot, manual collection with a cash incentive of 10 cents per container. The rationale for this form of scheme model is that it takes the best (most cost-effective) of what has occurred elsewhere while maintaining sufficient flexibility to develop further in future. While no explicit mention was made of the inclusion of reverse vending machines, the model proposed does not specifically exclude the use of such automated collection tools, but leaves that to “market-based” decisions by potential participants.

Governance and role of government

26. Governance arrangements cover an array of functions that can be performed by a number of different bodies, including various parts of government, industry and other stakeholders. These functions include setting the deposit level; establishing labelling requirements; managing financial flows (including reconciling deposits and refunds); coordinating system infrastructure and logistics; delivering education and communication campaigns; and monitoring return rates.12

27. The CDS proposed would involve a range of parties with legislative oversight and regulatory control being the responsibility of central government. A managing agency comprised of representatives from industry, government (both local and central) and others would be responsible for monitoring and reporting on system performance as well as administering the system.

Objectives of a CDS

28. There is a range of objectives of CDS’s. The specific objectives are likely to differ by jurisdiction. That is, what the CDS is trying to achieve may differ by location, driven by factors such as the legislative and regulatory environment, community attitudes, and customer preferences. In addition, the particular objectives of respective parties involved (e.g. local councils, central government, retailers, consumers, the wider community and manufacturers) may also differ.

29. Notwithstanding the potentially wide variation in objectives, common/general CDS objectives identified elsewhere seem to focus on CDS:13

- reducing litter;
- increasing the recycling of single-use containers; and
- increasing the collection and reuse of refillable containers.

30. From an economic point of view, the objectives above have primacy. However, a secondary objective is the concept of product stewardship, which has an economic dimension in terms of the efficient allocation of costs. Product stewardship is the responsible management of the environmental impact of a product. It aims to reduce the impact of manufactured products at stages of the product life cycle.\(^{14}\)

31. In a product stewardship scheme some or all of the environmental costs from a product (e.g. inefficient resource use or disposal costs) are included in the product’s price. The consumer pays for product stewardship in the price of the product they choose to buy. Without product stewardship, the costs of the environmental impact from a product are carried by society (e.g. rate and taxpayers) and the environment rather than by the consumer or producer. There is legislative provision for product stewardship in New Zealand under the Waste Minimisation Act 2008, where the Minister can declare a product to be a priority product. When this occurs, a product stewardship scheme must be developed and accredited.\(^{15}\)

32. The key to product stewardship is the allocation and acceptance of responsibility for the environmental impacts of particular products. This responsibility is not restricted solely to financial costs/impacts. Nevertheless, a CDS is an example of product stewardship in action, even if the transfer of financial costs to the consumer or producer is not a primary objective for a CDS.\(^{16}\)

33. These objectives should be contrasted with what might best be termed “extraneous” or consequential effects such as the creation of fundraising opportunities for community or non-profit organisations or local employment creation possibilities.

**Why CBA?**

34. A CBA systematically compares the costs associated with undertaking a policy option with the anticipated benefits, relative to the ‘base case.’ The ‘base case’ or status quo is the expected costs and benefits if the policy option is not pursued. The comparative exercise determines whether the policy is expected to deliver net benefits to society.\(^{17}\)

35. CBA is valued by decision-makers as it produces a clear understanding of the economic (resource) costs and benefits of particular proposals (i.e. whether society will be better off from the proposal). In addition, the results of CBAs are readily comparable across a range of policy and industry areas, enabling comparison (and prioritisation) of initiatives in a manner that is consistent and coherent.

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\(^{16}\) Such a “polluter pays” perspective is still premised on allocating costs to those who give rise to negative impacts, which in this case relate to litter, recycling and re-use. In this respect product stewardship is the regulatory tool to bring about changes in behaviours and outcomes, rather than necessarily being an objective itself.

36. The relevant perspective taken in a CBA is that of society as a whole, as opposed to particular groups or individuals or entities. This means that transfers (of costs and/or benefits) with no change to the underlying level of costs or benefits are not ‘counted’ in the analysis. What CBA does count is the extent to which society is made better off (well-being/welfare is improved) as a result of a policy proposal or action.

37. A distributional analysis is often undertaken in addition to a CBA. Distributional analysis focuses on the financial impacts across various stakeholder groups, such as local government, producers, retailers and consumers. Such analysis considers in more detail the transfers between parties. The clear separation of efficiency and distributional issues is important for ensuring that stakeholder perspectives are not confused with implications for society as a whole. Many previous assessments of CDS have failed to adequately distinguish between costs and benefits that accrue to society as a whole, and those that are merely transfer payments between stakeholders.18

Some limitations

38. CBA is also subject to limitations. A review of cost-benefit studies in the electricity industry provides the following generalisable insights:

- Assessments often overemphasised the benefits with little discussion of the costs of restructuring proposals.
- Models are gross simplifications of the complexity of markets and make simple and at times misleading assumptions about market behaviour.
- There are often data limitations necessitating assumptions, which can drive the results of the modelling. Sensitivity analysis of assumptions made is important.
- Often some of the most significant benefits are difficult to quantify (and monetise) and are therefore omitted from the studies (and reported results).

39. The main take-out from the review is that the criteria for decision-making should in most cases be broader than the quantified information available from the CBA. In other words, CBA is a useful (and often necessary) input into decision-making, but should not be the sole determinant.

Overseas experience

40. A range of overseas jurisdictions have a CDS in place. For our purposes, the most relevant country is Australia, where South Australia has had a CDS operating since 1977, and the Northern Territory introduced a CDS in 2012. New South Wales has agreed to introduce a CDS from 2017, while Queensland has recently decided to follow suit and introduce a CDS in 2018, having previously considered a scheme in

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The Western Australian Government has also announced its intention to implement a CDS, with a mid-2018 expected start date. The Western Australian Government has also announced its intention to implement a CDS, with a mid-2018 expected start date.

Tasmania has previously investigated a CDS but has to date not taken a decision to introduce a scheme. Victoria has previously operated a CDS but it was rescinded.

While CDSs have been implemented in a number of jurisdictions elsewhere (including Canada, the United States, Europe and the Pacific) there is a relatively small number of publicly available studies that evaluate CDS costs and benefits and their results are somewhat mixed. In a report for the New Zealand Packaging Forum Covec (2016) provides a summary of the key findings of the most relevant (primarily Australian) studies. Covec concluded that:

- the costs of a CDS generally outweighed benefits with infrastructure and household participation costs the largest cost contributors; and
- pre-CDS recycling rates are a key determinant in not only the willingness of policymakers to introduce a CDS but also the likely impacts of a CDS.

An earlier major study in New South Wales concluded that the economic benefits associated with the increased recovery of containers for recycling significantly outweigh the increased costs of the combination of kerbside recovery and CDS, and that this net benefit result is robust to changes in key parameters. In the Scottish context, a relatively recent study concluded that, while it was not intended to be a full cost-benefit analysis, indicative figures suggest that the monetary value of the environmental benefits may be significantly higher than the financial costs.

While instructive, overseas examples are idiosyncratic in terms of likely costs and benefits and therefore not directly useful for this analysis. Our approach is to draw from the overseas examples where necessary and relevant, but to focus more attention on the New Zealand material available (i.e. Covec (2016) and Envision (2015)) for guidance.

21  https://en.wikipedia.org/wiki/Container_deposit_legislation_in_Australia
Impact descriptions and basis

45. This section introduces the key impacts (costs and benefits) likely to result from the introduction of a CDS. The major factor driving these impacts is behaviour change; specifically an increase the degree to which containers will be recycled. A stylised depiction of such behaviour change is presented below with reference to three archetypal households (see Figure 2). Overall, reductions in the volume of containers going to landfill or put in kerbside collections are posited. Resulting cost and benefit impacts are described more fully further below.

Figure 2 Stylised behaviour change from CDS

<table>
<thead>
<tr>
<th>Status quo</th>
<th>Household A</th>
<th>Household B</th>
<th>Household C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Heavy container users</td>
<td>Zero container use</td>
<td>Heavy container users</td>
</tr>
<tr>
<td></td>
<td>No recycling activity (i.e. containers put in trash)</td>
<td></td>
<td>Use kerbside recycling</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CDS-driven behaviour change</td>
<td>Incentivised to recycle by deposit amount</td>
<td>No effect on behaviour</td>
<td>Reduction in kerbside recycling use and transfer into CDS</td>
</tr>
<tr>
<td>Overall behaviour change</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Sapere

Taxonomy of costs and benefits

46. There are myriad costs and benefits that could be included in the analysis, with differing levels of granularity. Our approach is to focus on those costs and benefits that are most relevant (i.e. are “universal” in nature as opposed to relying on specific design features), and where there is useful data or proxies that improve robustness.

47. Overview descriptions and comments on the main cost components for the proposed CDS are outlined in Table 3. Detail on the calculation basis and cost estimates is included further below, but it is clear from other relevant analyses that costs associated with infrastructure and participation by interested parties are the major contributors to overall scheme costs.

48. In terms of costs included elsewhere but omitted from this study, the major one relates to loss of producer surplus as a result of the imposition of the deposit. This loss comes about through the increase in price of beverages that attract the deposit leading to lower sales than would have otherwise been the case. Lower sales result in lower profits for manufacturers.

49. The Packaging Impacts Decision Regulation Impact Statement looking at a range of national options in Australia to increase packaging resource recovery rates and
decrease packaging litter derived provisional estimates of the loss in producer surplus for CDS options, amongst other options. The process involved segmenting the relevant market by product category and consumer segment.

50. Drawing on this segmentation, the change in surplus to industry is estimated as the average price per container multiplied by the change in volume multiplied by the profit margin. The key factors in the calculation were estimates of the:

- price elasticity of demand by product category
- average price by product category
- proportion of customers who redeem their own containers
- proportion of customers who do not redeem at all
- profit margin by product category

51. Our decision to exclude such costs is based on two factors. First there is a lack of suitable data on the elements listed above. The dearth of such data relates not only to quantity, but also precision. Any estimates would be unreliable and lack meaning as a result. The second factor driving exclusion is the nature of the refund system. A CDS is not exactly the same as a ‘normal’ price rise in that there is the possibility of recovering the additional amount paid at purchase. That is, the rise is not ‘unrequited’ (in the same way a tax might operate) and not necessarily enduring.

52. Finally, the proposed CDS would operate on all beverage containers (rather than specific product categories), meaning that substitution possibilities are somewhat restricted (i.e. it is difficult to change demand to non-container beverage options). This means that the demand response to the (temporary) change in price would be relatively minor.

Table 3 Cost descriptions

<table>
<thead>
<tr>
<th>Costs</th>
<th>Components/drivers</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collection costs</td>
<td>• Infrastructure and operating costs resulting from additional recycled container volumes</td>
<td>• Net impact of any additional costs less off-setting cost reductions</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Infrastructure design is major component</td>
</tr>
<tr>
<td>Transport and processing costs</td>
<td>• Pick-up and transport costs from collection points to Materials Recovery Facilities and subsequently recyclers and/or ports</td>
<td>• Allowance made for fixed costs</td>
</tr>
<tr>
<td></td>
<td>• Handling costs</td>
<td></td>
</tr>
</tbody>
</table>
53. The categories of benefit for the CDS are shown in Table 4 below. While there are fewer overall benefit categories than there are cost categories, the number of components is greater. Unlike the cost categories above, not all of the benefits listed are fully estimable, in terms of quantification and monetisation, either through lack of data or imprecision. Nevertheless, for completeness, we include those benefit components here and discuss them qualitatively further in the report.

54. To the extent that new data becomes available or measurement techniques improve quantified estimates may be available in the future. Further, even where there is relevant data, other studies have shown that there is no single or universal calculation method proposed. Estimates of benefits (and costs) are likely to be the subject of some debate. While we discuss this aspect further in respect of the computation of costs and benefits, we mention here that our general approach is to allow for such debate through the use of appropriate estimate ranges (as opposed to a particular point estimate).

### Table 4 Benefit descriptions

<table>
<thead>
<tr>
<th>Benefits</th>
<th>Components/drivers</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avoided costs</td>
<td>• Lower waste collection costs</td>
<td>• Both direct and indirect impacts estimated in some categories (i.e. externalities are included to the extent possible)</td>
</tr>
<tr>
<td></td>
<td>• Reduced litter clean-up costs</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Welfare gains from less litter</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Reduced landfill costs</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Implementation costs of legislative and regulatory change</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• On-going administration and oversight costs</td>
<td>• High-level, guesstimate basis used</td>
</tr>
</tbody>
</table>

- **Participation costs**
  - Time costs associated with any additional activity required by households
  - Contentious cost category with divergent views
  - Frequency and volume of household aggregation major cost determinant

- **Administrative costs**
  - Implementation costs of legislative and regulatory change
  - On-going administration and oversight costs
  - High-level, guesstimate basis used
### Benefits

<table>
<thead>
<tr>
<th>Benefits</th>
<th>Components/drivers</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value of materials collected</td>
<td>• Additional volumes of recyclable material recovered</td>
<td>• Cleaner/better quality non-container material likely as a result of CDS</td>
</tr>
<tr>
<td></td>
<td>• Increased value of existing material recovered</td>
<td></td>
</tr>
<tr>
<td>Indirect and/or co-benefits</td>
<td>• Non-CDS materials recycled as a result of CDS collection depots</td>
<td>• Additionality key to estimation (i.e. only include materials that would not otherwise have been recycled)</td>
</tr>
<tr>
<td></td>
<td>• Reducing litter (in general, not specifically containers)</td>
<td>• Some components not able to be quantified or monetised</td>
</tr>
<tr>
<td></td>
<td>• Employment creation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Marine and other environmental impacts</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Support for charitable organisations and objectives</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Energy efficiency gains from manufacturing using virgin materials</td>
<td></td>
</tr>
</tbody>
</table>

### Baseline context

55. In order to ascertain the incremental effect (costs and benefits) of the proposed CDS, a good understanding of the existing nature and scale of recycling of relevant materials is needed. No official statistics on container production and recycling rates are available. Studies into CDS impacts rely on unofficial estimates of these key measures and perhaps unsurprisingly there is some conjecture involved.26

56. Table 5 shows the most recent estimates for container consumption and recycling rates in New Zealand. It is clear from the table that material differences exist in the estimated volumes. While the Covec (2016) and Envision estimates of the total number of containers consumed are broadly similar, there is a difference of around 36 per cent in the respective consumption by weight figures. This difference is driven

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by the 50 per cent difference in estimated glass consumption. Infometrics calculate recovery volumes that are almost twice as high as those used by Envision.

57. A similar explanation applies to the estimated recycling volumes, where the total tonnes recycled estimated by Covec is 60 per cent greater than that estimated by Envision, driven strongly by 71 per cent higher estimate of tonnes of glass recycled by Covec. The comparative total number of recycled items is less stark, with Covec estimating that around 23 per cent more containers would be recycled than Envision estimates, with a difference of over 100 per cent for glass container numbers.

58. Using the estimated consumption and recycling figures from Table 5 we summarise the resulting recycling rates in Table 6. The table highlights the differences discussed above, both between the type of container and across the respective study authors. There is a recovery rate differential of between 10 and 13 percentage points for the Covec and Envision estimates.

59. The current rate of recycling is a very important component for the CBA. The additional impact of a CDS on recycling is defined by the difference between existing and predicted recycling rates. The latter is generally estimated by reference to rates achieved by CDS's elsewhere. By definition, if existing rates of recycling are relatively high, there is less scope for major beneficial impacts from achieving a desired recycling rate through the introduction of a CDS. The potential for changes in the relative shares of overall recycling volumes by material as a result of shifts in production/consumption (e.g. the substitution of plastic for glass) adds to this phenomenon.

60. On the other hand, given the fixed nature of some of the costs associated with a CDS (i.e. they are invariant to the level of recycling), the existing rate of recycling is less important on the cost side of the equation. That is, costs are not necessarily linearly related to recycling volumes and thus the change in volumes recycled as a result of a CDS may not result in a commensurate cost impact.

61. In addition, the interaction of a CDS with existing kerbside recycling activities will also influence the magnitude of expected impacts (costs and benefits). Some of the recycled material counted as additional would most likely have been recycled regardless of the presence of the CDS, using the existing kerbside system (i.e. the recycling is ‘diverted’ as opposed to ‘created’ by the CDS).

62. While significant for our analysis, establishing the correct or most accurate data is not the purpose of this work. Accordingly, rather than use a single figure we use the previous estimates summarised above as a range for our analysis.

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27 The method used by Envision utilised South Australian data, which we believe could tend to under-estimate the consumption data for glass in New Zealand, given the shift in production and availability away from glass in South Australia as a result of the CDS in place.

28 Infometrics use a different method for calculating and expressing total recovery, and their estimates are used mainly for illustrative purposes.
Table 5 Current container recycling estimates

<table>
<thead>
<tr>
<th></th>
<th>Covec</th>
<th>Envision (2010 data)</th>
<th>Infometrics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glass</td>
<td>1,025</td>
<td>214,156</td>
<td>744</td>
</tr>
<tr>
<td>Aluminium</td>
<td>410</td>
<td>6,139</td>
<td>194</td>
</tr>
<tr>
<td>Plastic</td>
<td>641</td>
<td>25,753</td>
<td>300</td>
</tr>
<tr>
<td>Liquid paper board</td>
<td>51</td>
<td>2,100</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>2,126</td>
<td>248,148</td>
<td>1,240</td>
</tr>
</tbody>
</table>
Table 6 Current recovery rate estimates

<table>
<thead>
<tr>
<th>Material</th>
<th>Covec Rate (no.)</th>
<th>Covec Rate (t)</th>
<th>Envision Rate (no.)</th>
<th>Envision Rate (t)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glass</td>
<td>73%</td>
<td>73%</td>
<td>64%</td>
<td>64%</td>
</tr>
<tr>
<td>Aluminium</td>
<td>47%</td>
<td>47%</td>
<td>45%</td>
<td>45%</td>
</tr>
<tr>
<td>Plastic</td>
<td>47%</td>
<td>47%</td>
<td>40%</td>
<td>40%</td>
</tr>
<tr>
<td>Liquid paper board</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Total</td>
<td>58%</td>
<td>69%</td>
<td>45%</td>
<td>58%</td>
</tr>
</tbody>
</table>

Predicted return rates

64. Again, we draw on the work previously done to estimate the effects of a CDS on container recycling. While there are a range of CDS’s in place overseas, both Envision (2015) and Covec (2016) use the experience of South Australia in their respective predictions. Covec (2016) used statistical (regression) analysis to estimate the relationship between the refund value and container returns in South Australia between 2005 and 2014 and then convert the results into return rates for each CDS material type. Envision (2015) apply return rates observed in South Australia in 2013.

65. Table 7 contains the total predicted return rate following the introduction of the CDS is similar in magnitude across both Envision and Covec estimations. However, for our purposes the similarity is somewhat deceptive given the different baseline volumes from which the recycling rates are calculated. This is shown in the respective difference columns, where the percentage point changes for each CDS material type are displayed. The percentage point change in the rate of total recycling between the two sources is eight percentage points.

Table 7 Predicted recycling rates following CDS (tonnes)29

<table>
<thead>
<tr>
<th>Material</th>
<th>Covec</th>
<th>Envision</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note that the Covec (2016) estimate (at page 15) of the total likely recycling rate post-CDS is 79%, the same figure used by Envision (2016).

29 Note that the Covec (2016) estimate (at page 15) of the total likely recycling rate post-CDS is 79%, the same figure used by Envision (2016).
As mentioned above, the estimated impacts (costs and benefits) are driven by the change in actual volumes/numbers of containers recycled as a result of the CDS; the change in the rate of recycling is an intermediate step in calculating those volumes/numbers. We use these figures to construct “upper bound” and “lower bound” estimates to produce a range for the additional recycling likely to result from the CDS. The “upper bound” uses the higher of the consumption estimates from Table 5 and the greatest predicted change in recycling for each CDS material from Table 7, while the “lower bound” starts from the lower consumptions figures and uses the lesser of the predicted changes for each CDS material type.

Table 8 shows that the range for the volume of additional recycling possible as a result of the CDS is 21,415-61,549 tonnes. These figures represent a total change from baseline figures of 12% and 24% respectively. Covec (2016) estimated an increase in recycled volumes following CDS of 34,020 tonnes (a change of around 20%), while Envision (2015) calculated that an additional 45,865 tonnes of recycling would result from the CDS (a change of around 43%).

It is conceivable that some of the additional container recycling following a CDS will continue to be recovered through existing kerbside systems. We suggest that this proportion would be 10%.30

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30 The reasons for this might be that the deposit is not sufficient for some householders to separate and accumulate containers to redeem themselves, or that they are willing to effectively donate the deposit to others.

31 This is consistent with Covec (2016). Jacob Marsden, in their data assumptions report use a figure of 7%. Reported estimates for South Australia indicate that around 12% of eligible containers come through the kerbside system (New South Wales Environment Protection Authority (2015) Op. cit. p.24. Envision (2015)
### Table 8 Additional recycling following CDS

<table>
<thead>
<tr>
<th></th>
<th>Upper bound</th>
<th></th>
<th>Lower bound</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>Tonnes</td>
<td>Number</td>
<td>Tonnes</td>
</tr>
<tr>
<td></td>
<td>(millions)</td>
<td></td>
<td>(millions)</td>
<td></td>
</tr>
<tr>
<td>Glass</td>
<td>226</td>
<td>47,114</td>
<td>51</td>
<td>12,811</td>
</tr>
<tr>
<td>Aluminium</td>
<td>327</td>
<td>4,721</td>
<td>160</td>
<td>2,394</td>
</tr>
<tr>
<td>Plastic</td>
<td>207</td>
<td>7,726</td>
<td>128</td>
<td>4,992</td>
</tr>
<tr>
<td>Liquid paper board</td>
<td>97</td>
<td>1,988</td>
<td>30</td>
<td>1,218</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>857</strong></td>
<td><strong>61,549</strong></td>
<td><strong>369</strong></td>
<td><strong>21,415</strong></td>
</tr>
</tbody>
</table>

Assume 20% of containers recovered under a CDS would come from existing kerbside or commercial schemes.
Estimated effects

69. This section presents estimates of the costs and benefits relevant to the analysis. When estimating these costs and benefits we acknowledge that the predicted return rates identified above will take time to fully accrue. Based on previous experience and expert opinion\(^\text{32}\) we apply a ramped approach over five years to cost and benefit accrual. In particular, we assume that achievement of predicted return rates (and the resulting costs and benefits associated with such return rates) is as follows:

- Year 1 30%
- Year 2 55%
- Year 3 70%
- Year 4 80%
- Year 5 100%

Costs

70. This section presents the estimated costs of the proposed CDS. The costs in this section are presented in non-discounted (actual) terms. All of the estimates contained in this section are relative to a counterfactual of “no CDS.”

Collection costs

71. The most recent study investigating national options to increase packaging resource recovery in Australia found that for CDS options “…a large amount of new infrastructure is required for the collection, handling and processing of beverage containers.”\(^\text{33}\) This analysis, subsequently applied by Covec (2016) in their assessment of the costs and benefits of a CDS in New Zealand. The estimated costs are expressed on a per unit (i.e. per container) basis, and are fully inclusive of both operating and capital costs.

72. The model envisaged by Envision (2015) does not require additional basic collection infrastructure. There is no requirement for the introduction of Reverse Vending Machines (RVMs) as it is proposed that direct returns would be through collection depots.

73. Existing and proposed infrastructure could be used as collection depots, which would reduce the need for capital expenditure markedly. For instance, in Auckland capital and operating funding has been agreed to establish 12 Community Recycling facilities under the banner of its Resource Recovery Network, between 2014 and 2016.

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\(^{32}\) Personal communication with Geoff Johnston, One World Environmental Services Pty.

2024. These Community Recycling Centres (and transfer stations) are designed to be “one-stop shop” recycling facilities with wide geographical coverage and on land that is already owned by Council. We understand that there is sufficient capacity for the facilities to handle the anticipated volumes of recyclate following the introduction of the CDS. In common with South Australia, existing transfer stations could also be utilised.

74. Furthermore, charitable and volunteer and other organisations such as those providing work skills for people with disabilities, may wish to operate as collection depots. We have not been able to ascertain the extent to which such organisations have available space and infrastructure, but the operating costs of such activity would likely fall within their core (voluntary and charitable) purposes. In addition, such organisations are likely to be pro-active in their pursuit of container refunds in terms of operating “bottle drives” and the like.

75. Finally, there are existing businesses that might feasibly be involved as collection depots. The most obvious example is scrap metal dealers, but a range of other existing businesses could conceivably participate, with little additional cost involved.

76. Taken together, these factors support the notion that significant investment in new infrastructure would not be required, at least in Auckland. We are unsure the degree to which this situation applies more widely across New Zealand. However, we do note that survey data contained in the Envision report indicates all responding Councils had community recycling programmes in place. We also note that the organisations and private businesses who could participate in the CDS could do so on a national basis with little difficulty.

77. We use a three-step process to calculate the collection costs of the CDS, while accounting for the presence of existing infrastructure. First, we divide the estimated unit cost for collection infrastructure for depots used most recently (4.9 cents/container)\(^{34}\) into capital and operating components. Previous studies provide no guidance on the correct split; for simplicity we assume in the first instance that capital costs account for 50% of unit costs, and operating costs the remaining half.

78. While there is a range of existing infrastructure available for use, we anticipate that some adaptation would be required and that the additional volumes under the CDS would impose some costs in terms of capacity. We assume that the share of infrastructure costs relating to capital that apply to this analysis is 50% (i.e. this share accounts for capacity costs on, and adaptation of, existing capital). The assumption applied to operating costs is 25% (i.e. to account for the addition of particular skills and expansion of capacity driving labour force needs).

79. Applying these assumptions to the predicted number of containers likely to be returned following the CDS shows the likely collection infrastructure costs of the CDS. The range of costs, on a steady-state annualised basis is $49.4 million-$30.7 million (see Table 9). Of these total costs, fixed capital accounts for $32.9 million - $20.5 million while $16.5 million - $10.2 million relates to associated operating costs.

80. We assume that operating costs accrue in line with the profile above (i.e. over a five-year period). Capital costs however, are assumed to occur in the first two years, with two-thirds incurred in year one and one third in year two. Furthermore, we assume that further purchase of capital after the initial two year phase-in period is not required.

Table 9 Annualised collection infrastructure costs of CDS

<table>
<thead>
<tr>
<th>Container numbers (m)</th>
<th>Costs ($m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper bound</td>
<td>2,689</td>
</tr>
<tr>
<td>Lower bound</td>
<td>1,672</td>
</tr>
</tbody>
</table>

Offsetting reduction in collection costs

81. There are likely to be collection cost savings as a result of a CDS. While existing kerbside recycling collection costs are not solely driven by volumes of relevant recylcate, costs naturally reduce where there is less to collect. In addition, the overall density of materials is increased (i.e. less volume per tonne of collected material, so for a given body size each truck is able to be loaded more fully) and the average value of materials is increased, principally as a result of the removal of low value glass.

82. We draw on specialist advice and analysis using a proprietary model to estimate possible costs savings to collection authorities (principally Councils). We provide a summary here and full details are provided in a separate expert report.35 The key cost dimensions of interest are:

(a) Labour
(b) Fuel
(c) Plant operating costs
(d) Plant depreciation
(e) Margin
(f) Overheads
(g) Contamination control (labour and administration)

83. We have the most detailed and complete data for collection services in Auckland. Within the confines of commercial sensitivity we were able to calibrate a proprietary collection cost model to Auckland settings, given an idea of total collection costs

35 One World Environmental Solutions (2017) XXXX.
In order to estimate national collection cost savings, we collected relevant data from other Territorial Authorities (TAs) and used the basic input relationships in the Auckland model to extrapolate potential cost savings for different TA groupings, based on the collection method currently in use. Three basic cost groupings were used (see Table 10).

### Table 10 Collection taxonomy

<table>
<thead>
<tr>
<th>Collection</th>
<th>Territorial Authorities</th>
<th>Services</th>
</tr>
</thead>
</table>

---

36 See the appendix for more detail on the estimation model and expert advice received.

37 Note that the analysis excludes services provided by private parties, of which there were 127,848 services provided in 12 jurisdictions.
<table>
<thead>
<tr>
<th>Collection</th>
<th>Territorial Authorities</th>
<th>Services</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two-bin system co-mingled, excluding glass</td>
<td><strong>26:</strong> Hamilton City Council, Hauraki District Council, Matamata-Piako District Council, Rotorua District Council, South Waikato District Council, Thames-Coromandel District Council, Whakatane District Council, New Plymouth District Council, South Taranaki District Council, Stratford District Council, Hastings District Council, Manawatu District Council, Palmerston North City Council, Carterton District Council, Masterton District Council, South Wairarapa District Council, Wellington City Council, Tasman District Council, Nelson City Council, Buller District Council, Ashburton District Council, Mackenzie District Council, Selwyn District Council, Central Otago District Council, Dunedin City Council, Queenstown-Lakes District Council</td>
<td>469,453</td>
</tr>
<tr>
<td>Two-bin system, glass collection component</td>
<td>As immediately above</td>
<td>469,543</td>
</tr>
</tbody>
</table>

**Source:** One World Environmental Solutions

84. The annual average cost savings for Auckland Council (once the CDS is fully operational) are estimated to be $3.29 million. This calculation is based on 570,000 services with a fortnightly collection and an assumed 100% rate of presentation. These cost savings reflect a change in truck numbers required from an initial 51 to 39 once the scheme is fully operational.

85. The assumed lift rate (i.e. number of bins lifted per hour) remained the same with and without the CDS. However, the rate at which the truck could be packed with recycled material rose from the current rate of 166 kg/m³ to 220 kg/m³. In other words, more material for a given truck axle weight is able to be carried. The amount of recycled material collected per lift reduces from 11.46 kilograms to 7.2 kilograms.

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38 The 100% presentation rate means that every bin that is available to be collected is put out every fortnight. While that is not necessarily realistic it is the assumption used for contracting purposes.
86. The process for extrapolating Auckland-specific cost savings to the national situation involved two steps. The first step was to extrapolate system costs with a CDS in place for Auckland to a national setting. That is, model New Zealand with a CDS in place as an enlarged version of Auckland (a fortnightly single-bin co-mingled service). Implicit in this approach is a move away from other systems toward a more uniform system nationwide. This simplifying assumption was necessary to make the analysis tractable. The result is an estimated annual average cost of collection totalling $35.7 million.

87. The second step involved adjustment of the underlying costing model to reflect the varying systems in place throughout the country. The costs associated with each system without a CDS (i.e. the status quo or existing situation) are summed to provide an estimate of existing aggregate national expenditure on recycling collection. Estimated annual average recycling collection costs nationally were $55.8 million, made up as follows:

- $30.9 million associated with the operation of a single bin co-mingled system
- $12.3 million for co-mingled collection services that do not include glass
- $12.6 million for the separate collection of glass only

88. On this basis, the national collection cost savings figure was estimated to be $20.1 million (once the CDS is fully operational across the country). We treat this as an “upper bound” figure in our analysis, with the “lower bound” figure representing a reduction in total volumes collected between the two scenarios- $12.5 million (a reduction of around 37%).

89. Clearly, given the relativity between the estimated annual average cost savings possible for Auckland and New Zealand as a whole, the gains to be made from moving away from a two bin to a single bin collection system with a CDS are significant. In effect, a CDS largely removes the need for a ‘doubling up’ of collection systems to account for glass and other recyclates.

90. We stress that while the cost saving estimates are derived from the best available information, they are not perfect. They give a robust approximation of likely savings at the national level based on expert opinion, a useful sample of key data inputs (from Council contacts around the country) and proprietary modelling.

91. We assume the national savings accrue over a five year period in the proportions outlined in paragraph 69 above.

**Transport and processing costs**

92. Covec (2016) identified additional transport costs associated with delivery of returned containers from collection depots to a Materials Recovery Facility and the transportation of additional processed material to recyclers or elsewhere. They then

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39 Note that the estimated costs do not allow for inflation, which is customary in cost-benefit analyses.
use transport costs per tonne kilometre for trucks, average distances and the relevant tonnage of material to derive the additional transport costs following a CDS.

93. We essentially replicate that process, but produce “upper bound” and “lower bound” estimates, based on the tonnes recovered figures derived earlier in the report. In the absence of improved data, we use the same underlying assumptions as Covec (2016).40 Table 11 shows that that additional transport costs are estimated to lie between $1.4 million and $2.7 million on an annualised basis. Consistent with the other costs that depend on the amount of CDS material recycled, we use a linear ramp-up assumption in our net present value analysis further below.

Table 11 Additional transport costs following CDS

<table>
<thead>
<tr>
<th></th>
<th>Cost per tonne km</th>
<th>Average distance</th>
<th>Tonnes</th>
<th>Total cost ($000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collection point to MRF</td>
<td>$0.129</td>
<td>50km</td>
<td>229,425 (Upper)</td>
<td>$1,480 (Upper)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>157,987 (Lower)</td>
<td>$1,019 (Lower)</td>
</tr>
<tr>
<td>MRF to Recycler</td>
<td>$0.129</td>
<td>150km</td>
<td>61,549 (Upper)</td>
<td>$1,191 (Upper)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>21,415 (Lower)</td>
<td>$414 (Lower)</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td>$2,671 (Upper)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$1,433 (Lower)</td>
</tr>
</tbody>
</table>

94. We apply a similar process to estimation of processing costs. That is, we use the same cost parameters as Covec (2016), adjusted for the range of estimated tonnes collected to produce upper and lower bound estimates of processing costs. We estimate processing costs by comparing the cost of base case recycling with that related to CDS recycling by CDS material type, using sorting costs for commingled material and source-separated material. In the base case we assume that 20% of recycling is separated at source with the remainder commingled. For the CDS case we take account of the assumption that 10% of returns will be through kerbside recycling.

95. Inputting the predicted CDS recycling amounts from Table 5 and Table 8 above results in processing costs savings, despite the increase in tonnes collected. The savings are because of cleaner material relative to the base case commingled situation. Annualised estimated costs are as follows:

- Using “upper bound” tonnage amounts- -$1.5 million
- Using “lower bound” tonnage amounts- -$2.2 million

40 Note that the cost per tonne km assumed an average payload of 13.1 tonnes.
96. Two points relating to processing impacts are worth noting. The first is the possibility of further investment in machinery or other sorting technology being required to process the additional CDS materials. We acknowledge this possibility but lack the necessary information on which to estimate such potential costs. In addition, there is an existing processing facility in place so it seems reasonable to us to assume that any additional investment would be marginal at best.

97. The second point relates to the possibility of a reduction in gate revenue to the processing facility as a result of lower volumes being sent for processing from existing kerbside collections. The corollary of this is that the organisation/s that send the material to the processing facility (usually a TA) would see a reduction in the gate fees paid. While potentially important for the two parties involved, for the purposes of this analysis, this is essentially a transfer between parties and is therefore not included in the CBA. Thus, while we acknowledge the possibility of such a transfer, we do not explicitly include any figures relating to this aspect in this report.

98. To the extent that there are other impacts to processors that give rise to reductions in revenue that may be greater than the savings of other parties (e.g. the quality of material may not necessarily improve) it is plausible that processors are negatively impacted. The available evidence (from an independent expert and the 2016 Covec report) does not support such a proposition, but we acknowledge the possibility. Further work is needed to establish the basis and quantum of any such impacts, but our assessment is that such impacts would not materially affect the analysis.

**Participation costs**

99. There are two major cost categories relating to household participation: the value of time taken to participate in the scheme (to accumulate containers, travel to drop containers off and the redemption process), and the vehicle operating costs of transporting containers for redemption. Where the CDS leads to behaviour that differs from what would otherwise be the case in the absence of the CDS, there is a cost from the CDS. The question is the extent to which behaviour is changed and whether the cost involved is greater than any benefit as a result of the behaviour change (i.e. is there a net cost?).

100. Measuring the costs of participation is not straightforward. Indeed, one major study undertaken in New South Wales excludes some major components of household participation costs from its analysis. Specifically, the costs of consumers’ time and unpaid labour were excluded from the formal CBA undertaken due to difficulties in valuing such effects.

101. Furthermore, the cost of consumers’ time was excluded from the formal CBA “…because it does not account for the fact that many consumers are willing to pay (by donating time) for improved recycling outcomes and participate in the CDL system for reasons other than

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42 Note that fuel and vehicle operating costs were included in the analysis.
financial motivation.” 43 The study authors also note that “[P]revious studies reviews of the costs and benefits of recovering used packaging material have not included unpaid labour, including most analyses of kerbside recycling …”

102. However, other relevant studies have included such participation costs. Covec (2016) estimates that household participation costs of a CDS in New Zealand would amount to $33m per year, as a result of return rates increasing to 82% (by weight) as a result of the CDS.

103. Similarly, Marsden Jacobs Associates include household participation costs that include the value of unpaid time in studies into national CDS options, and a specific study of a proposed CDS in Tasmania. They estimate (at table 36) total annual household participation costs in 2020 for national CDS options that range from around $41 million to around $54 million.45 In the case of Tasmania, Marsden Jacob Associates estimate (at table 14) total annual household participation costs in 2025 to be $1.1 million.

104. Given the above, the following observations are germane to the appropriate treatment of household participation costs for our purposes:

- Household participation costs that relate to the value of time are not automatically or compulsorily included in studies of CDSs or other recycling initiatives
- Estimating value of time costs for households is complex, lacks precision and could span from 0% to 100% of the relevant base costing factor
- Comparable estimates in Australia suggest that the most recent New Zealand costs estimated for household participation may be overstated, particularly given the infrastructure type studied46.
- Consumers’ willingness to pay for recycling outcomes and underlying motivations are important, but often overlooked factors in determining net impacts

105. There are two obvious questions relating to household participation costs; should the value of time be included in the analysis and if so, what is the best method for calculating such costs (taking into account potential offsetting benefits)? There are reasonably strong theoretical arguments in favour of including the value of time as a cost. However, there is equally strong justification for the inclusion of offsetting benefits. To the extent that one element is included, so too should the other.

106. From a practical perspective, obtaining sufficient and robust data is difficult. While it is useful to include quantitative estimates of as many cost elements as possible,

44 Ibid, footnote 17, p.166.
45 Note however, that in determining the appropriate value of time to use, a survey of the relevant literature was undertaken. A wide span of values, linked to the average or median wage rate, was suggested in the literature, ranging from 0%-100%, acknowledging the proposition that such costs could be effectively valued at zero.
46 RVMs are generally acknowledged as requiring less time for consumer returns than collection depots. The Covec analysis (2016, p.21) used RVMs as the basis for costing and assumed that depot costs would be the same.
where data is patchy the inevitable cost is lack of accuracy. Further, use of a single point estimate invites spurious accuracy- an over-confidence in the precision of the resulting estimate.

107. Our approach is to again consider “upper bound” and “lower bound” possibilities to establish a range of potential costs. The “upper bound” includes the value of time as well as the vehicle operating costs of participation. The “lower bound” includes just the latter.

108. The key assumptions used to calculate household participation costs are shown in Table 12. The assumed number of trips per year was taken from the Marsden Jacob Associates national study in Australia for non-RVM CDS infrastructure. This relatively low frequency reflects trip-specific purposes and thus, the proportion of trips that are considered “new” (and relevant to the CBA) is higher than for RVM infrastructure (assumed to be 5%-10% elsewhere). The 50% proportion is also higher than the 30% assumed by Marsden Jacob.

109. The use of this share is for reasons of conservatism, as well as the need to account for predicted volumes of CDS material, which might not necessarily fit into “normal” planning for trips to transfer stations or other non-RVM infrastructure. The remaining assumptions around trip distance and trip time also take figures previously used and adjust these upwards slightly, consistent with the conservatism in this cost category.

Table 12 Household participation cost assumptions

<table>
<thead>
<tr>
<th>Input</th>
<th>Value</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of households</td>
<td>1,691,500</td>
<td>Statistics New Zealand (Mean year ended June 2016)47</td>
</tr>
<tr>
<td>Number of trips per year</td>
<td>3.55</td>
<td>Marsden Jacob Associates (2013)</td>
</tr>
<tr>
<td>Time per trip (includes redemption time)</td>
<td>12 minutes</td>
<td>Own estimate</td>
</tr>
<tr>
<td>Proportion of trips that are new</td>
<td>50%</td>
<td>Own estimate</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Input</th>
<th>Value</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time cost (per hour)</td>
<td>$6.90</td>
<td>Covec (2016), from NZTA</td>
</tr>
<tr>
<td>Cost per kilometre travelled</td>
<td>$0.72</td>
<td>Inland revenue(^48)</td>
</tr>
<tr>
<td>Trip distance (kilometres)</td>
<td>5</td>
<td>Own estimate</td>
</tr>
</tbody>
</table>

110. We estimate annualised total household costs for returns would be between $11 million and $15 million. The difference of approximately $4 million represents the value of time calculated by multiplying the first four items in the table above. We apply the same effective ramp-up period of five years as was used above in the net present value calculations to follow. That is, in year one the costs lie between $3.2 million and $4.5 million, while the corresponding interval for year five is $10.8 million to $14.9 million.

111. Following the introduction of a CDS there would be costs associated with monitoring, enforcing and reviewing the operation of the scheme. The Envision (2015) model proposes such activities be undertaken by a public agency, which makes sense from a probity perspective. The costs of such activities are not routinely made public so it is difficult to estimate these with any precision. Envision (2015) report that discussions with parties overseas suggests that monitoring and review activities requires up to two staff (FTE). Covec (2016) assigns a cost of $0.5 million per year for administration. This figure is broadly in line with our previous attempts to estimate such costs in other contexts and are included as such.

112. In addition, Covec (2016) has estimated that private costs of $1 million per annum would be incurred for the auditing of deposits paid to the various parties. Given the number of parties involved and likely burden, this seems an appropriate estimation, relative to the public costs identified above. Covec (2016) also includes an annualised cost of $0.8 million for education and communications activities. We have no basis on which to disagree with such costs and again consider they are a reasonable estimation. We do note however, that the need for such activities would reduce over time. We phase out these costs linearly in a five-year period following the initial year.

113. Thus, administration costs of $2.3 million are included in the first year, which reduces to $1.5 million by the sixth year. There is no “upper bound” and lower bound” for these costs.

Benefits

114. This section presents the estimated benefits of the proposed CDS. The benefits in this section are presented in non-discounted (actual) terms. All of the estimates contained in this section are relative to a counterfactual of “no CDS.”

Reduced costs of waste collection

115. We estimated that between 21,415 and 61,549 tonnes of CDS material that wasn’t previously recycled would now be recycled as part of a CDS and hence would be diverted from landfill. Using an assumed cost of waste collection broadly consistent with Covec (2016)\(^49\) of $60 per tonne, total avoided costs of waste collection are between $1.3 million and $3.7 million on an annualised basis once the CDS is fully operational. For the purposes of calculating the net present value of effects in the next section, we assume the benefits accrue over five years in the same manner as described in paragraph 69 above.

Reduced costs of waste disposal

116. These benefits relate to the avoided costs associated with the additional volume of containers that would have previously gone to landfill now being redeemed and recycled as a result of a CDS (between 21,415 tonnes and 61,549 tonnes). The weighted average cost of waste disposal in New Zealand was estimated to be $155/tonne in 2012.\(^50\) This is essentially a representation of the private costs of commercial provision. In Auckland, we understand that the bulk rate for disposal in 2016 ranged from $144-$180 per tonne (exclusive of transport costs).

117. However, there are some external (largely environmental) costs that are not necessarily reflected in this commercial charging regime. These social costs range from $1-$2-$19/tonne, though most likely to be in the lower half of the range.\(^51\) The current waste levy is within this range. While no further study has taken place, it has been suggested elsewhere that a modest estimate of the “true” costs of disposal to New Zealand landfills would be $200/tonne.\(^52\)

118. A host of other factors are relevant to estimating this cost, including the:

- high volume to weight ratio of beverage containers resulting in space savings for landfill operators from diverted containers;
- imperfect way landfill charges are passed on to households (i.e. some households face user charges while other households pay indirectly through rates); and

\(^{51}\) Ibid. p.17.
\(^{52}\) Private conversation, and unpublished paper on the costs and benefits of a CDS.
timeframe over which some of the external effects may arise (and by implication the estimated lifetime of a landfill and the ability to account for externalities in the timeframes for studies such as these).

We are not in a position to accurately or adequately account for such factors in this analysis, and take the general approach of seeking “the middle ground” of estimates. Accordingly we use a value of $175 per tonne (including transport costs) for our analysis.

119. We calculate avoided costs of landfill associated with a CDS to be between $3.8 million and $10.8 million on an annualised basis once the CDS is fully operational. For the purposes of calculating the net present value of effects in the next section, we assume the benefits accrue over five years in the same manner as described in paragraph 69 above.

Reduced litter

Market-based avoided costs

120. The impact of a CDS on litter reduction is well established. The recent decision to introduce a CDS in New South Wales was made principally on the back of the results of a CBA where benefits to communities from reduced litter volumes were estimated using their willingness to pay for such reductions. In addition to these welfare-related benefits, there are benefits in the form of reduced costs of litter clean-up.

121. In terms of litter clean-up Covec (2016) estimated savings (avoided costs) of around $0.9 million per year using assumptions for the proportion of litter explained by beverage containers, the fall in beverage container litter, and the current costs of litter clean-up activities in Auckland (extrapolated nationally). This seems a reasonable approach, though may underestimate avoided costs. We apply the same method, using the Covec (2016) parameters as a “lower bound” and adjusted parameters to estimate the “upper bound” of the range.

122. The 2014/15 National Litter Survey showed that drinks packaging accounted for 19.4% of litter, with a range among the eight urban areas surveyed of 14%-27%. For the past ten years the Watercare Harbour Clean Up Trust has cleaned up 4 million litres of waste from Auckland Harbour. They estimate that beverage containers would account for around half of that volume.

123. No New Zealand-based figures are available for the expected reduction in beverage container litter following a CDS, but Northern Territory estimates suggest that beverage container litter fell 46% following the introduction of a CDS. Expert opinion, and an examination of the very low share of litter (2.2% of total litter) accounted for by beverage containers in South Australia suggests that the rate of change for beverage container litter after a CDS would be greater. For our purposes

we assume that beverage container litter would fall by 70% after a CDS. This suggests that national litter volumes in New Zealand would fall between 8.9% and 13.6% following a CDS.  

124. Auckland Council spends an estimated $8.3 million per annum on litter collection from roads, shopping areas, public places, carparks and footpaths. In addition, costs associated with street sweeping, motorway litter clearing, storm water litter management and event clean-up are estimated to conservatively total a further $2.8 million per year.  

125. Thus, estimated litter clean-up costs in Auckland are in the order of $11 million per annum, which means average annual litter clean-up costs per person of $6.96 (for a population of 1,600,000). Using $6.96 as a national figure and the 8.9%-13.6% reduction in predicted litter volumes following a CDS, we estimate that avoided costs of litter clean-up across New Zealand would be between $2.9 million and $4.4 million on an annualised basis once the CDS is fully operational. For the purposes of calculating the net present value of effects in the next section, we assume the benefits accrue over five years in the same manner as described in paragraph 69 above.

Non-market benefits

126. The avoided costs calculated above are in essence market-based. In addition to these, there may be non-market benefits, some of which may be quantified. For instance, we are aware of a range of volunteer organisations involved in litter clean-up work in Auckland and nationally. These include:

- The Watercare Harbour Clean Up Trust, who undertake cleaning activities in and around the Waitemata Harbour involving around 16,500 volunteer hours
- Manukau Beautification Trust, who picked up almost 14 tonnes of rubbish from Auckland’s rail corridor in the 2015/16 year, as well as undertaking a one-off clean-up event at Puhinui Stream, involving over 1,900 volunteers for an average of four hours per person
- Sustainable Coastlines who provide around 5,000 volunteer hours per year on litter clean-up activities
- Keep New Zealand Beautiful, who run Keep New Zealand Beautiful week in which over 43,000 volunteers give 2 hours each to remove litter from local communities around the country

127. These volunteer hours are treated in much the same manner as the value of time for household participation costs above. At one end of the spectrum, time volunteered is done so for motivations other than financial reward and given willingly. Therefore, it is valued at zero and any benefits from the effective reduction in time spent clearing

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55 Again, we assume a five year period for realisation of these results, with the same profile as outlined in paragraph 69.
56 Conservative in the sense of excluding relevant staff costs for those who let contracts (i.e. we include contract values for providers only). Further, no allowance has been included for costs associated with parks and community facilities litter clean-up.
litter are zero. At the other end of the spectrum is to value volunteer time in the same way that it was for household participation in a CDS (i.e. at the non-work travel time of $6.90 in NZTA's Economic Evaluation Manual).

128. We use the higher of the litter reduction figures above (13.6%) to reflect the higher proportion of litter in waterways accounted for by beverage containers (up to 50% versus a maximum of 27% for urban areas). We conservatively estimate a total of 200,000 volunteer hours nationally, leading to a range of non-market benefits for litter clean-up of $0-$1.38 million per year.

129. To this we add non-market benefits from litter reduction in the form of marine wildlife impacts. It has been estimated that around 10 green turtles per year for plastic ingestion. Of these, half do not survive. It is not clear the extent to which drink container plastic (versus plastic bags, for instance) are responsible for the deaths, but there is some evidence of beverage container labels and plastic.

130. We start with the value of statistical life figure used to estimate benefits associated with reduced road transport fatalities of $4.06 million. Assuming the relevant proportion of this value that would apply to marine life is 5% and that the proportion of deaths attributable to beverage container materials is 25%, we multiply the calculated value by the estimated number of deaths to arrive at the maximum possible benefit from avoided marine life death of $203,000 per year. Using the 8.9%-13.6% reduction in predicted litter volumes following a CDS in a probabilistic sense, we estimate that the annual benefit from avoided marine life death due to litter is between $23,000 and $34,000 per year once the CDS is fully operational.

131. The major non-market benefit category relates to consumer welfare. In particular, people may perceive and value the aesthetics of cleaner public places due to less (beverage container) litter now and into the future (i.e. “bequest” benefits for future generations from less visible litter and litter going to landfill). A frequently cited Australian study sought to quantify/monetise such amenity benefits. The study found that households were willing to pay $4.15 for a 1% point reduction in litter. However, the authors caution that such a figure should only be used where litter reductions are 10% or greater of the total volume.

132. In our view, the likely range of litter reduction impacts as a result of a CDS (8.9%-13.6%) is sufficiently close to this suggested threshold to be suitable for use in our analysis. That is, we believe that 8.9% is synonymous with a ‘noticeable improvement’ in litter reduction (relative to a base case of 0% litter reduction), the

57 This is the equivalent of the “lower bound” treatment of participation costs above, where the value of time is excluded.
61 Ibid pp.iii and iv.
level that respondents were informed corresponds to a 10% reduction. Intuitively, it is difficult to conceive that people would not be willing to pay anything at all for an 8.9% reduction in litter, while being willing to pay $41.50 for a 10% litter reduction.

133. Nevertheless, we acknowledge the uncertainty in terms of applying the full willingness-to-pay figures to litter reductions below the threshold of 10% of total volume. Given how close our estimated “lower bound” litter reduction figure is to this threshold and the possibility that measurement error has resulted in the threshold not being met, we do not support the view that the “lower bound” estimate of benefits should be zero. Rather than assume linearity, we apply a 50% reduction to the “lower bound” estimates of the willingness-to-pay for litter reductions as a conservative approach to accounting for the so-called threshold effects.

134. Using figures adjusted for differences in currency value and GDP, we calculate the equivalent willingness to pay in New Zealand for a 1% reduction in litter volumes to be $3.49. Applying that to our estimated range of litter reductions following the introduction of a CDS, we estimate that households would be willing to pay between $15.58 (50% of the calculated figure of $31.17) for a reduction of 8.9%, and $47.43 for a reduction of 13.6%. On a national level, this range is $26.4 million to $80.2 million per year on an annualised basis once the CDS is fully operational.

135. Obviously these impacts are significant, and there is some uncertainty attached to them. Willingness to pay surveys have been accused of producing over-stated benefits, as respondents either do not fully understand the context of the question and more importantly claim values that are greater than what they would actually pay as they don’t believe there is a strong possibility that they will be faced with having to pay.

136. In the context of litter reduction, a particular question is whether the willingness to pay is predicated on the mechanism used to bring about the change in question. In particular, is adequate consideration given to the cost-effectiveness of particular options to reduce litter? Covec (2016) suggests that amenity values should only be included in the analysis if a CDS is the most cost-effective policy to reduce litter and increase public space amenity and that further work should be done on optimal litter reduction measures.

137. While we agree further research could be helpful, we also acknowledge that analyses of this type often take place in an information-poor environment, and judgment is required. In other words, it is very rare for a CBA to take place with perfect information or complete certainty. Reliance on the best available evidence will always be required, and we believe that this is the case here. In addition, the objective of a CBA is to determine the extent to which society is made better off (if at all) as a result of a policy proposal, rather than to necessarily determine the least cost method of achieving a particular goal.

138. A further question that has been raised in relation to the type of direct consumer benefits under study here is whether they are additional to the other benefits. Covec (2007) questioned whether there is a benefit that households are receiving that is not accounted for elsewhere? Their view was that there is and that including the
consumer surplus (the difference between their willingness to pay and current costs of litter reduction) can be added to other avoided cost-related benefits.62

139. Using the estimated $6.96 per person as the national clean-up cost, annualised total costs in New Zealand are $32.7 million. The estimated consumer surplus benefits (i.e. willingness to pay less the costs of litter reduction) for the litter reductions estimated above are $23.4 million–$75.8 million on an annualised basis once the CDS is fully operational.63 For the purposes of calculating the net present value of effects in the next section, we assume the benefits accrue over five years in the same manner as described in paragraph 69 above.

Value of materials

140. The additional CDS material collected for recycling would have an additional market value. In addition, the value of existing collected materials would increase due to reduced cross-contamination (i.e. a CDS produces cleaner material than existing systems). We use the values and assumptions in table 15 of Covec (2016), applied to the range of additional tonnage collected by material type, and in the case of plastic the existing tonnage collected that is now less contaminated to derive the relevant values. The annualised values we estimate once the CDS is fully operational are $7.9 million–$18.5 million. The time profile for accrual of these benefits is the same as that described in paragraph 69 above.

Welfare gains from additional recycling

141. There are direct consumer benefits associated with recycling which are likely to be relevant to a CDS. In a CBA of recycling Covec (2007) acknowledge “…that there is a consumer benefit associated with recycling and a disbenefit from not recycling.”64

142. Like the direct consumer benefit (amenity value) from a reduction in litter discussed previously, there is a benefit that households are receiving that is not accounted for elsewhere, and these benefits are additional to “…the other benefits of recycling which take account of the external costs of landfill and where steps are being taken in other markets, through other regulations, to tackle externalities of resource use.”65 We consider these benefits to be additional to those in respect of litter reduction, as we interpret litter reduction relating to visual amenity (i.e. the presence of litter), while recycling is what happens to relevant litter once it is cleared (i.e. the disposal of beverage containers).

143. Covec (2007) calculated that the central estimate of households’ willingness-to-pay for additional recycling was $183/tonne for paper, plastic, glass and metals. This value was based on households’ willingness to spend additional time recycling over and above the time or money currently spent on recycling. The difference represents

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63 Recall the “lower bound” estimate is discounted by 50%.
65 Ibid.
a consumer surplus and was used as an estimate of direct consumer benefit in the Covec (2007) study.

144. We use an updated value of time of $6.90{66} to derive a value per tonne of recycling of $242 per tonne. This translates to a value of 24.2 cents a kilogram. Using the upper bound and lower bound for additional recycling as a result of a CDS, we calculate that households would recycle an additional 12.66 kilograms-36.39 kilograms per year.

145. Multiplying this volume by the value results in an estimated value for consumer surplus from additional recycling between $3.06 and $8.81 per household. Aggregated across all 1,691,500 households results in total benefits in the order of $5.2 million-$14.9 million per year on an annualised basis once the CDS is fully operational. The time profile for accrual of these benefits is the same as that described in paragraph 69 above.

**Qualitative benefits**

146. The preceding material sought to quantify and where possible monetise the expected benefits from a CDS. In addition, there is a range of other effects from a CDS that could be considered beneficial. These include non-quantifiable benefits as well as those that are not routinely considered as benefits from a resource-based economic CBA perspective. This section summarises these potential benefits. While we have made no attempt to quantify and monetise these impacts, we note that to the extent such quantification and monetisation is possible, the net effect would most likely be positive (i.e. benefits would outweigh costs and total net benefits would rise).

* Employment creation

147. A CDS is commonly thought to give rise to business and employment opportunities in terms of the collection and redemption of beverage containers following CDS introduction. Some claim that these opportunities are a benefit of a CDS and therefore should be included in any CBA. In general, CBA does not directly or explicitly include employment effects. The opportunity cost of labour employed (i.e. the going wage rate) is implicitly included as part of the various cost elements while any beneficial effect that arises from the deployment of labour to produce goods or services would be captured in terms of the outputs of that labour process (e.g. in the scale of additional recycling, or reduced litter).

148. The rationale generally used is that labour resources used to undertake activities associated with a CDS would (or could) have been deployed elsewhere in the economy. However, where there is unemployment in the relevant catchment or for the relevant skill area, it is possible that the opportunity cost of labour employed could be low (perhaps even zero). In such cases the impact of employment could be viewed as positive (i.e. the output produced comes at very low or no cost). There may also be fiscal benefits if the labour that is to be used was previously receiving

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66  Covec (2007) used the applicable rate at the time of their study- $5.20 per hour.

transfer payments from the government, but would no longer do so following a CDS.

149. Lack of available data and the transfer nature of employment effects (i.e. labour deployed in a CDS would likely have been deployed elsewhere in the economy) means we do not include employment effects in the analysis as such. We note however, that the benefits associated with employment may be broader than just the market wage, with such “externalities” thought to include better civic engagement, enhanced social interactions and overall gains in self-esteem/well-being. To the extent that a CDS does give rise to employment opportunities for previously unemployed or underemployed people, then such external effects could occur as a result.

* Other marine impacts

150. The material above considered the possible impact on sea turtles due to a reduction in beverage container litter in the marine environment. It is possible that other marine life (including sea birds) and/or the general marine ecosystem would also be positively impacted through the same channel. We do not have sufficient data to estimate the possible effects, but again note that they are likely to be positive in nature.68

* Greenhouse gas emission reductions

151. Raising the recycling rate and increasing the range of containers collected is likely to mean that far fewer virgin resources are needed to make new containers. As a result, savings in energy and reduced greenhouse gas emissions (GHGs) are likely.69 The potential for such reductions is acknowledged in the national packaging impacts cost-benefit analysis undertaken by Marsden Jacob Associates in Australia.70 Rather than assess the extent to which GHGs are affected in the production process for containers (i.e. resource use) the Marsden Jacob Associates analysis looks at the GHG issue from the perspective of landfill externalities. That is, it assesses the impact on GHGs of a CDS with reference to the (avoided) costs of GHGs from material that is deposited into landfills, but would not be under a CDS.

152. Regardless of the perspective taken, estimating impacts on GHGs from a CDS is not straightforward. The Marsden Jacob Associates approach listed five key factors including the monetary value of environmental damage caused by GHGs, emissions factors for each of the relevant materials, the presence of an emissions trading scheme and the average efficiency rate of landfill gas capture. All of these factors require detailed work to derive estimates appropriate for inclusion in the CBA. Further detail would be required to accurately estimate the production process benefits mentioned in the Envision report, and then calculate what the net effect would be on GHG emissions.

68 In addition, at least some of the beneficial effect could conceivably have already been captured in the litter reduction WTP estimates and therefore to explicitly include a further marine impact effect would be double counting.


153. There is no question that a CDS would have some impact on the amount of GHG emissions. However, the precise nature and extent of any impact is difficult to quantify and for that reason, while acknowledging the likely presence of beneficial impacts, we do not include any quantification or monetisation of such impacts in this analysis.

*Other external or co-benefits*

154. As part of their assessment, Marsden Jacob Associates investigated the potential for what they called co-benefits to arise from a CDS. The major co-benefit relates to additional recycling of non-CDS materials as a result of CDS collection depots or hubs becoming a “drop-off” service. The key issue for that analysis was the ability to determine the extent to which whether any non-beverage container recycling that does take place at the “drop-off” was over and above what would have happened in the absence of a CDS.

155. Due to insufficient evidence Marsden Jacobs Associates were unable to answer this question conclusively. As a result they did not include co-benefits in the main CBA. Without discounting the possibility of such effects occurring (which could result in beneficial impacts) we take a similar approach in this CBA.

*Support for charitable objectives*

156. Experience in South Australia suggests that voluntary and/or charitable organisations are able to capitalise on a CDS to boost their fundraising activities. Scouts in particular are frequently mentioned as major beneficiaries of a CDS. This can occur either in terms of such organisations establishing collection points or through the redemption of containers that are donated by others or sourced directly.

157. In CBA terms the degree to which people voluntarily donate their containers to charitable organisations is effectively a transfer (i.e. it does not alter the resources available to the economy in any meaningful way). As such, a CBA does not account for such transactions. As discussed in relation to employment, where organisations establish operations to undertake other activities that have financial reward, these undertakings are captured in terms of resources invested (i.e. opportunity costs) and outputs from the activities (i.e. increased recycling and/or avoided costs of landfill). Separate consideration of such impacts would risk double-counting.

158. There may be some argument that revenue raising through a CDS means that volunteer or charitable organisations are better able to supply services or could reduce their reliance on other fundraising actions. The latter might give rise to the possibility of additional resources being made available to other charities (who might otherwise have given to the organisation who now has CDS-sourced revenue streams). In essence, this series of possibilities also represents wealth transfers from one party to another. To the extent that there is some additional well-being effect from the transfer it is likely that it would be captured in the willingness-to-pay

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estimates summarised above. Again, our approach is to recognise the possibility of such effects, but not include such effects in the CBA.
Net effects

159. This section compares the benefits to the costs over the study period, in order to derive the net benefit to society from the CDS proposal. In order to make this information most useful for decision-makers, costs and benefits are expressed in present value terms. The time period for this analysis is 10 years and the discount rate applied is 6%. A five year phase-in period is assumed for the majority of costs and benefits, with exceptions for public information and education costs, which apply straight away but reduce linearly over five years to be zero in year six, and the capital costs of required infrastructure, which accrue in two years (two thirds in year one and the remaining third in year two).

160. Table 13 shows that the range of estimated net benefits (i.e. the extent to which society is made better off as a result of a CDS) is $184 million-$645 million in present value terms. Benefits exceed costs by over a factor of six in the upper bound scenario while the lower bound results in benefits that are well over three times the costs. Even in a worst-case scenario (high costs and low benefits) benefits are over twice the costs (i.e. the benefit-cost ratio is 2.22, with net benefits to society of around $144.4 million in present value terms).

161. It is important to note that these results do not include indirect or qualitative impacts. Our assessment is that the effect of including such impacts would be to raise the net benefits, so again the estimates produced here can be considered conservative in nature.

Table 13 Summary CBA results (NPV, $m)

<table>
<thead>
<tr>
<th></th>
<th>Upper bound</th>
<th>Lower bound</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total benefits</td>
<td>$762.5</td>
<td>$261.9</td>
</tr>
<tr>
<td>Total costs</td>
<td>$117.5</td>
<td>$77.9</td>
</tr>
<tr>
<td>Net benefits</td>
<td>$645.0</td>
<td>$184.0</td>
</tr>
<tr>
<td>Benefit-cost ratio</td>
<td>6.49</td>
<td>3.36</td>
</tr>
</tbody>
</table>

162. The composition of costs and benefits is shown below. Figure 3 shows the proportions that each cost category contributes to total costs (of $117.5 million). Household participation as well as operating and capital infrastructure costs are responsible for the vast majority of actual costs. On the other hand, processing and collection costs are negative (i.e. the processing and collection costs are reduced as a result of a CDS- due to cleaner material and reduced volumes of material respectively). In the case of reduced collection costs, the figure shows that total costs would be slightly more than double were it not for the contribution of collection cost savings.
Meanwhile, Figure 4 shows that over half of the estimated benefits relate to consumer welfare gains from reduced litter. Combined with welfare gains from increased recycling, the two benefit categories account for 70% of benefits.

**Figure 4 Composition of benefits (Upper bound scenario)**

Figure 5 presents a combined “mass balance” view. It is a summary of economic costs and benefits by the key impact areas with estimated dollar figures attached. The
The sum of the respective costs and benefits represents the net benefit to society from a CDS for the upper bound scenario (i.e. $117.5 million).

**Figure 5 Summary of economic mass balance**

**Sensitivity analysis**

165. In addition to the summary results shown above, this section considers the impacts of adjusting key assumptions and testing alternative scenarios. While there are myriad factors that can potentially be altered, we focus our attention on the study time period and the discount rate applied to the original 10 year period.

**Different time periods**

166. The effect of altering the relevant time period is to increase the estimated net benefits of a CDS, largely reflecting the profile of “upfront” and “one off” costs associated with capital infrastructure (see Table 14).
Table 14 Alternative time periods (NPV, $m)

<table>
<thead>
<tr>
<th></th>
<th>10 Years</th>
<th></th>
<th></th>
<th>20 Years</th>
<th></th>
<th></th>
<th>30 Years</th>
<th></th>
<th></th>
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<tr>
<td></td>
<td>Upper</td>
<td>Lower</td>
<td>Upper</td>
<td>Lower</td>
<td>Upper</td>
<td>Lower</td>
<td>Upper</td>
<td>Lower</td>
<td></td>
</tr>
<tr>
<td></td>
<td>bound</td>
<td>bound</td>
<td>bound</td>
<td>bound</td>
<td>bound</td>
<td>bound</td>
<td>bound</td>
<td>bound</td>
<td></td>
</tr>
<tr>
<td>Total benefits</td>
<td>$762.5</td>
<td>$261.9</td>
<td>$1,294.7</td>
<td>$430.6</td>
<td>$1,591.9</td>
<td>$546.8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total costs</td>
<td>$117.5</td>
<td>$77.9</td>
<td>$175.2</td>
<td>$165.3</td>
<td>$207.5</td>
<td>$137.4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Net benefits/NPV</td>
<td>$645.0</td>
<td>$184.0</td>
<td>$1,119.5</td>
<td>$265.3</td>
<td>$1,384.4</td>
<td>$409.4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Benefit-cost ratio</td>
<td>6.49</td>
<td>3.36</td>
<td>7.39</td>
<td>2.60</td>
<td>7.67</td>
<td>3.98</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Different parameter values

167. We now consider the effect of alterations to the discount rate applied. We examine the effects of such changes with reference to the 10 year timeframe. Table 15 shows the benefit-cost ratio is largely insensitive to changes in the discount rate. Even at a relatively high discount rate of 20%, the lower bound benefits are almost three times the lower bound costs.

Table 15 Alternative discount rates (NPV, $m, 10 years)

<table>
<thead>
<tr>
<th>Discount rate</th>
<th>2%</th>
<th>4%</th>
<th>6%</th>
<th>12%</th>
<th>20%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Upper bound</td>
<td>Lower bound</td>
<td>Upper bound</td>
<td>Lower bound</td>
<td>Upper bound</td>
</tr>
<tr>
<td>Net benefits/NPV</td>
<td>$817.1</td>
<td>$235.7</td>
<td>$724.3</td>
<td>$207.8</td>
<td>$645.0</td>
</tr>
<tr>
<td>Benefit-cost ratio</td>
<td>6.81</td>
<td>3.53</td>
<td>6.65</td>
<td>3.44</td>
<td>6.49</td>
</tr>
</tbody>
</table>
168. The following diagram provides a more detailed depiction of how a generic CDS operates and the key players.

Figure 6 Detailed flow diagram of CDS operation

Source: Envision (2015)
Appendix 2 Financial savings model

169. As mentioned in the main body of the report, one of the deliverables of the project is a “methodology template” for use by other local authorities (i.e. those outside Auckland) to determine the possible impacts a CDS might entail for such local authorities. The focus of this element of the research was financial in nature. That is, the task was to estimate dollar-value cost savings for kerbside recycling collection activities from a CDS, as opposed to broader economic welfare measures.

Inputs

170. The model is essentially a hybrid that combines both ‘generic’ and specific information on the existing costs of kerbside recycling collection with insights into the effect a CDS would have on such costs.

171. The ‘generic’ information comes from specialist advice commissioned from Geoff Johnston, an expert in Container Deposit Legislation in Australia, particularly South Australia. The advice draws on insights from the experiences in South Australia and other jurisdictions that have implemented or are considering implementing a CDS, as well as detailed operational knowledge of the collection equipment and human capabilities and capacities required before and after a CDS is implemented. That is, it takes the perspective of a collection business.

172. The advice is ‘generic’ in the sense of applying to a typical entity responsible for kerbside recycling collection. The key parameters that matter for kerbside collection cost savings possible from a CDS are shown below (see Figure 7).

173. The first major change factor is the profile of dry recyclate material left in the kerbside recycling collection stream. Following the introduction of a CDS, material that is covered by the CDS is effectively removed from kerbside collections. This removal has two effects. First, it reduces the average weight of wheelie bins, for a given propensity to recycle. This effect is driven by the removal of glass from kerbside collections.

174. Second, and perhaps more importantly the capacity to pack (i.e. squash) more into the collection vehicle when collecting from households is increased. Current packing rates without a CDS in place (i.e. when there is more glass in the co-mingled collection) is estimated to range from 60 kilograms per cubic metre for the smallest vehicles to 166 kilograms per cubic metre for the larger vehicles used currently in

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73 Expert advice suggests that only two CDS items per wheelie bin lift remain in kerbside collections. Recall that the assumption used in this analysis is that 10% of CDS material recycled would remain in kerbside collections.
Auckland. The higher the glass content the lower the packing rate. With a CDS in place, the maximum packing rate rises to 220 kilograms per cubic metre.

175. As a result of the improved packing rate, the collection vehicle spends more time lifting bins and less time driving to the disposal point and back, resulting in reductions in fuel costs and maintenance. It is feasible to consider alterations to the configuration of the vehicles used (i.e. the nature of the compacting paddle used and the possibility of larger bodies as a result of lower axle weights). Finally, the size of the fleet is able to be reduced. The time needed for such changes is estimated to be up to seven years.

**Figure 7 Overview of key change factors**

![Overview of key change factors diagram]

Source: One World Environmental Solutions Pty Ltd (2016)

176. The two key drivers of cost savings resulting from the expert advice are lower labour costs and the need for fewer vehicles to undertake the collection and disposal activities. The latter arises due to the ability to pack more into a larger vehicle without exceeding allowable axle weights. The former arises because of a reduced need to pay overtime. The “with CDS” scenario assumes a larger truck (35 m$^3$ versus 25 m$^3$) is now feasible for existing single bin co-mingled collection systems, and the associated costs have been included in the assessment.

177. In the case of two-bin systems, there is a change to a single-bin co-mingled system with larger trucks. In other words the need for separate glass collections is eliminated. Moreover the rate at which bins are able to be lifted increases.
considerably. This has a significant implication for cost reductions and drives the overall national savings numbers.

178. Optimisation of the utilisation of available vehicles was undertaken to produce savings estimates based on the factors in the figure above. The assessment does not assume that the vehicle is emptied at the end of every day. Specifically, any vehicle makes three trips to disposal across two days (i.e. one on the first day and two on the second), which means half a load remains in the vehicle after the first day which is taken out at the start of the second day.

179. The specific information relates to actual average costs incurred by Auckland Council across their recycling collection activities in the region, indicated by existing contracts for rural and urban collections. Such costs were aggregate in nature and averaged across providers and particular areas. Hence the cost data are essentially anonymised. Key cost dimensions of interest are:

(a) Labour
(b) Fuel
(c) Plant operating costs
(d) Plant depreciation
(e) Margin
(f) Overheads
(g) Contamination control (labour and administration)

**Process**

180. The information at hand is combined in a basic spread sheet model to exploit the insights from expert evidence on the cost impacts from a CDS (with appropriate assumptions as to the overall structure as well as household behaviour) with the actual cost data for existing collection activity in Auckland, which is extrapolated to New Zealand as a whole in the “with CDS” situation.

181. An estimate of the costs of collection “without CDS” is constructed by allocating Council-provided collection systems into one of two basic systems- a single-bin co-mingled collection and a two-bin collection excluding glass.

182. The simple model requires users to input specific data on the:

(a) type of system in use;
(b) number and composition of households in each system in their jurisdiction;
(c) presentation rate for recycling (i.e. the average proportion of households who put their recycling on the kerbside for collection); and
(d) total annual expenditure on kerbside recycling in the jurisdiction.
183. If users are unable to identify total annual expenditure on recycling, the model provides an estimate based on the number of collections annually multiplied by an assumed cost per collection. The model assumes a fortnightly collection takes place and estimates average annual potential costs savings across an assumed seven-year contract period. Thus, the estimated cost savings in the financial model differ from those included in the CBA as the latter uses the first year (without inflation estimates) only while the financial model averages across seven years and includes an assumed 1.5% inflation component.

184. Thus, the model shows an estimated average annual cost saving for Auckland of around $3.29 million across a seven-year contract period (see Figure 8), which differs from the amount that would be included in a CBA for Auckland alone, of $3.21 million.

185. Figure 9 shows the estimated average annual cost saving for Council-provided collection services across a seven-year contract period for New Zealand of $20.98 million. This is based on 1,077,731 single-bin services (including Auckland) and 469,453 two-bin services, with separate glass collections. The (upper bound) amount included in the CBA was $20.1 million (see paragraph 88).
Figure 8 Estimated Auckland cost savings, model screen-shot

CDS annual cost saving model
Input figures no. of eligible properties, presentation rate, and total costs of collection (if known) in the blue cells

<table>
<thead>
<tr>
<th>System type</th>
<th>Single bin</th>
<th>Two bin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of eligible properties</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Presentation rate</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Input total collection costs (leave blank if unknown)
Total cost used in model

<table>
<thead>
<tr>
<th></th>
<th>100%</th>
<th>100%</th>
</tr>
</thead>
<tbody>
<tr>
<td>$17,068,829</td>
<td>$0</td>
<td></td>
</tr>
</tbody>
</table>

Average cost savings by system type
Average cost savings from CDS (per annum once fully in place)

<table>
<thead>
<tr>
<th></th>
<th>100%</th>
<th>100%</th>
</tr>
</thead>
<tbody>
<tr>
<td>$3,285,739</td>
<td>$0</td>
<td></td>
</tr>
</tbody>
</table>

Source: Sapere and One World Environmental Solutions Pty Ltd
Figure 9 Estimated cost savings nationwide, model screenshot

Source: Sapere and One World Environmental Solutions Pty Ltd