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economics
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Cost-benefit analysis of options to improve resource recovery in NSW

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Final Report

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Acronyms and abbreviations

BCR	Benefit-cost ratio
C&I	Commercial and industrial
CBA	Cost-benefit analysis
CDS	NSW Container Deposit Scheme
EPA	NSW Environment Protection Authority
FOGO	Food organics and garden organics
GO	Garden organics
HDPE	High-density polyethylene
L	Litre
LGA	Local Government Area
MFA	Material flows analysis
MRF	Material recovery facility
MSW	Municipal solid waste
MUD	Multi-unit dwelling
NPV	Net present value
PET	Polyethylene terephthalate
PV	Present value
RTD	Ready-to-drink
SKU	Stock keeping unit

Glossary

CDS collection point	A fixed location for drop-off of CDS eligible containers and redemption of the container deposit. These collection points can include: • Reverse vending machines (RVMs) • Over the counter (OTC) points, often located in supermarkets and small retail outlets • Automated and manual depots, which are designed to take large volumes of containers.
Discounting/discount rate	Discounting is the usual method employed to add and compare costs (or avoided costs) that occur over time. Discounting involves summing across future time periods net costs that have been multiplied by a discount rate, typically greater than zero. If the discount rate is zero, then equivalent costs in each time period are valued equally. If the discount rate is infinite, then only the current period is valued. Thus, the higher the discount rate, the less the value attached to future costs. The rationale behind discounting is that individuals and businesses attach less weight to a cost (or avoided cost) occurred in the future than they do to the same cost incurred now.
Disposal (of waste)	Disposal of used/end of life material via any of the pathways described in the description of MSW (below). While some of this disposed waste will end up in landfill, much of it will be recovered/recycled. In other words, 'disposal' is not a synonym for 'landfill' or 'throwing away'.
Material recovery facility (MRF)	A specialised waste management plant that receives, sorts, and prepares recyclable materials for re-manufacturers/reprocessors.
Municipal solid waste	Solid material/items that are considered to have reached the end of their useful life, so are deposited by households in kerbside bins or at CDS collection points or collected from C&I sources by waste collection/disposal service providers. MSW includes recyclable materials (e.g., plastic bottles, cardboard boxes), non-recyclable materials, garden organics (e.g., grass clippings), food organics, etc. MSW does not include liquid waste.
Net present value (NPV)	The value of discounted future benefits less the value of discounted future costs.
Nominal value/real value	The value that is stated on a coin or note, i.e., its face value. This differs from the real value, which reflects the stated value minus inflation, since inflation decreases the coin's/note's purchasing power.
Recycling rate	The amount (tonnes) of waste delivered to material recovery facilities (MRFs) via kerbside recycling bins or to CDS collection points, expressed as a proportion of total waste generated (tonnes),

	where total waste generated also includes waste disposed via kerbside garbage bins and other pathways that go directly to landfill.
Recovery rate	The amount (tonnes) of waste material recovered/recycled expressed as a proportion of total waste delivered (tonnes) to MRFs (via kerbside recycling bins) and to CDS collection points.

Executive summary

This report describes a cost-benefit analysis of four proposed options to improve recycling and recovery outcomes in NSW, particularly by increasing rates of source separation of glass container waste.

Introduction

The Container Deposit Scheme (CDS) is capturing clean streams of source separated materials, with significantly less contamination and cross-contamination than materials collected through the kerbside system and, to a lesser extent, commercial and industrial (C&I) waste disposal pathways.

The NSW Environment Protection Authority (EPA) is investigating options to improve recycling outcomes by increasing rates of source separation of glass container waste. These include three options (detailed following) that involve an expansion of the scope of the current CDS to also cover (some or all of the following categories) glass wine and spirits bottles, and large juice bottles, plain milk contains and a wide range of other beverage containers – glass, paper/cardboard, plastic, and metal.

A fourth option is also considered, where a fourth kerbside bin – only for glass containers – is added to the existing mix of kerbside bins. This option is also expected to reduce contamination and cross-contamination of materials collected through the kerbside system.

To inform decision making, the EPA has engaged Marsden Jacob to investigate the economic viability of options to improve the recovery and recycling outcomes of glass (and other dry recyclables), and reduce community confusion by either:

- expanding the scope of containers collected under the NSW CDS; or
- providing an additional kerbside bin for the collection of glass containers.

Approach to the analysis

Marsden Jacob has undertaken a cost-benefit analysis (CBA) of four options incremental to a base case, over an analysis period of 2021-22 to 2040-41. The base case reflects the business-as-usual case with the existing CDS scope assumed to be retained over the analysis period and no change to the existing mix of bins for general waste, recyclable materials[1] and, for some councils, garden organics and/or food organics.[2]

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[1] We note that a small number of NSW councils (e.g., Northern Beaches, Hunters Hill) have separate kerbside bins for paper/cardboard material. This disposal pathway has not been modelled separately from the kerbside comingled recycling bin; however, this simplifying assumption is not expected to have a material impact on the results and conclusions of the analysis.

[2] The analysis underpinning this CBA has assumed the status of FOGO/GO bins as at 30 June 2021 and, therefore, does not take into account the NSW Government's recently announced FOGO mandate. However, this mandate is not expected to have a material impact on the results for this CBA.

The four options assessed are:

- **Option 1 – Adding larger juice bottles, and glass wine and spirit bottles to CDS**:
  - glass wine bottles
  - glass spirits bottles
  - all juice bottles 1 litre and larger
- **Option 2 – Comprehensive addition to CDS** to include:
  - All containers eligible for Option 1, plus
  - water (aseptic packs) – 1 litre to 3 litres
  - pure juice (all container types) – 1 litre to 3 litres
  - flavoured milk (all container types) – 1 litre to 3 litres
  - concentrated fruit and vegetable juice intended to be diluted before consumption (all container types) – 150mL to 3 litres
  - cordial (undiluted) (all material types) – 150mL to 3 litres
  - wine (sachets – plastic and/or foil) – 250mL to 3 litres
  - wine (aseptic packs) – 1 litre to 3 litres
  - flavoured alcoholic beverages with a wine base (aseptic packs) – 1 litre to 3 litres
- **Option 3 – Comprehensive addition plus plain milk to CDS** to include:
  - All containers eligible for Option 2, plus
  - Plain milk containers[3] intended for drinking (all container types) – 150mL to 3 litres
    - 'Plain milk' is defined to include the following unflavoured milks:
      - Cow milk
      - Goat milk
      - Long-life milk
      - Plant milks e.g., soy, oat, almond, coconut
- **Option 4 – The addition of a fourth kerbside bin for the collection of glass containers**, which will be in addition to the existing bins for:
  - general waste;
  - recyclable materials – paper/cardboard, plastic (and, currently, glass containers); and

[3] By mass, the material types for plain milk containers disposed in either kerbside recycling or kerbside garbage bins are HDPE (74%), Tetra Pak/Liquid paperboard (21%), PET (4%), and glass (1%).

- food organics and garden organics (FOGO) or garden organics (GO), depending on the council.

We note that there are a range of practical challenges associated with Option 4. The challenge will likely be greatest for multi-unit dwellings (MUDs) because they are the dwelling type most likely to lack the physical space for more bins. This space constraint might also be relevant for detached and semi-detached houses. Where applicable, there is an opportunity cost to the space. This potential cost has not been factored into the current analysis, because we have not been able to access any information on the opportunity cost.

The CBA model integrates an economic model with a material flows analysis (MFA) model. Physical flows of waste and recycling ultimately drive many of the costs and benefits of the options. For further detail on the material flows analysis, refer to Section 3.

Material fates and avoided landfill disposal

Two key results of the material flows analysis are presented below. These results illustrate:

- Increased recovery of materials for all options incremental to the base case, including increased proportions of sorted/higher value materials; and
- Substantial quantities of avoided landfill disposal for all options incremental to the base case.

Material fates

The expected fates of household waste, expressed as proportional splits, are illustrated in Figure 1 to Figure 3, and Table 1 to Table 3.[4] These estimates are for material *exiting* MRFs and CDS aggregation points, and include both *in-scope* and *out-of-scope* materials. This explains why, for example, Figure 3 and Table 3 show ~80% of household plastic waste going to landfill, although this proportion would be much smaller if considering only in-scope plastic containers.

[4] The impacts of the options on fates for metal waste are minor, so these impacts are not shown.

Figure 1: Material fates for the base case and options (household sources) – Glass
[includes both in-scope and out-of-scope materials]

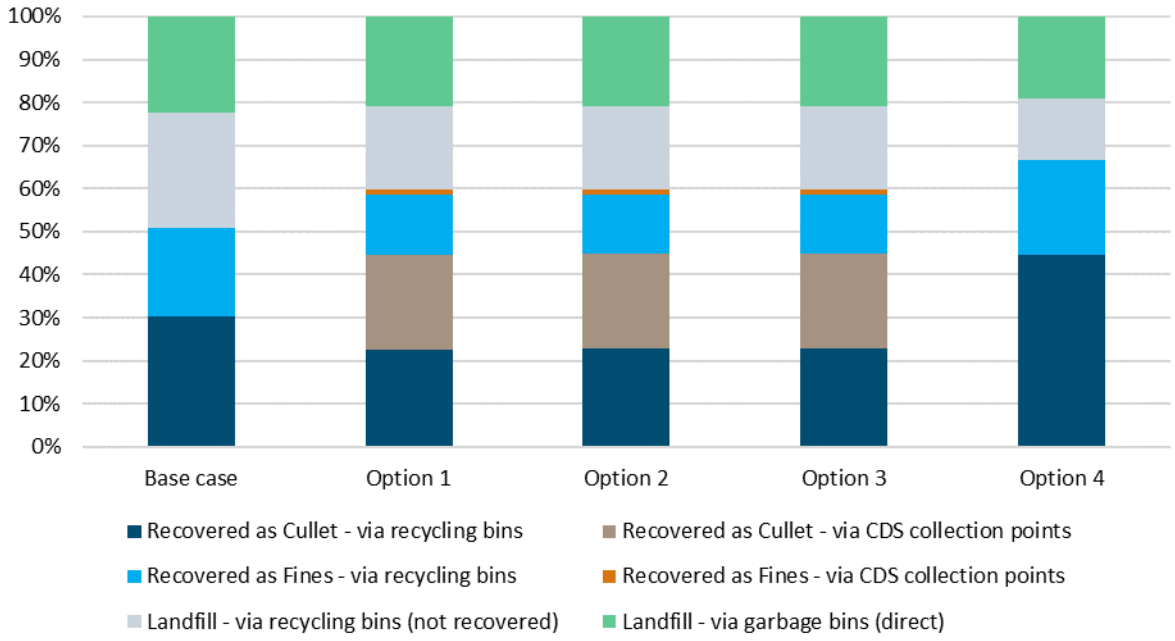


Figure 2: Material fates for the base case and options (household sources) – Paper/Cardboard
[includes both in-scope and out-of-scope materials]

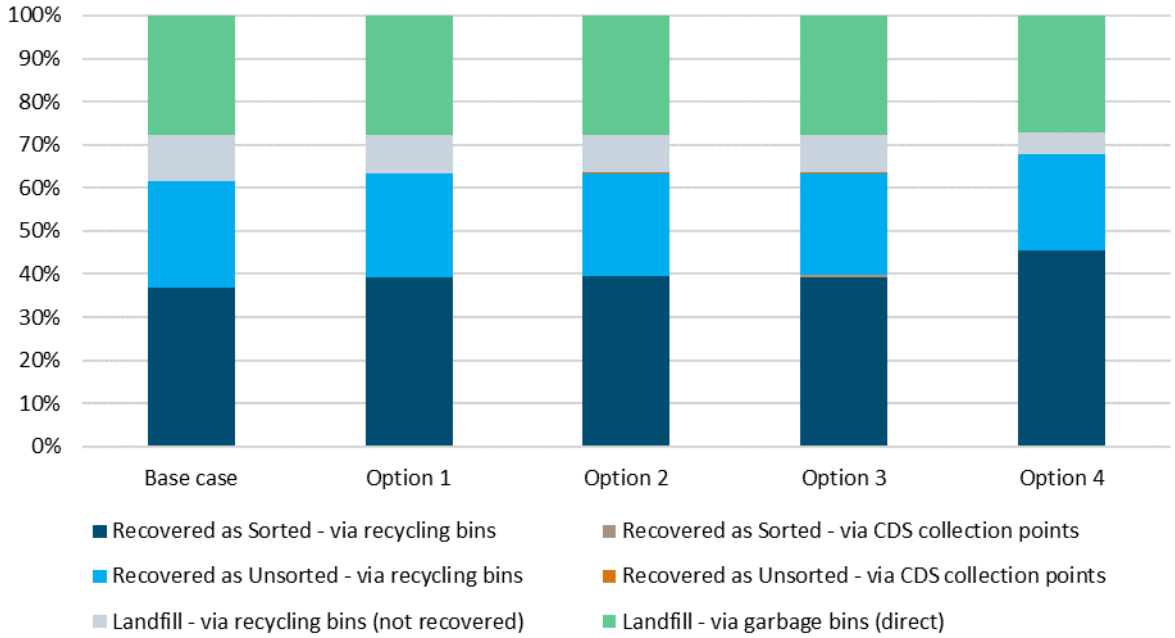


Figure 3: Material fates for the base case and options (household sources) – Plastic
[includes both in-scope and out-of-scope materials]

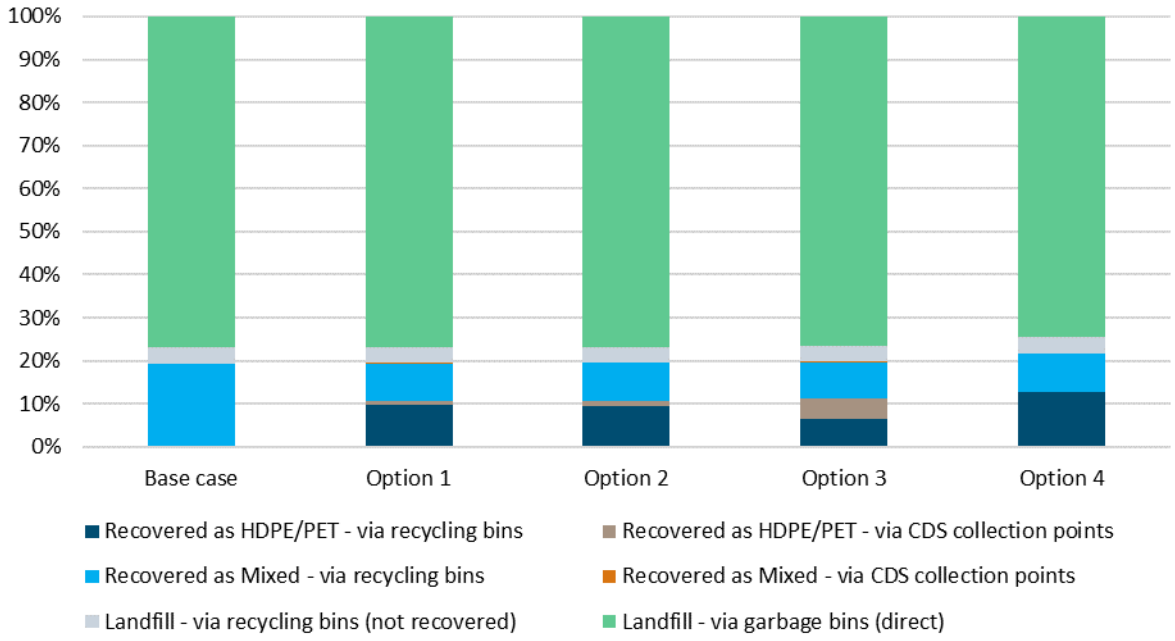


Table 1: Material fates for the base case and options (household sources) – Glass
[includes both in-scope and out-of-scope materials]

Material fate	Base case	Option 1	Option 2	Option 3	Option 4
Recovered as Cullet – via recycling bins	30.4%	22.6%	22.8%	22.7%	44.6%
Recovered as Cullet – via CDS collection points	0.0%	22.0%	22.2%	22.2%	0.0%
Recovered as Fines – via recycling bins	20.3%	14.0%	13.7%	13.7%	22.2%
Recovered as Fines – via CDS collection points	0.0%	1.2%	1.2%	1.2%	0.0%
Landfill – via recycling bins (not recovered)	26.8%	19.4%	19.3%	19.3%	14.2%
Landfill – via garbage bins (direct)	22.4%	20.9%	20.9%	20.9%	19.0%
Total – Cullet	**30.4%**	**44.6%**	**44.9%**	**45.0%**	**44.6%**
Total – Fines	**20.3%**	**15.1%**	**14.9%**	**14.9%**	**22.2%**
Total – Landfill	**49.3%**	**40.3%**	**40.2%**	**40.2%**	**33.3%**

Table 2: Material fates for the base case and options (household sources) – Paper/Cardboard
[includes both in-scope and out-of-scope materials]

Material fate	Base case	Option 1	Option 2	Option 3	Option 4
Recovered as Sorted – via recycling bins	37.0%	39.2%	39.6%	39.2%	45.4%
Recovered as Sorted – via CDS collection points	0.0%	0.0%	0.1%	0.5%	0.0%

Material fate	Base case	Option 1	Option 2	Option 3	Option 4
Recovered as Unsorted – via recycling bins	24.6%	24.2%	23.8%	23.6%	22.6%
Recovered as Unsorted – via CDS collection points	0.0%	0.0%	0.0%	0.3%	0.0%
Landfill – via recycling bins (not recovered)	10.5%	8.7%	8.7%	8.6%	5.0%
Landfill – via garbage bins (direct)	27.9%	27.9%	27.8%	27.7%	27.0%
Total – Sorted	**37.0%**	**39.2%**	**39.6%**	**39.8%**	**45.4%**
Total – Unsorted	**24.6%**	**24.2%**	**23.9%**	**23.9%**	**22.6%**
Total – Landfill	**38.4%**	**36.5%**	**36.5%**	**36.3%**	**32.1%**

Table 3: Material fates for the base case and options (household sources) – Plastic [includes both in-scope and out-of-scope materials]

Material fate	Base case	Option 1	Option 2	Option 3	Option 4
Recovered as HDPE/PET – via recycling bins	0.0%	9.7%	9.6%	6.5%	12.6%
Recovered as HDPE/PET – via CDS collection points	0.0%	0.8%	1.1%	4.9%	0.0%
Recovered as Mixed – via recycling bins	19.2%	8.9%	8.9%	8.2%	9.1%
Recovered as Mixed – via CDS collection points	0.0%	0.0%	0.1%	0.3%	0.0%
Landfill – via recycling bins (not recovered)	3.9%	3.7%	3.7%	3.6%	3.7%
Landfill – via garbage bins (direct)	76.9%	76.8%	76.8%	76.5%	74.6%
Total – HDPE/PET	**0.0%**	**10.5%**	**10.6%**	**11.4%**	**12.6%**
Total – Mixed	**19.2%**	**9.0%**	**8.9%**	**8.5%**	**9.1%**
Total – Landfill	**80.8%**	**80.5%**	**80.5%**	**80.1%**	**78.2%**

Avoided landfill disposal

All four options are expected to result in substantial quantities of avoided landfill, with Option 4 generating the largest impact (Figure 4, Table 4). Based on the modelling assumptions, Option 1 avoids 628,000 tonnes of landfill disposal over the 20-year analysis period, Option 2 avoids 641,000 tonnes, Option 3 avoids 677,000 tonnes, and Option 4 avoids 1.4 million tonnes over the same period.

Note that for Options 1 to 3, most of the 'heavy lifting' is being done by containers that are in-scope for Option 1 (i.e., glass wine and spirits bottles). For Option 2, an additional 13,000 tonnes of landfill disposal are avoided compared to Option 1. Finally, for Option 3, an additional 36,000 tonnes of landfill disposal are avoided compared to Option 2.

Figure 4: Avoided landfill disposal over the analysis period

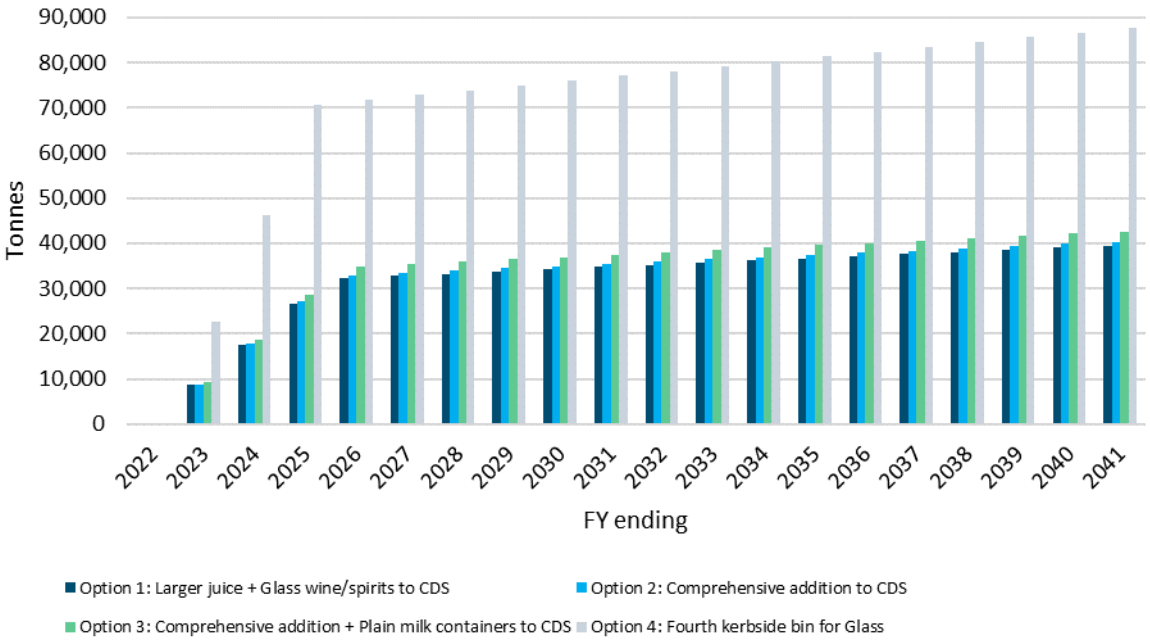


Table 4: Avoided landfill disposal (tonnes), for individual years

Option	2025-26	2030-31	2035-36	2040-41
Option 1: Larger juice + Glass wine/spirits to CDS	32,000	35,000	37,000	40,000
Option 2: Comprehensive addition to CDS	33,000	35,000	38,000	40,000
Option 3: Comprehensive addition + Plain milk containers to CDS	35,000	37,000	40,000	43,000
Option 4: Fourth kerbside bin for Glass	72,000	77,000	82,000	88,000

Results of CBA

CBA

The central results of the CBA, based on a 7% discount rate and 20-year analysis period, are presented in Table 5.

Table 5: Results, Options 1 to 4, 20-year analysis period ($ million PV at 7% discount rate)

Costs and benefits	Option			
	20 years			
	1	2	3	4
Costs	**147.4**	**153.3**	**181.5**	**482.3**
State government and local councils				
Additional collection and transport – Glass only bin	0.0	0.0	0.0	330.5

Costs and benefits	Option			
Capital cost of bins – Glass only bin	0.0	0.0	0.0	151.8
Additional container approvals	0.3	0.3	0.4	0.0
Industry				
Additional collection and transport – CDS collection points	13.2	13.8	16.5	0.0
Additional CDS collection and sorting costs	77.8	79.7	95.0	0.0
Additional participation costs – CDS	3.1	3.2	3.9	0.0
Additional container approvals	1.1	1.1	1.2	0.0
Additional compliance – re-labelling (refund marking requirements)	4.5	5.0	5.5	0.0
Additional compliance – reporting	5.1	5.8	6.3	0.0
Entering into Supply Arrangements	0.4	0.5	0.6	0.0
Households				
Additional participation costs – CDS	41.9	43.8	52.3	0.0
Benefits	**203.6**	**211.0**	**256.4**	**522.2**
State government & local councils				
Avoided collection and transport – Garbage (red) bin	3.4	3.8	4.5	17.8
Avoided collection and transport – Comingled recycling (yellow) bin	78.4	80.2	97.4	247.3
Avoided landfill disposal costs	22.2	22.7	23.9	50.6
Industry				
Increased value of recyclate	64.7	68.8	84.5	174.2
Avoided MRF processing costs	25.5	25.9	35.1	19.6
Avoided collection and transport – C&I waste disposal	3.9	4.0	4.9	0.0
Community				
Avoided landfill externalities	5.5	5.6	6.0	12.6
Net Benefit ($m NPV)	**56.2**	**57.7**	**74.9**	**39.8**
BCR	**1.38**	**1.38**	**1.41**	**1.08**

Information in Table 5 permits a comparison of the performance of the options using two key metrics:

- Net Present Value (NPV), which is the Present Value (PV) of benefits delivered by the policy less the PV of costs incurred; and
- Benefit Cost Ratio (BCR), which is the ratio of the PV of benefits to PV of costs.

The NPV measures the expected benefit (or cost) to society of implementing the policy, expressed in monetary terms. The option with the higher NPV is expected to deliver greater net benefits to society, while the option with the higher BCR is expected to provide greater benefit per unit of cost.

As shown in Table 5, all options have positive net present values and benefit cost ratios (BCRs) greater than 1. This indicates that all options are expected to deliver a net community benefit. With an NPV of $74.9 million over 20 years, Option 3 delivers the highest NPV, and has the highest BCR, of the four options.

Based on these results, expanding the scope of containers eligible for the CDS (Options 1 to 3) is preferred over the introduction of a fourth kerbside bin to collect glass containers (Option 4) because the NPV and BCR results are higher than for the introduction of a fourth kerbside bin to collect glass containers. We note, however, that Option 4 will generate substantially greater recovery of materials than Options 1 to 3. Finally, we note that these differences in NPV for Options 1 to 3 are relatively small and could be within the error bounds of the modelling, meaning there is not a strong preference order for Options 1 to 3 (expanding the scope of containers eligible for the CDS).

Sensitivity analysis

Results of the analysis are quite sensitive to changes in assumptions relating to material values (recyclate) and improvements in sorting of recovered materials (and the resulting impact on the value of recovered materials). The sensitivity analysis highlights the importance of achieving good outcomes from the options in terms of both the quantity and quality of material recovered.

All options are moderately sensitive to assumed processing/sorting costs, while the CDS scope change options (Options 1 to 3) are moderately sensitive to assumed CDS participation costs[5], and the fourth glass bin option (Option 4) is very sensitive to assumed capital costs for kerbside bins.

Conclusions from the analysis

Results of the CBA indicate that any of the assessed options, if implemented, can be expected to generate a net community benefit. Based on the central assumptions, Option 3 is preferred, with Options 1 and 2 following closely behind. However, these differences in NPV are relatively small and could be within the error bounds of the modelling, meaning there is not a strong preference order for Options 1 to 3 (expanding the scope of containers eligible for the CDS). The key benefit driving the results for all options is the increased quantity and quality of recovered materials (recyclate) resulting from improved sorting and reduced contamination of other waste materials.

[5] Participation costs relate mainly to the time cost (for households and C&I sources) associated with transporting containers to a CDS collection point.

It should be noted that the results for CDS scope expansion options (Options 1 to 3) assume that no further capital expenditure is required to facilitate additional throughput at CDS collection points. If any significant augmentation of existing infrastructure is required, the net benefit from Options 1 to 3 will be lower. Further, no direct or indirect costs to industry associated with scheme compliance, including re-labelling containers/bottles, have been included for Options 1 to 3. Any costs associated with scheme compliance are not expected to materially alter the conclusions of this analysis, and these costs can be mitigated by providing sufficient lead time to industry prior to expanding the scope of containers eligible for the CDS.

It should also be noted that Option 4 is expected to deliver substantially greater benefits in terms of avoided landfill and value of recovered material than Options 1 to 3.

Expansion of the scope of eligible containers for the CDS (Options 1 to 3) is expected to reduce throughput of material at material recovery facilities (MRFs). It is expected that reduced processing costs for MRFs will be accompanied by an associated reduction in revenue from the materials, but also improved recovery rates and an increase in container deposit revenue. A separate detailed analysis of the impact of options on the financial position of MRFs would be needed to determine the overall financial impact of options on MRFs. For further detail on the impact of the options on material throughput at MRFs, refer to Section 3.8.

For Option 4, the result is very sensitive to assumed capital costs for kerbside bins, so, if this option is to be implemented, careful consideration should be given when determining the number of glass only bins to provide to residential dwellings. It might be reasonable to assume that every house will be provided with a new kerbside bin. Whereas, for multi-unit dwellings (MUDs), glass only bins might be provided at a rate that is proportionately less than for comingled recycling bins. For example, 3 glass bins per 5 comingled recycling bins, where this ratio could be determined based on the relative waste volumes of paper/cardboard and plastic (which would continue to be disposed via the comingled recycling bin) and glass (which would be disposed in the new glass only bin[6]).

The issue of constrained space could be mitigated by there being fewer comingled and/or garbage bins required in future due to some kerbside waste being redirected to the glass only bin. Thus, there might be an avoided cost (reduced bin replacement cost) as the number of kerbside bins is optimised over time. This potential benefit has not been modelled but its inclusion as a benefit for Option 4 would not be anticipated to change the order of options.

Finally, a key risk facing both the CDS scope expansion options (Options 1 to 3) and fourth bin option (Option 4) is the potential absence of markets for the additional materials recovered – both sorted and unsorted materials – or, at least, markets that are sufficiently strong to maintain prices for recovered materials. This risk is greatest for Option 4 due to the greater volume of recovered material expected to be achieved under that option. Reflecting this risk, prices for recovered materials assumed in the analysis, for all options, are conservative. This risk should be significantly mitigated by government policy initiatives, such as investments in processing infrastructure.

[6] Monthly collection has been assumed for kerbside glass bins.

1. Introduction

This report presents an analysis of four options for improving recycling and recovery outcomes, particularly by increasing rates of source separation of glass containers from kerbside/household and C&I[7] waste sources.

1.1 Background

The NSW Environment Protection Authority (EPA) is responsible for regulating the waste management sector in NSW to ensure waste is managed, and waste activities are carried out, in an environmentally safe manner that promotes greater waste avoidance and resource recovery, and minimises litter and illegal dumping of waste. The *NSW Waste and Sustainable Materials Strategy 2041* outlines the actions the NSW Government will take over the next six years – in the first phase of the strategy – to deliver on its long-term objectives. Within this remit, the EPA is responsible for the design, development, and oversight of the NSW Container Deposit Scheme (CDS), including ensuring compliance with the *Waste Avoidance and Resource Recovery Act 2001* and Regulation, and the approval of beverage containers eligible for a 10c refund.

The CDS has been designed as a litter reduction initiative and, therefore, focusses on the beverage types that are most commonly found in the litter stream. However, evidence to date has shown that the CDS is delivering positive recycling outcomes. The CDS is capturing clean streams of source separated materials, with significantly less contamination and cross-contamination than materials collected through the kerbside system. The EPA would like to investigate whether expanding the objectives of the CDS to include improved recycling outcomes and, therefore, an expansion of the scope of containers covered by the CDS would deliver a net public benefit. In particular, the inclusion of glass wine and spirits glass bottles has the potential to reduce glass contamination in the kerbside recycling system and improve recycling outcomes for both the CDS and the kerbside system.

Furthermore, the exclusion of some beverage types and container types from the CDS on the basis that they are not common in the litter stream is a source of confusion for CDS users.[8] Many citizens see the CDS primarily as a recycling initiative for beverage containers, such that they do not distinguish between different beverages or different beverage container types. Notable examples of beverage containers that are not eligible are wine and spirits in glass containers and juice containers 1 litre and larger. As such, in addition to the benefits described above, expanding the scope of beverage containers that are eligible for the CDS has the potential to remove a disincentive to participate in the CDS and, therefore, increase the capture of containers that are common in the litter stream.

[7] C&I waste is in-scope for Options 1 to 3 only.

[8] Improving South Australia's Recycling Makes Cents: A discussion paper to review SA's container deposit scheme, EPA South Australia (2021), available https://www.epa.sa.gov.au/files/15078_cds_discussion_paper_sep2021.pdf.

Consequently, the EPA has engaged Marsden Jacob to investigate the economic viability of options to improve the recovery and recycling outcomes of – mainly – glass containers, and reduce community confusion, by either:

- expanding the scope of containers collected under the NSW CDS; or
- providing an additional kerbside bin type for the collection of glass containers.

1.2 Statement of the problem

The main aspects considered in this cost-benefit analysis are described below:

- Broken glass is a major source of contamination for potentially recyclable material (i.e., paper/cardboard and plastics). In particular, glass contamination is problematic for material disposed in kerbside comingled (yellow) recycling bins, and is problematic to a relatively lesser degree for potentially recyclable material from C&I sources.[9]
- This contamination results in two main costs:
  - Some potentially recyclable material is disposed to landfill rather than recovered, due to excessive/unacceptable levels of contamination[10]; and
  - Some material that is recovered is of a lower quality, due to a degree of contamination, and therefore attracts a price discount commensurate to the reduction in quality caused by contamination.
- Whether expanding the scope of eligible containers to include a broader range of beverage containers would be economically beneficial or whether any scope change should focus only on glass.
- The four options considered in this analysis are expected to reduce the scale of contamination in streams of recyclable material by incentivising improved source separation of glass containers, thus resulting in improved recycling and recovery outcomes for NSW across all dry recycling material types (paper/cardboard, plastics, metals, and glass). For Options 1 to 3, source separation of glass containers is expected to improve across both kerbside bins and C&I waste disposal, as some glass waste is redirected to disposal via CDS collection points. Options 1 to 3 are also expected to improve recovery rates of some non-glass containers. For Option 4, source separation of glass containers is only expected to improve contamination outcomes for MSW kerbside disposal.

1.3 This report

The remainder of this report is structured as follows:

- Chapter 2 describes the approach to the analysis including a description of options that were considered.
- Chapter 3 describes the material flows analysis that has been used to underpin analysis of many of the

[9] Glass Working Group 2018, Australian Packaging Covenant (APCO) (2019).
[10] The impact of contamination on recovery rates is most substantial for paper/cardboard, followed by plastics.

costs and benefits of the options.

- Chapter 4 discusses the results of the CBA including key drivers of results and sensitivity analysis of key uncertain variables.
- Chapter 5 details the data assumptions that underpin the analysis including material flow assumptions and cost and benefit assumptions.

2. Approach to the analysis

Four options for improving recovery and recycling outcomes are assessed using cost-benefit analysis. The options all include improved source separation of glass and reduced glass contamination. Three options (Options 1 to 3) involve significant expansion of the scope of containers that would be eligible for the CDS, while another option (Option 4) involves introducing a fourth kerbside bin for glass.

2.1 Options definitions

In this report, four options for improving recovery and recycling outcomes in NSW are examined and compared to a business-as-usual base case. The base case reflects the business-as-usual case with the existing CDS scope assumed to be retained over the analysis period and no change to the existing mix of bins for general waste, recyclable materials[11] and, for some councils, garden organics and/or food organics.[12]

We note that the NSW government's *Waste and Sustainable Materials Strategy* requires councils to provide food and garden waste collections to all NSW households by 2030 and large food waste generating businesses to source separate food waste by 2025. However, this food organics and garden organics (FOGO) mandate is considered not relevant to the definition of the base case because any impacts of this policy are expected to apply equally to both the base case and option cases, meaning the incremental impact is zero. This means the policy outcomes from the FOGO mandate are independent of the two options considered in this CBA, which focus on dry recyclables.

The four options assessed are described below:

- **Option 1 – Adding larger juice bottles, and glass wine and spirit bottles to CDS**:
  - glass wine bottles
  - glass spirits bottles
  - all juice bottles 1 litre and larger
- **Option 2 – Comprehensive addition to CDS** to include:
  - All containers eligible for Option 1, plus
  - water (aseptic packs) – 1 litre to 3 litres

[11] We note that a small number of NSW councils (e.g., Northern Beaches, Hunters Hill) have separate kerbside bins for paper/cardboard material. This disposal pathway has not been modelled separately from the kerbside comingled recycling bin; however, this simplifying assumption is not expected to have a material impact on the results and conclusions of the analysis.

[12] The analysis underpinning this CBA has assumed the status of FOGO/GO bins as at 30 June 2021 and, therefore, does not take into account the NSW Government's recently announced FOGO mandate. However, this mandate is not expected to have any material impact on the results for this CBA.

- pure juice (all container types) – 1 litre to 3 litres
- flavoured milk (all container types) – 1 litre to 3 litres
- concentrated fruit and vegetable juice intended to be diluted before consumption (all container types) – 150mL to 3 litres
- cordial (undiluted) (all material types) – 150mL to 3 litres
- wine (sachets – plastic and or foil) – 250mL to 3 litres
- wine (aseptic packs) – 1 litre to 3 litres
- flavoured alcoholic beverages with a wine base (aseptic packs) – 1 litre to 3 litres

- **Option 3 – Comprehensive addition plus plain milk to CDS** to include:
  - All containers eligible for Option 2, plus
  - Plain milk containers[13] intended for drinking (all container types) – 150mL to 3 litres
    - 'Plain milk' is defined to include the following unflavoured milks:
      - Cow milk
      - Goat milk
      - Long-life milk
      - Plant milks e.g., soy, oat, almond, coconut
- **Option 4 – The addition of a fourth kerbside bin for the collection of glass containers**, which will be in addition to the existing bins for:
  - general waste;
  - recyclable materials – paper/cardboard, plastic (and, currently, glass containers); and
  - food organics and garden organics (FOGO) or garden organics (GO), depending on the council.

The objectives of these options include:

- reducing the contamination rate in kerbside recycling bins – particularly, glass contamination – which results in both:
  - higher rates of material recovery / lower rates of landfilling; and
  - improved average quality of recyclate, which results in higher average prices / value uplift for recovered materials.
- encouraging additional quantities of waste material to be disposed via pathways that result in material recovery (CDS for Options 1 to 3; kerbside glass only bin for Option 4) and reducing disposal via pathways that go directly to landfill (e.g., kerbside garbage bin).

[13] By mass, the material types for plain milk containers disposed in either kerbside recycling or kerbside garbage bins are HDPE (74%), Tetra Pak/Liquid paperboard (21%), PET (4%), and glass (1%).

There are a range of practical challenges associated with Option 4, with the challenge likely to be greatest for multi-unit dwellings (MUDs) because they are the dwelling type most likely to lack the physical space for more bins. This space constraint might also be relevant for detached and semi-detached houses. Where applicable, there is an opportunity cost to the space.[14] This potential cost has not been factored into the current analysis.

Experience in Victorian Local Government Areas (LGAs) where the fourth bin has been trialled does not point to any significant problems with space for detached houses; in part, achieved through downsizing of bins over time. Further, any problems with MUDs seemingly are being overcome with greater use of bin sharing, both for glass and other recyclables and/or downsizing. However, it is also possible that the relevant Councils have chosen to overlook or failed to report these potential problems.

2.2 CBA approach

The purpose of the CBA is to assess the costs and benefits of each option incrementally to the base case. Economic impacts (costs and benefits) are assessed in an economic model by aggregating discounted annual estimates of each cost and benefit over the analysis timeframe. The aggregated costs and benefits are expressed for each option as a net present value (NPV) and benefit cost ratio (BCR); providing a comparable basis for prioritising between the options.

The CBA has been undertaken consistent with the NSW Treasury's *TPP17-03 NSW Government Guide to Cost-Benefit Analysis* (2017). Major features of the CBA are:

- analysis has been undertaken over 10-year and 20-year analytical timeframes;
- a central discount rate of 7% real, with sensitivity analysis using discount rates of 3% and 10%; and
- further sensitivity analysis has been undertaken based on changes to other key variables.

The CBA model integrates an economic model with a material flows analysis (MFA) model; noting that physical flows of waste and recycling ultimately drive many of the costs and benefits of the options.

2.2.1 Costs and benefits assessed

We have estimated key economic cost and benefit items along both the (i) municipal solid waste (MSW)/kerbside and (ii) commercial and industrial (C&I) supply chains incurred as a result of option implementation, as well as costs arising directly from the options. These include:

- costs associated with changes to the volume of recyclates being collected and sorted;
- benefits associated with an increase in the quantity and quality of recyclate;

[14] Potentially, there is an opportunity cost associated with the use of household space to store additional CDS containers for the CDS expansion options (Options 1 to 3), though this cost is likely to be small and is not expected to materially impact the conclusions of the analysis.

- avoided landfill operating costs;
- avoided landfill environmental and amenity costs;
- avoided garbage collection costs;
- additional recycling and CDS collection costs;
- additional participation (time and travel) costs for disposal of CDS-eligible items; and
- additional costs for scheme compliance and administration for both industry and government.

Further details of these costs and benefits are provided in Section 4.5 of the report.

3. Material flows analysis

A detailed material flows analysis (MFA) has been developed to support the CBA. The MFA estimates the quantities of kerbside and C&I waste generated and the subsequent movements of this material through waste and recycling supply chains for the base and option cases.

3.1 Approach

The CBA model integrates the economic model with the MFA model. Physical flows of waste and recycling ultimately drive many of the costs and benefits of the options, so, a conceptual 'physical flow' of materials is used as the basis for identifying many of the costs and benefits. The base case reflects the business-as-usual case with the existing CDS scope assumed to be retained over the analysis period, while Options 1 to 3 assume the CDS scope is expanded, and Option 4 assumes a fourth kerbside bin (glass only) is added.

The parameters estimated for the MFA are detailed below.

Base case

- Current and future annual generation of household waste, by weight (tonnes), split by bin type (recycling bin and garbage bin);
- Current and future annual generation of C&I waste, by weight (tonnes);
- Future diversion of CDS material from kerbside bins (recycling and garbage) once the CDS has been expanded from 2022-23;
- Materials continue to progress through existing points on the waste and recycling supply chain once they leave the household or C&I source – collection, MRFs or CDS collection points, processing, recovery/landfill;
- Materials entering MRFs are split by material type: paper & cardboard, plastics, glass, metals, all other materials/contamination;
- Materials exiting MRFs are also split by material type: paper & cardboard (sorted, unsorted); plastics (HDPE, PET, mixed), glass (cullet, fines), metals (aluminium, steel), contamination/residual to landfill;
- Recovery rates of household and C&I waste (separately), by material type (calculated as total material to MRFs/total waste disposed);
- Recycling rates of household and C&I waste (separately), by material type calculated as total material to MRFs less contamination/MSW generated); and
- Proportion of recycled material exiting MRFs as sorted/unsorted.

Options

- Consistent with the base case, but with changes to the following parameters, reflecting the impacts of option implementation:
  - split of household waste generated by bin type;
  - materials entering MRFs or CDS collection points;
  - materials sent direct to landfill;
  - contamination rate of materials entering MRFs;
  - recovery rates of household/kerbside waste;
  - recycling rates of household/kerbside waste; and
  - proportion of recycled material exiting MRFs as sorted/unsorted.

Multiple sources have been used to estimate material flows under the base case, including:

- Analysis of NSW Kerbside Red Lid Bin Audit Data Report (2020)
- SSROC Kerbside Waste Audit (2019)
- NSW Local Government Waste and Resource Recovery Data Report 2019–20 (2021)
- Disposal-based audit Commercial and industrial waste stream in the regulated areas of New South Wales (2015)
- ABS data: Apparent Consumption of Alcohol, Australia for 2017-18 (2019)
- Australian wine: Production, sales and inventory 2016–17 (2018)
- Return and Earn: Annual Statutory Report 2019–20 (2020)
- Recovered Resources Market Bulletin February 2022 (2022), and previous editions

Noting that stakeholder consultation was not undertaken as part of this analysis, estimates of the impacts of options on material flows draw on previous analysis undertaken by Marsden Jacob.

3.2 Scope of eligible containers and expected changes to waste disposal pathways

The total annual consumption of glass wine and spirits bottles was estimated based on analysis of detailed kerbside bin audit data provided by NSW EPA and the ABS dataset *Apparent Consumption of Alcohol, Australia for 2017-18 (2019)*. Glass wine bottle consumption has been estimated based on Wine Australia data published in *Australian wine: Production, sales and inventory 2016–17 (2018)*. The results of these various approaches for estimating glass wine bottle consumption were very

similar, as well as closely aligning with estimates from previous Marsden Jacob analysis[15], which gives a degree of confidence in the estimated values.

The ABS dataset provides the estimated volume of wine available for consumption in Australia in 2017-18. Assuming per capita consumption in NSW is similar to per capita consumption nationally, about 32% of the total consumption can be attributed to NSW. Additionally, the available evidence indicates that around 75% of wine is packaged in glass bottles with the remaining 25% in casks or similar. Finally, volume of wine was converted to the number of bottles (assuming an average bottle volume of 750mL) and mass (assuming an average bottle mass of 400g).

The ABS dataset provides the estimated consumption of spirits – both straight spirits and ready-to-drink (RTD) – in a slightly different fashion. Consumption is estimated in terms of litres of pure alcohol. A detailed internet-based survey of the most popular straight spirits and RTD beverages was undertaken to estimate the average alcohol content and size/mass of containers. This process was used to convert from litres of pure alcohol to estimated number of bottles. Straight spirits bottles have an estimated average alcohol content of 37% and average mass of around 400g, while RTD bottles have an estimated average alcohol content of 5.2% and average mass of 250g. A final adjustment was required to account for only about one-quarter of RTD containers being glass[16], with the remaining three-quarters being aluminium cans or similar. On the other hand, effectively all straight spirits are sold in glass bottles.

Finally, it should be noted that consumption does not necessarily equal disposal on an annual basis because wine and straight spirits bottles are frequently stored/stockpiled for several years.

Estimated disposal of other in-scope containers is based mainly on analysis of NSW kerbside bin audit data and other data sources listed above in Section 3.1. Estimated disposal of in-scope glass and non-glass containers for 2021-22 is shown in Table 6 (mass of containers, expressed in tonnes) and Table 7 (quantity of containers, expressed as millions of containers). Note that these tables include only containers within the size limits for each option as described in Section 2.1.

Table 6: Mass (tonnes) of in-scope containers (Options 1, 2, and 3) in NSW in 2021-22[17]

Container type	Glass	Plastic	Paper/ Cardboard	Metal	Total mass (tonnes)	Option(s)
Wine (glass)	78,500				**78,500**	1, 2, 3
Straight spirits (glass)	15,000				**15,000**	1, 2, 3
Juice (Option 1)	500	3,600	120		**4,200**	1, 2, 3
Cordial *plus* juice containers not already included in Option 1	760	450	940	2	**2,200**	2, 3

[15] Marsden Jacob Associates (2018). Analysis of CDS materials and reprocessing opportunities.
[16] Containers already eligible for the CDS are out of scope for Options 1, 2, and 3.
[17] Excludes containers eligible for the CDS under the base case. Rounding means some totals do not match the sum of columns.

Container type	Glass	Plastic	Paper/ Cardboard	Metal	Total mass (tonnes)	Option(s)
Wine (non-glass)		32	16	0	**48**	2, 3
Water			94		**94**	2, 3
Flavoured milk		860	140		**1,000**	2, 3
Plain milk	250	17,000	4,600		**21,750**	3
Total – Option 1	**94,000**	**3,600**	**120**	**0**	**97,750**	
Total – Option 2	**94,750**	**4,900**	**1,300**	**2**	**101,000**	
Total – Option 3	**95,000**	**22,000**	**5,750**	**2**	**122,750**	

Table 7: Quantity of disposed in-scope containers (Options 1, 2, and 3) in NSW in 2021-22[18]

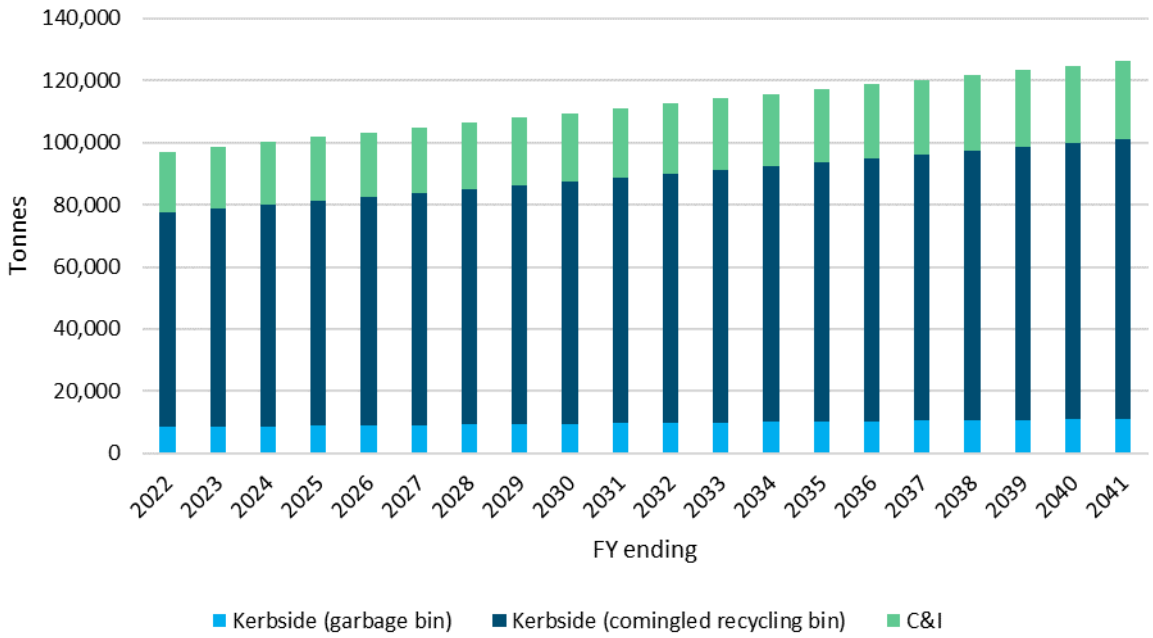
Container type	Glass	Plastic	Paper/ Cardboard	Metal	Total containers (million)	Option(s)
Wine (glass)	196				**196**	1, 2, 3
Straight spirits (glass)	37				**37**	1, 2, 3
Juice (Option 1)	2	67	3		**72**	1, 2, 3
Cordial *plus* juice containers not already included in Option 1	3	29	56	0.1	**88**	2, 3
Wine (non-glass)		2	0.3	0.8	**3**	2, 3
Water			7		**7**	2, 3
Flavoured milk		19	5		**24**	2, 3
Plain milk	0.4	276	174		**450**	3
Total – Option 1	**235**	**67**	**3**	**0**	**305**	
Total – Option 2	**240**	**115**	**71**	**1**	**425**	
Total – Option 3	**240**	**395**	**245**	**1**	**875**	

The split of disposal between household/kerbside and C&I sources has been estimated based on an analysis of kerbside[19] and C&I[20] bin audit data. Following further calibration, using other data sources

[18] Excludes containers already disposed via the CDS under the base case. Rounding means totals do not match the sum of columns.
[19] Analysis of NSW Kerbside Red Lid Bin Audit Data Report (2020), SSROC Kerbside Waste Audit (2019), and NSW Local Government Waste and Resource Recovery Data Report 2019–20 (2021).
[20] Disposal-based audit Commercial and industrial waste stream in the regulated areas of New South Wales (2015).

described above, it is estimated that the split is approximately 80% disposal from household/ kerbside sources and 20% from C&I sources. Of the household/kerbside disposal, the split is about 85% in the comingled recycling bin and 15% in the garbage bin (Figure 5). Only Option 2 is shown because the equivalent graphs would look almost identical for Options 1 and 3.

Figure 5: Disposal pathways for in-scope glass containers (Option 2)[21] under the base case



Finally, Table 8, Figure 6, and Figure 7 illustrate that the magnitude of in-scope containers for material types other than glass differs substantially between Options 1, 2, and 3. For Option 1, only large juice containers are in-scope while for Option 2, the range of in-scope containers is extended to include larger water, pure juice, flavoured milk, concentrated fruit and vegetable juice, and several other container types. The smaller sizes of these containers are already eligible for the CDS, so are considered to be out-of-scope for this analysis. For Option 3, the range of in-scope containers is extended further to include plain milk containers, which comprises of 17,000 tonnes of plastic containers and 4,600 tonnes of paper/cardboard containers in 2021-22.

Table 8: In-scope non-glass containers (tonnes) (Options 1 and 2) in NSW in 2021-22

	Large (≥1L) juice containers (Options 1 only)	Other in-scope containers (Option 2 incremental to Option 1)	Other in-scope containers (Option 3 incremental to Option 2)	Total (Option 1)	Total (Option 2)	Total (Option 3)
Paper/Cardboard	120	1,200	4,600	120	1,200	5,800
Plastic	3,530	1,360	17,000	3,530	5,000	22,000

[21] Only Option 2 is shown here; however, the scope of eligible glass containers for Options 1, 2, and 3 very similar.

	Large (≥1L) juice containers (Options 1 only)	Other in-scope containers (Option 2 incremental to Option 1)	Other in-scope containers (Option 3 incremental to Option 2)	Total (Option 1)	Total (Option 2)	Total (Option 3)
Metal	0	2	2	0	2	2
Total	3,650	2,550	22,000	3,650	6,200	27,800

Figure 6: In-scope non-glass containers (Options 1 and 2)

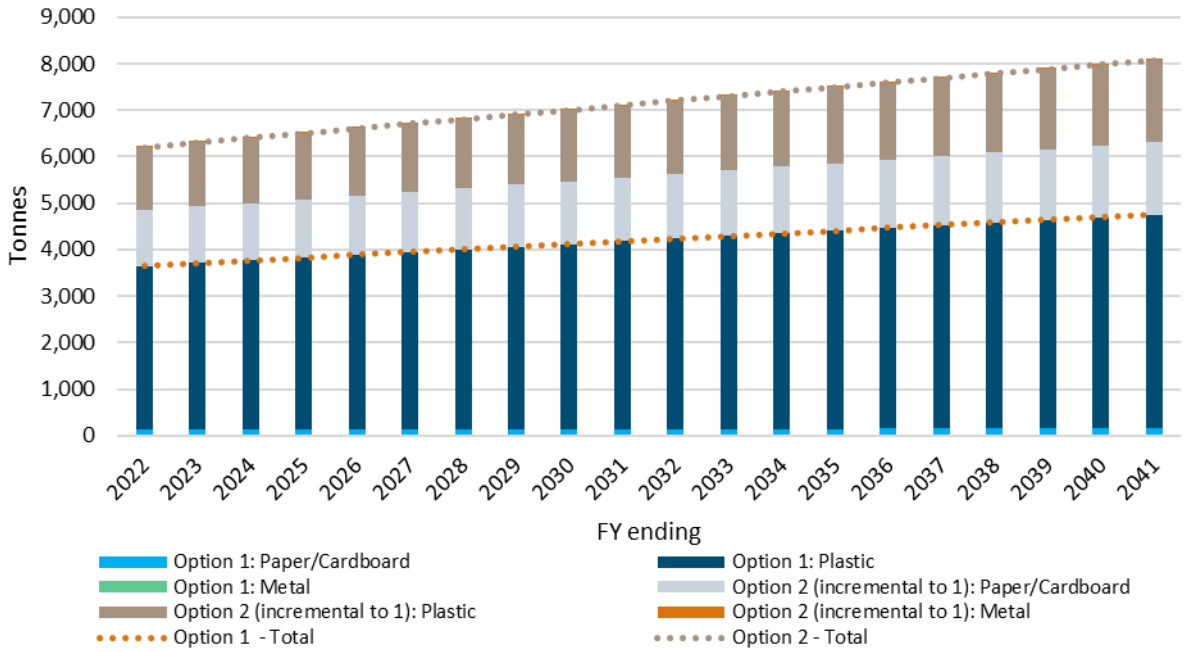
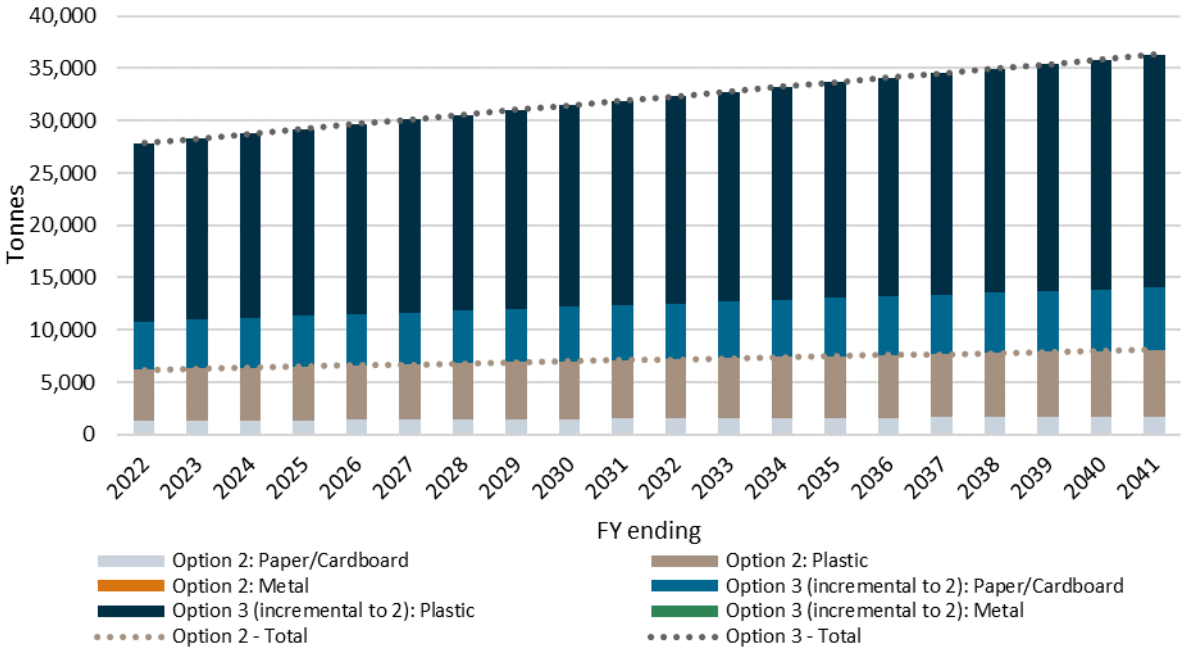


Figure 7: In-scope non-glass containers (Options 2 and 3)



3.3 Waste generation and recovery under the base case and options

Total household waste[22] generated then disposed through the kerbside garbage and comingled recycling bins (i.e., excluding organics) in NSW is estimated to be approximately 2.4 million tonnes in 2021-22. Based on population growth, this figure is projected to increase to about 3.1 million tonnes in 2040-41.

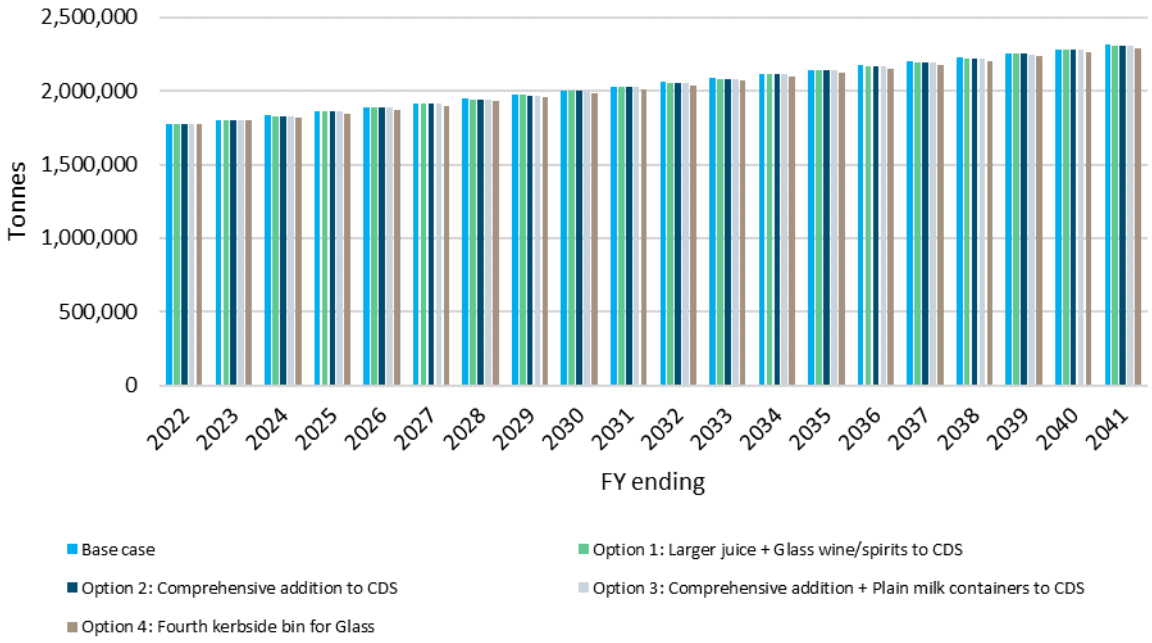
As shown in Figure 8, under the base case, household waste that is disposed in garbage bins is estimated to be about 1.8 million tonnes in 2021-22. This figure is expected to increase in line with population growth; however, at reduced rates for the options, as some household waste is redirected to the expanded CDS (Options 1 to 3) or recycling bins (Option 4).

All options – with their focus on improved recycling outcomes – are estimated to achieve reductions in disposal via the garbage bin. Under Option 1, the total quantity of material going through garbage bins is projected to decline by about 4,000 tonnes in 2030-31 and 4,500 tonnes in 2040-41, respectively, incremental to the base case. For Option 2, the projected declines are about 4,400 tonnes in 2030-31 and 5,000 tonnes in 2040-41. For Option 3, the projected declines are about 5,300 tonnes in 2030-31 and 6,000 tonnes in 2040-41. For Option 4, the projected declines are about 20,000 tonnes in 2030-31 and 23,000 tonnes in 2040-41.

A detailed description of the assumptions regarding the behavioural changes driving these changes to material flows is provided in Section 3.4 below.

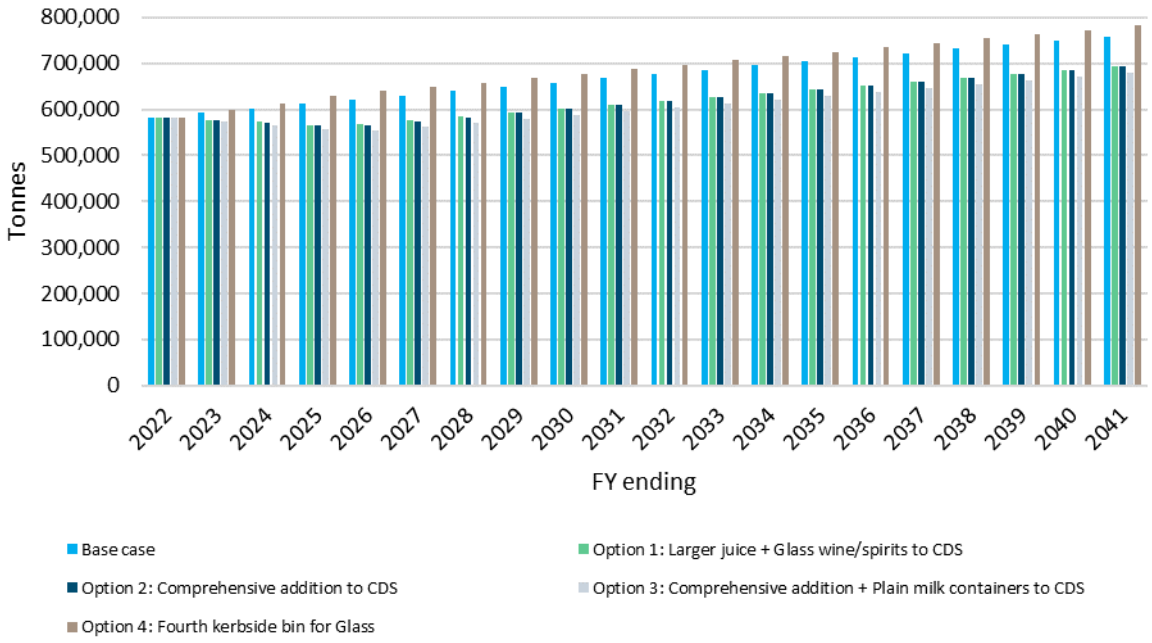
[22] Municipal solid waste (MSW) is solid material/items that are considered to have reached the end of their useful life, so are deposited by households in kerbside bins or at CDS collection points or collected from C&I sources by waste collection/disposal service providers. MSW includes recyclable materials (e.g., plastic bottles, cardboard boxes), non-recyclable materials, garden organics (e.g., grass clippings), food organics, etc. MSW does not include liquid waste.

Figure 8: Household waste disposed through the garbage bin under the base case and options



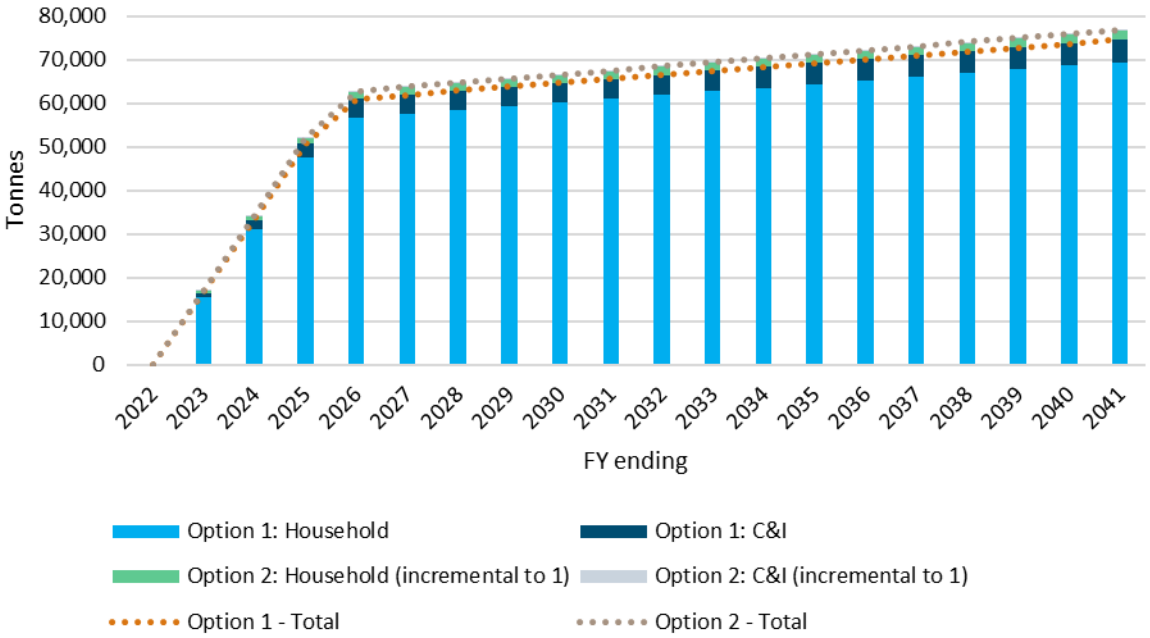
For Options 1 to 3, the quantities of waste material disposed via the dry recycling bins is expected to decline, initially, as additional containers are redirected to disposal through CDS collection points, then eventually increase as the population effect (growth in waste volume) dominates the diversion effect. For Option 4, the quantities of waste material disposed via the dry recycling bins is expected to increase throughout the analysis period, as a result of behavioural change stimulated by the introduction of glass only bins (Figure 9).

Figure 9: Household waste disposed through the dry recycling bins (comingled & glass only) under the base case and options



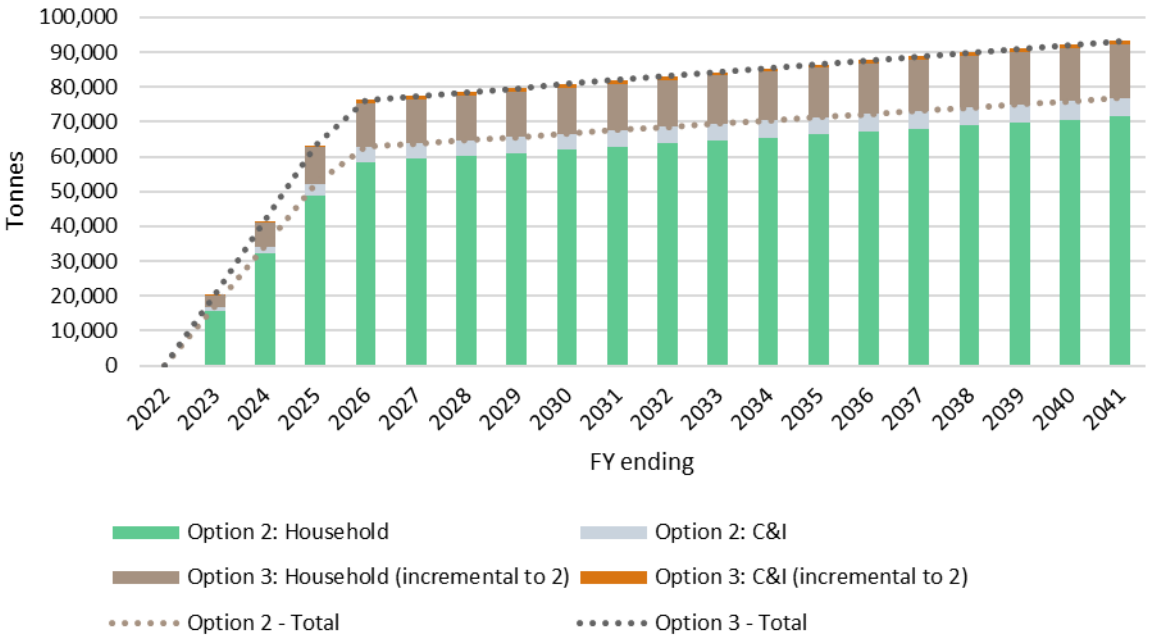
For Option 1, the expanded scope of the CDS is estimated to result in an additional 66,000 tonnes of material (mostly glass) being disposed of via CDS collection points in 2030-31 and an additional 75,000 tonnes of material in 2040-41. For Option 2 (incremental to Option 1), an additional 1,900 tonnes of material is expected to be disposed of via CDS collection points in 2030-31 and an additional 2,200 tonnes of material in 2040-41 (Figure 10).

Figure 10: Incremental change in household and C&I waste disposed through CDS collection points under Options 1 & 2



Finally, for Option 3 (when compared to Option 2), an additional 14,400 tonnes of material (mostly plastic and paper/cardboard) is expected to be disposed of via CDS collection points in 2030-31, and an additional 16,400 tonnes of material in 2040-41 (Figure 11).

Figure 11: Incremental change in household and C&I waste disposed through CDS collection points under Options 2 & 3



3.4 Recycling and recovery rates under the base case and options

Under the base case, the recycling rate[23] for MSW[24] is assumed to remain steady at 43.9% for the duration of the analysis period (2021-22 to 2040-41). This 43.9% rate (and all other rates reported) are for all MSW – dry recyclables, garbage, garden organics, and food organics – not only for in-scope containers.

For Option 1, Option 2, Option 3, and Option 4, this recycling rate is estimated to gradually increase to 44.1%, 44.1%, 44.2%, and 44.3%, respectively, by 2026-27, with no further improvement in recycling rates assumed beyond 2026-27 (Figure 12). These changes represent a 0.5% increase in the recycling rate for Option 1, 0.5% increase for Option 2, 0.6% increase for Option 3, and 0.9% increase for Option 4 incremental to the base case. For all options, these improvements are mainly due to expected behavioural changes resulting in containers/material that would, for the base case, be disposed in the kerbside garbage bin (and go directly to landfill), instead being disposed via pathways that deliver containers/material to MRFs (through kerbside recycling bins) or through CDS collection points. The relatively larger scope of containers/material for Option 4 is expected to result in more substantial improvement to the recycling rate compared to Options 1 to 3.

[23] The recycling rate is the amount (tonnes) of waste delivered to material recovery facilities (MRFs) via kerbside recycling bins or to CDS collection points, expressed as a proportion of total waste generated (tonnes), where total waste generated also includes waste disposed via kerbside garbage bins and other pathways that go directly to landfill.

[24] Municipal solid waste (MSW) is solid material/items that are considered to have reached the end of their useful life, so are deposited by households in kerbside bins or at CDS collection points or collected from C&I sources by waste collection/disposal service providers. MSW includes recyclable materials (e.g., plastic bottles, cardboard boxes), non-recyclable materials, garden organics (e.g., grass clippings), food organics, etc. MSW does not include liquid waste.

In contrast, the recovery rates described in Figure 13 are for kerbside *recycling* bins only (i.e., comingled recycling and glass only bins). Under the base case, the recovery rate is assumed to remain steady at 69.8% for the duration of the analysis period. For Option 1, Option 2, Option 3, and Option 4, this recovery rate is estimated to gradually increasing to 71.5%, 71.5%, 71.0%, and 80.3%, respectively, by 2026-27 and with no further improvement in recovery rates assumed beyond 2026-27. These changes represent a 2.5% increase in the recovery rate for both Options 1 and 2, 1.8% increase for Option 3, and 13.2% increase for Option 4 incremental to the base case.

Figure 12: Recycling rate for kerbside and CDS pathways

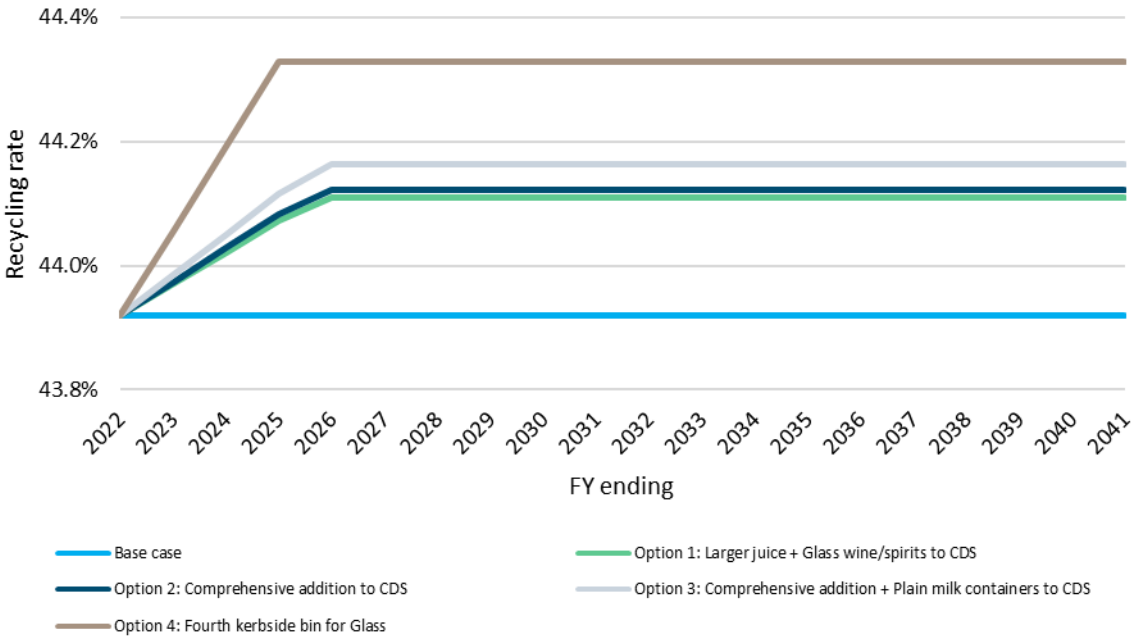
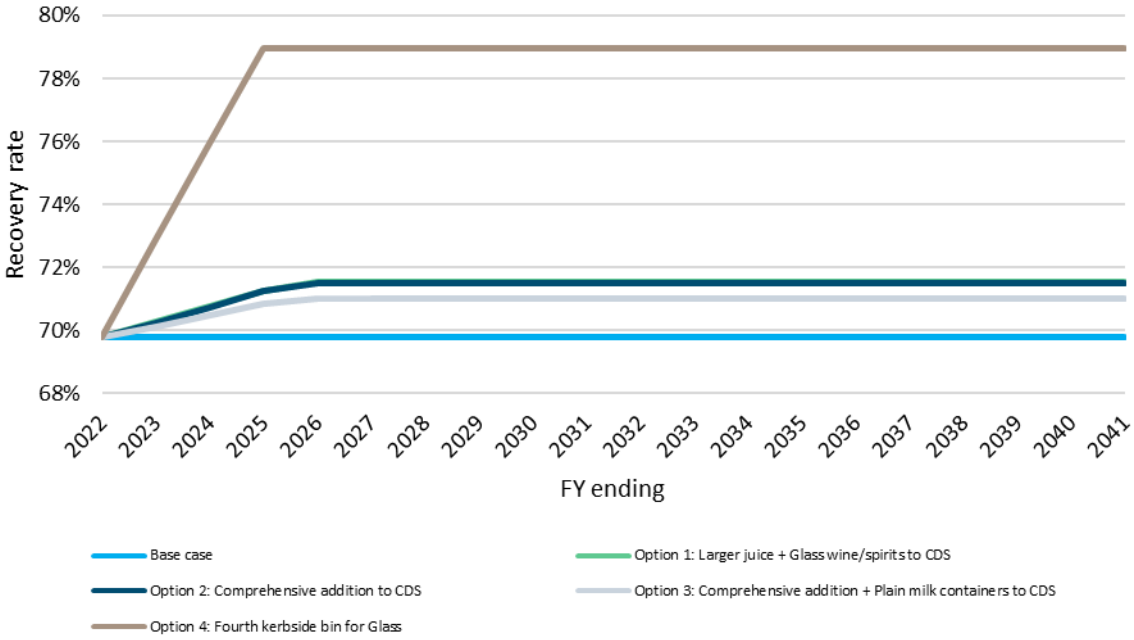


Figure 13: Recovery rate for kerbside recycling bins (comingled & glass only)



For Options 1 to 3, it is assumed the scope of the CDS is expanded from 2022-23, with participation by households gradually ramping up over time before plateauing in 2025-26, at which point it is assumed scheme maturity is reached for the newly eligible (mostly glass) containers[25]. Available evidence suggests that, at maturity, around 70% of CDS eligible items are disposed at CDS collection points.[26] Therefore, this is the level of diversion from the comingled recycling bin to CDS collection points assumed for 2025-26.[27] The remainder (30%) is assumed to continue being disposed via the comingled recycling bin. Similar assumptions are applied to glass waste from C&I, but with only 20% of newly eligible containers disposed to CDS collection points by 2025-26, and the remaining 80% continuing to be disposed via the same C&I disposal pathways as currently.

For Option 4, the change in behaviour of households is proportionately smaller but translates to more substantial improvements to recycling and recovery rates due to the difference in scope for Options 1 to 3 compared to Option 4. This is because the scope for Options 1 to 3 is only glass wine and spirits bottles, and juice bottles 1L and larger (plus relatively small quantities of other beverage containers for Option 2; and those same beverage containers, plus plain milk containers for Option 3), while the scope for Option 4 is all glass containers.

The main assumptions driving the results for Option 4 concern the redirection of glass containers previously being disposed by households in the garbage or comingled recycling bin under the base case, instead of being disposed in the glass bin under Option 4. These changes are illustrated in Figure 12 and Figure 13.

The relevant assumptions for Option 4 are that by 2024-25, (i) 15% of glass containers previously disposed in the garbage bin will instead be redirected to the glass bin[28], and (ii) 95% of glass containers previously disposed in the comingled recycling bin will instead be redirected to the glass bin[29].

These behavioural changes will result in cleaner streams of recyclables – glass, plastics, paper/cardboard – which drives improved recovery rates.

3.5 Material fates

The expected fates of household waste, expressed as proportional splits, are illustrated in Figure 14 to Figure 16, and Table 9 to Table 11.[30] These estimates are for material *exiting* MRFs and CDS

—

[25] For Option 1, glass wine and spirits bottles, and juice bottles ≥1L. For Option 2, the previously listed items plus relatively smaller quantities of mostly paper/cardboard and plastic containers. For Option 3, the listed items for Option 2 plus plain milk containers.

[26] An average redemption rate of total containers supplied of 67% is reported in *Return and Earn Annual Statutory Report 2020–21* (p. 15) and *Return and Earn: Annual Statutory Report 2019–20* (p. 13). Since wine bottles have not previously been included in the CDSs of other Australian jurisdictions, there is no available evidence to suggest that redemption rates for wine bottles will differ from those of container types currently eligible for the CDS. For this reason, the analysis assumes the same redemption rate at maturity for all eligible container types.

[27] The full schedule for diversion of newly eligible containers from the comingled recycling bin to CDS collection points is 20% in 2022-23, 40% in 2023-24, 60% in 2024-25, and 70% from 2025-26 onward.

[28] This assumption is based on evidence from glass bin trials conducted by several local councils in Victoria. We feel this assumption is likely to be conservative, and not optimistic.
It is assumed the remaining 85% of containers will continue to be disposed in the garbage bin under Option 4.

[29] The remaining 5% will continue to be disposed in the comingled recycling bin under Option 4.

[30] The impacts of the options on fates for metal waste are minor, so these impacts are not shown.

aggregation points, and include both *in-scope* and *out-of-scope* materials. This explains why, for example, Figure 16 and Table 11 show ~80% of household plastic waste going to landfill, although this proportion would be much smaller if considering only in-scope plastic containers.

Figure 14: Material fates for the base case and options (household sources) – Glass
[includes both in-scope and out-of-scope materials]

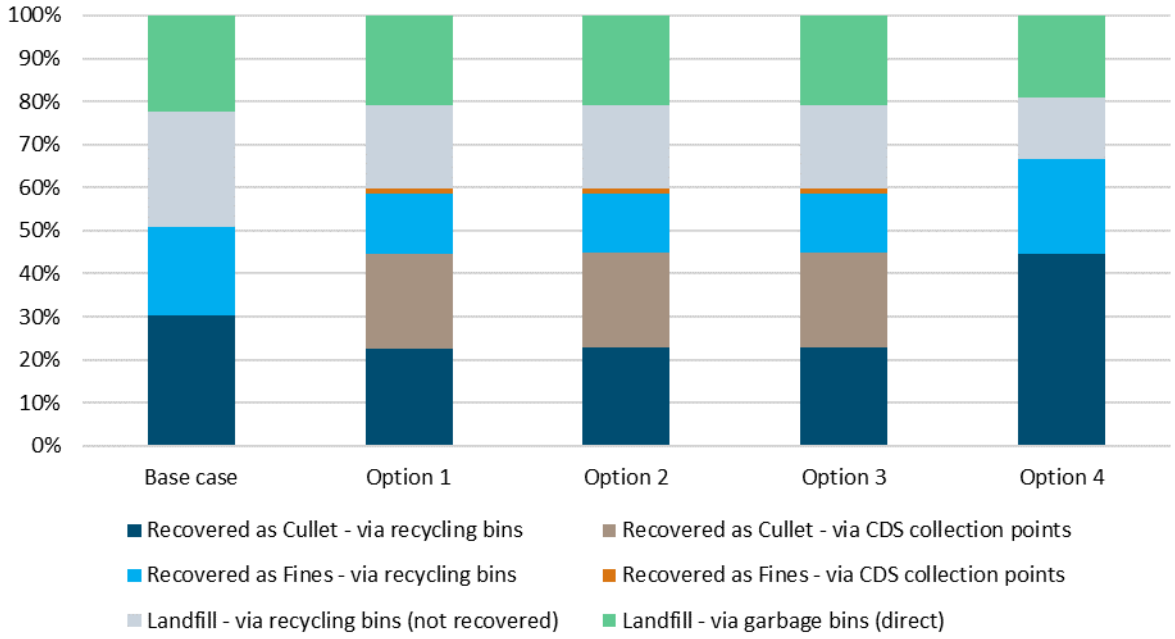


Figure 15: Material fates for the base case and options (household sources) – Paper/Cardboard
[includes both in-scope and out-of-scope materials]

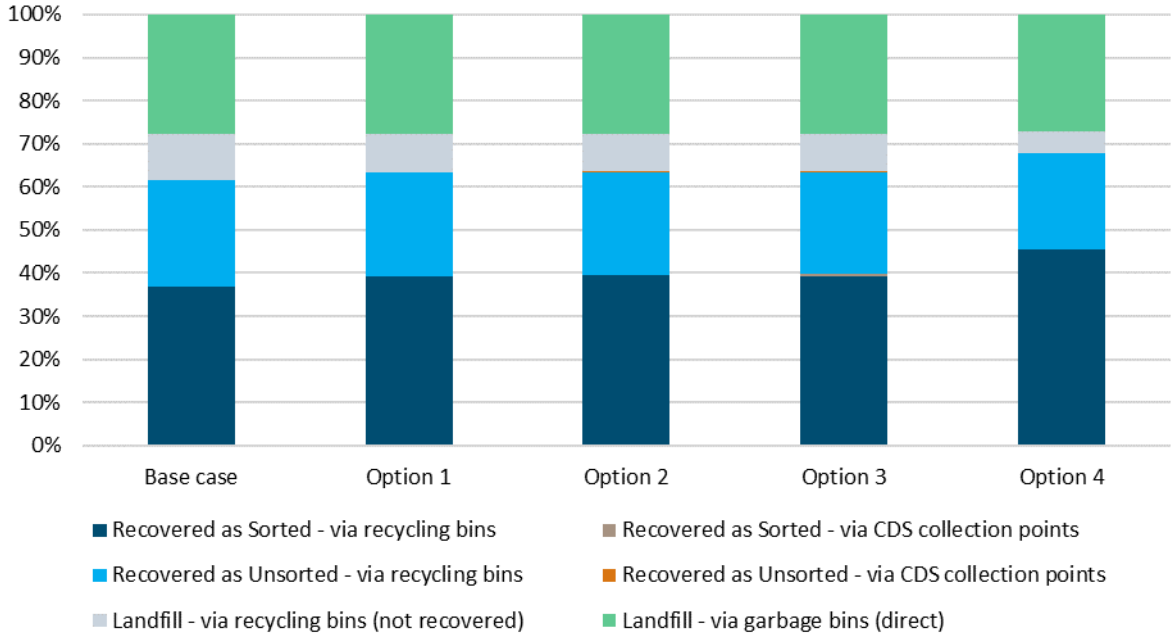


Figure 16: Material fates for the base case and options (household sources) – Plastic
[includes both in-scope and out-of-scope materials]

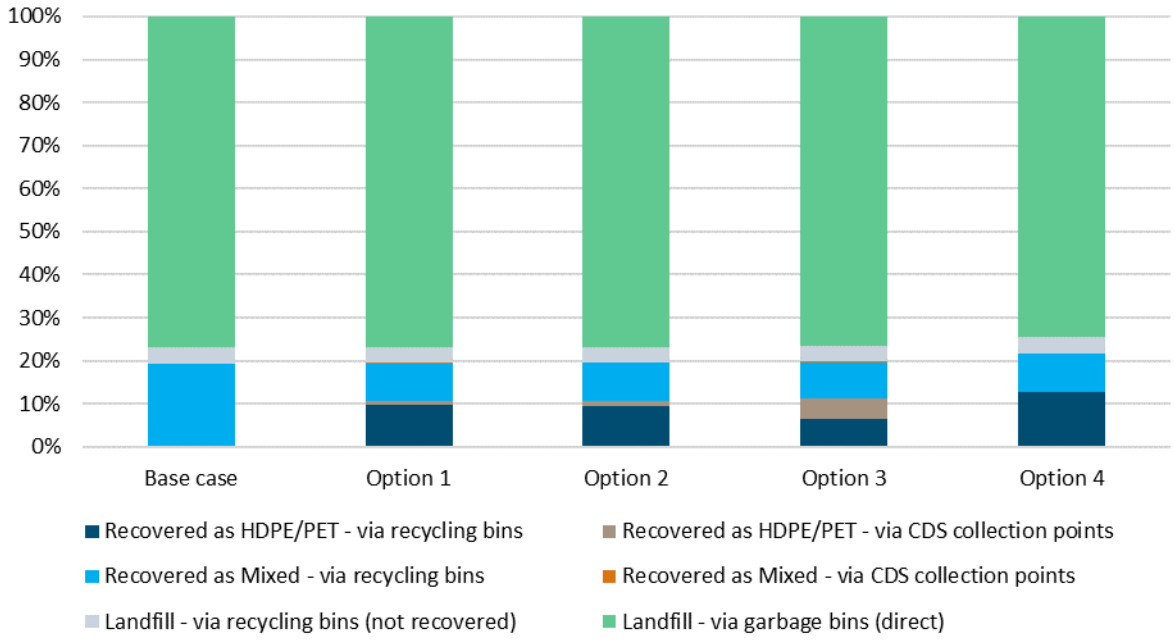


Table 9: Material fates for the base case and options (household sources) – Glass
[includes both in-scope and out-of-scope materials]

Material fate	Base case	Option 1	Option 2	Option 3	Option 4
Recovered as Cullet – via recycling bins	30.4%	22.6%	22.8%	22.7%	44.6%
Recovered as Cullet – via CDS collection points	0.0%	22.0%	22.2%	22.2%	0.0%
Recovered as Fines – via recycling bins	20.3%	14.0%	13.7%	13.7%	22.2%
Recovered as Fines – via CDS collection points	0.0%	1.2%	1.2%	1.2%	0.0%
Landfill – via recycling bins (not recovered)	26.8%	19.4%	19.3%	19.3%	14.2%
Landfill – via garbage bins (direct)	22.4%	20.9%	20.9%	20.9%	19.0%
Total – Cullet	**30.4%**	**44.6%**	**44.9%**	**45.0%**	**44.6%**
Total – Fines	**20.3%**	**15.1%**	**14.9%**	**14.9%**	**22.2%**
Total – Landfill	**49.3%**	**40.3%**	**40.2%**	**40.2%**	**33.3%**

Table 10: Material fates for the base case and options (household sources) – Paper/Cardboard
[includes both in-scope and out-of-scope materials]

Material fate	Base case	Option 1	Option 2	Option 3	Option 4
Recovered as Sorted – via recycling bins	37.0%	39.2%	39.6%	39.2%	45.4%
Recovered as Sorted – via CDS collection points	0.0%	0.0%	0.1%	0.5%	0.0%

Material fate	Base case	Option 1	Option 2	Option 3	Option 4
Recovered as Unsorted – via recycling bins	24.6%	24.2%	23.8%	23.6%	22.6%
Recovered as Unsorted – via CDS collection points	0.0%	0.0%	0.0%	0.3%	0.0%
Landfill – via recycling bins (not recovered)	10.5%	8.7%	8.7%	8.6%	5.0%
Landfill – via garbage bins (direct)	27.9%	27.9%	27.8%	27.7%	27.0%
Total – Sorted	**37.0%**	**39.2%**	**39.6%**	**39.8%**	**45.4%**
Total – Unsorted	**24.6%**	**24.2%**	**23.9%**	**23.9%**	**22.6%**
Total – Landfill	**38.4%**	**36.5%**	**36.5%**	**36.3%**	**32.1%**

Table 11: Material fates for the base case and options (household sources) – Plastic [includes both in-scope and out-of-scope materials]

Material fate	Base case	Option 1	Option 2	Option 3	Option 4
Recovered as HDPE/PET – via recycling bins	0.0%	9.7%	9.6%	6.5%	12.6%
Recovered as HDPE/PET – via CDS collection points	0.0%	0.8%	1.1%	4.9%	0.0%
Recovered as Mixed – via recycling bins	19.2%	8.9%	8.9%	8.2%	9.1%
Recovered as Mixed – via CDS collection points	0.0%	0.0%	0.1%	0.3%	0.0%
Landfill – via recycling bins (not recovered)	3.9%	3.7%	3.7%	3.6%	3.7%
Landfill – via garbage bins (direct)	76.9%	76.8%	76.8%	76.5%	74.6%
Total – HDPE/PET	**0.0%**	**10.5%**	**10.6%**	**11.4%**	**12.6%**
Total – Mixed	**19.2%**	**9.0%**	**8.9%**	**8.5%**	**9.1%**
Total – Landfill	**80.8%**	**80.5%**	**80.5%**	**80.1%**	**78.2%**

3.6 Avoided landfill for the options incremental to the base case

Improved recycling and recovery rates[31] – as described in Section 3.4 above – go hand-in-hand with avoided disposal to landfill. First, all four options are expected to induce a degree of behavioural change resulting in containers/material that would, for the base case, be disposed in the kerbside garbage bin (and go directly to landfill), instead being disposed via pathways that deliver containers/material to MRFs or through CDS collection points. Second, improved source separation of waste material results in lower contamination rates, therefore, improving recovery rates for waste material delivered to MRFs. In combination, these two factors increase the quantity of material recovered and reduce the quantity of material disposed to landfill.

[31] Note: The recycling rates reported directly above apply only to kerbside/household waste sources.

All four options are expected to result in substantial quantities of avoided landfill, with Option 4 generating the largest impact (Figure 17, Table 12). Based on the modelling assumptions, Option 1 avoids 628,000 tonnes of landfill disposal over the 20-year analysis period, Option 2 avoids 641,000 tonnes, Option 3 avoids 677,000 tonnes, and Option 4 avoids 1.4 million tonnes over the same period.

Note that for Options 1 to 3, most of the 'heavy lifting' is being done by containers that are in-scope for Option 1 (i.e., glass wine and spirits bottles). For Option 2, an additional 13,000 tonnes of landfill disposal are avoided compared to Option 1. Finally, for Option 3, an additional 36,000 tonnes of landfill disposal are avoided compared to Option 2.

Figure 17: Avoided landfill disposal over the analysis period

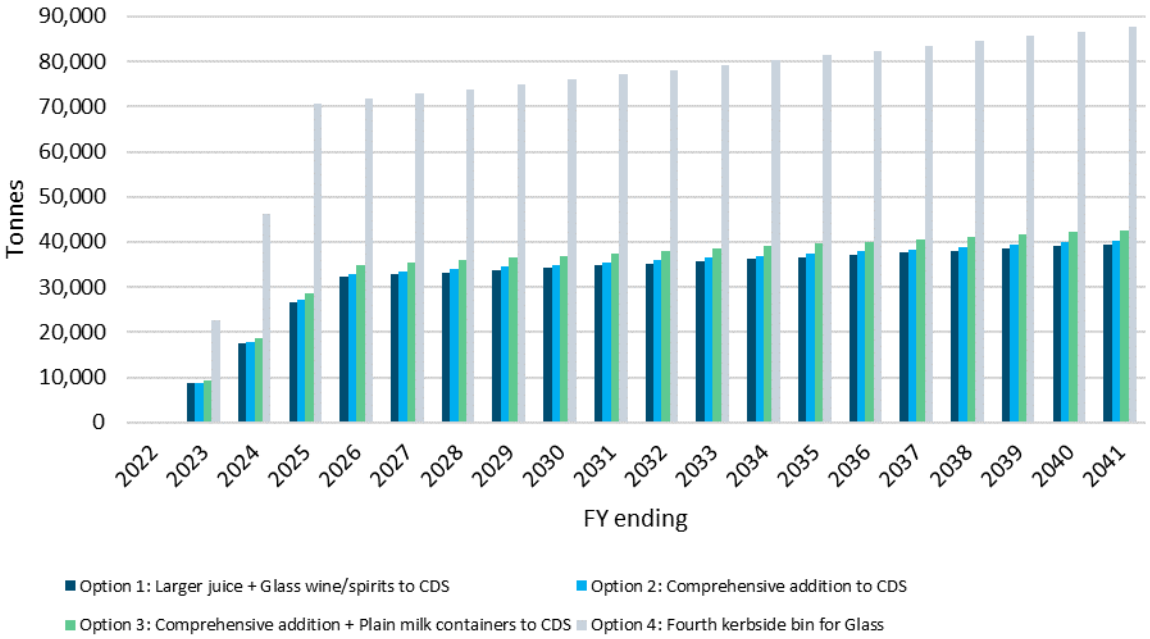


Table 12: Avoided landfill disposal (tonnes)

Option	2025-26	2030-31	2035-36	2040-41
Option 1: Larger juice + Glass wine/spirits to CDS	32,000	35,000	37,000	40,000
Option 2: Comprehensive addition to CDS	33,000	35,000	38,000	40,000
Option 3: Comprehensive addition + Plain milk containers to CDS	35,000	37,000	40,000	43,000
Option 4: Fourth kerbside bin for Glass	72,000	77,000	82,000	88,000

3.7 Improved sorting of material under the base case and options

All options are expected to improve the 'quality' of recyclate exiting MRFs through reduced recycling bin contamination and enhanced sorting of recycling material at the MRFs. The increase in levels of sorting of materials has been estimated proportionate to the impact of the glass bin on recovery

rates at MRFs (especially of glass, but also of paper/cardboard and plastics) and the associated impact on recycling rates.

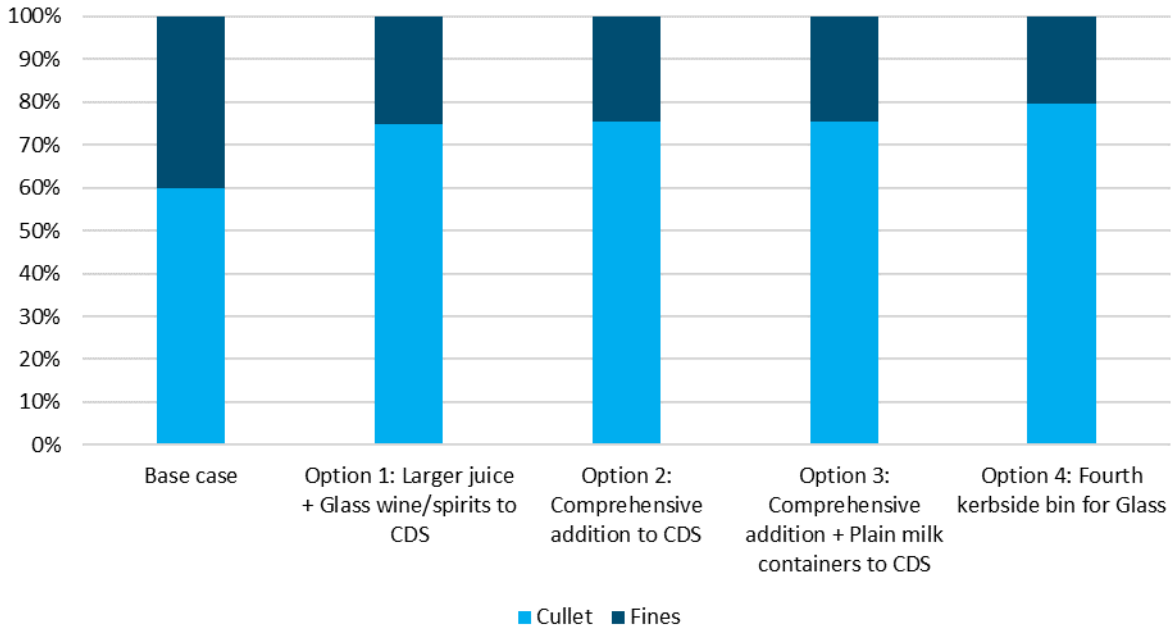
Proportional splits of recovered material (e.g., cullet vs. fines) are presented below for all options. Across each of the three CDS options (Options 1 to 3), the assumed material splits are very similar. This is because the reduction of glass contamination in kerbside waste streams is the main source of differences between the base case and option cases, and this impact is almost identical for Options 1 to 3.[32]

We estimate the proportion of glass exiting MRFs that will be recovered (via beneficiation) as cullet to increase from 60% under the base case to 75% for Options 1 to 3, and 79% for Option 4 (Figure 18).

The proportion of recovered paper/cardboard exiting MRFs that has been sorted (as opposed to mixed, unsorted paper) is estimated to increase from 60% under the base case to 62% for Options 1 to 3, and 67% for Option 4 (Figure 19).

Finally, the proportion of sorted plastics is estimated to increase from 52% under the base case to 54% for Options 1 and 2, 57% for Option 3, and 58% for Option 4 (Figure 20).

Figure 18: Proportional split of recovered glass under base case and options (2025-26)



[32] Marginally higher recovery of higher quality outputs (i.e., sorted paper/cardboard, HDPE and PET plastic, and glass cullet) has been assumed for Options 2 and 3 incremental to Option 1.

Figure 19: Proportional split of recovered paper/cardboard under base case and options (2025-26)

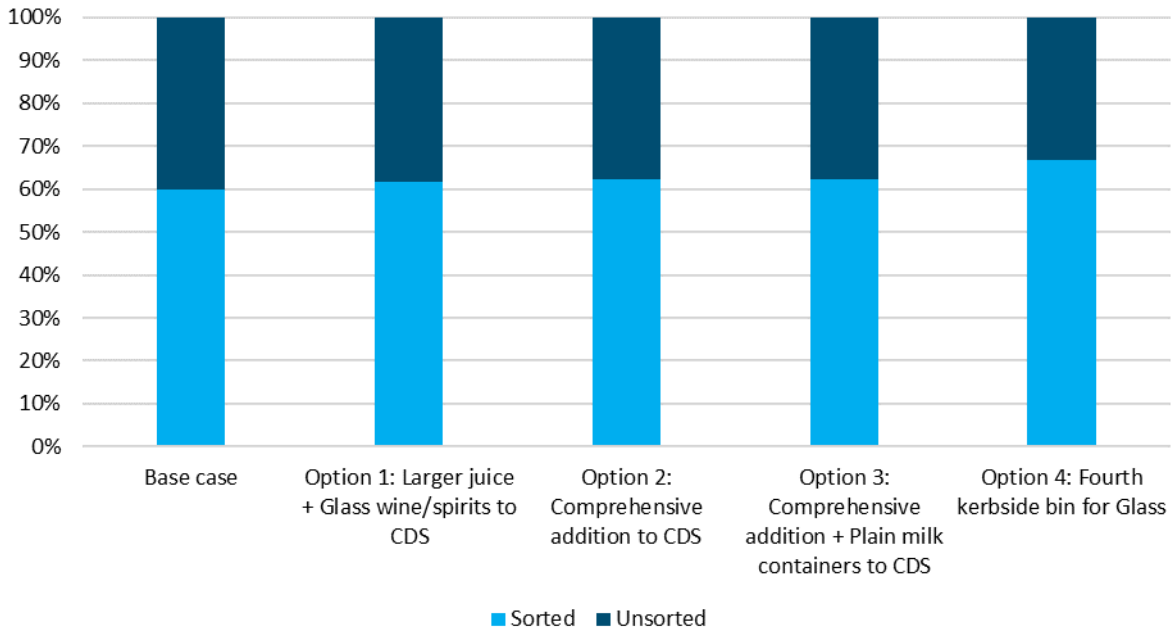
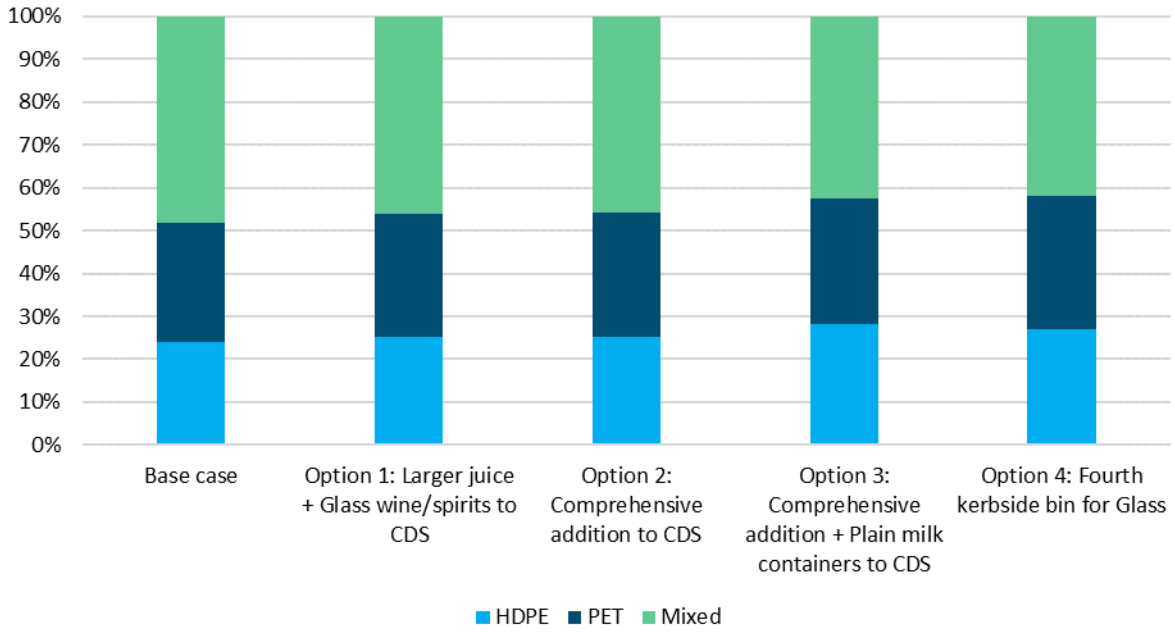


Figure 20: Proportional split of recovered plastics under base case and options (2025-26)



3.8 Impacts on throughput and recovery for MRFs

Expansion of the scope of eligible containers for the CDS (Options 1 to 3) is expected to have two main impacts on MRFs. First, some containers will be redirected from disposal via kerbside bins to instead be disposed via CDS collection points. Second, removal of some degree of contamination from the kerbside waste stream is expected to result in improved recovery rates at MRFs. For Options 1 to 3, these combined impacts are expected to result in increased recovery for

paper/cardboard and lower recovery for plastic and glass. Recovery of metal is expected to be effectively unchanged.

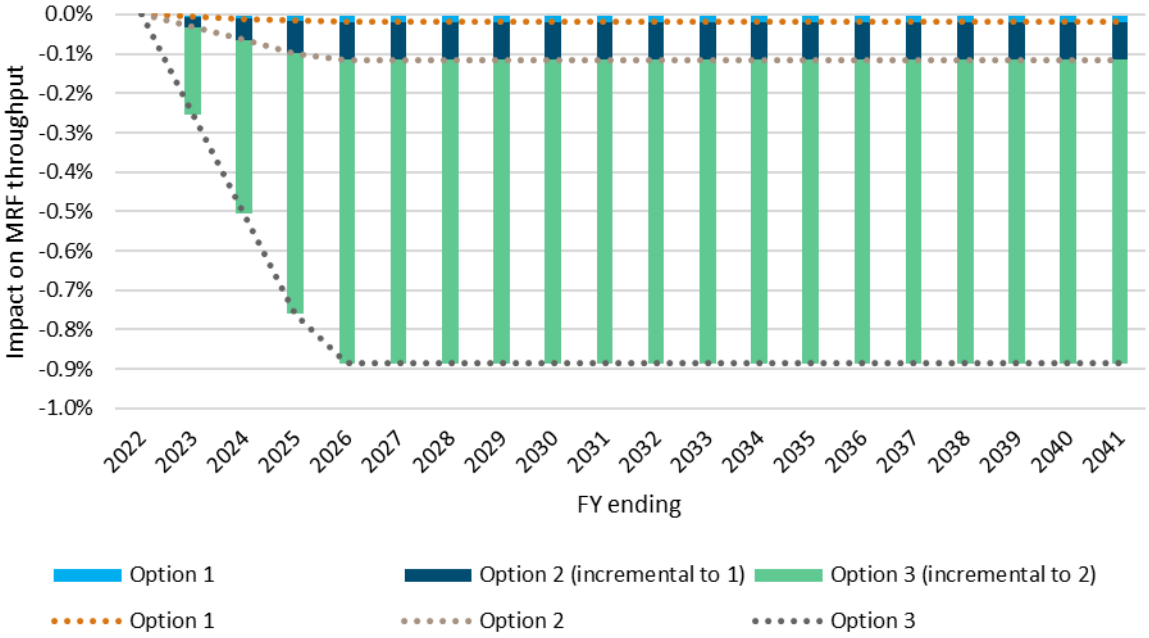
3.8.1 Impacts on throughput at MRFs

Expected proportional changes to the throughput of paper/cardboard, plastic, and glass are shown below in Figure 21 to Figure 23. There is expected to be effectively no change to the throughput of metal to MRFs resulting from the policy options.

For Option 3, throughput of paper/cardboard waste to MRFs via kerbside recycling bins is expected to decline by 0.9%, which is comprised of the following containers:

- Wine: unchanged
- Spirits: unchanged
- Large juice: -0.02%
- Plain milk: -0.8%
- All other containers: -0.08%

Figure 21: Impact on MRF throughput, relative to base case – Paper/Cardboard

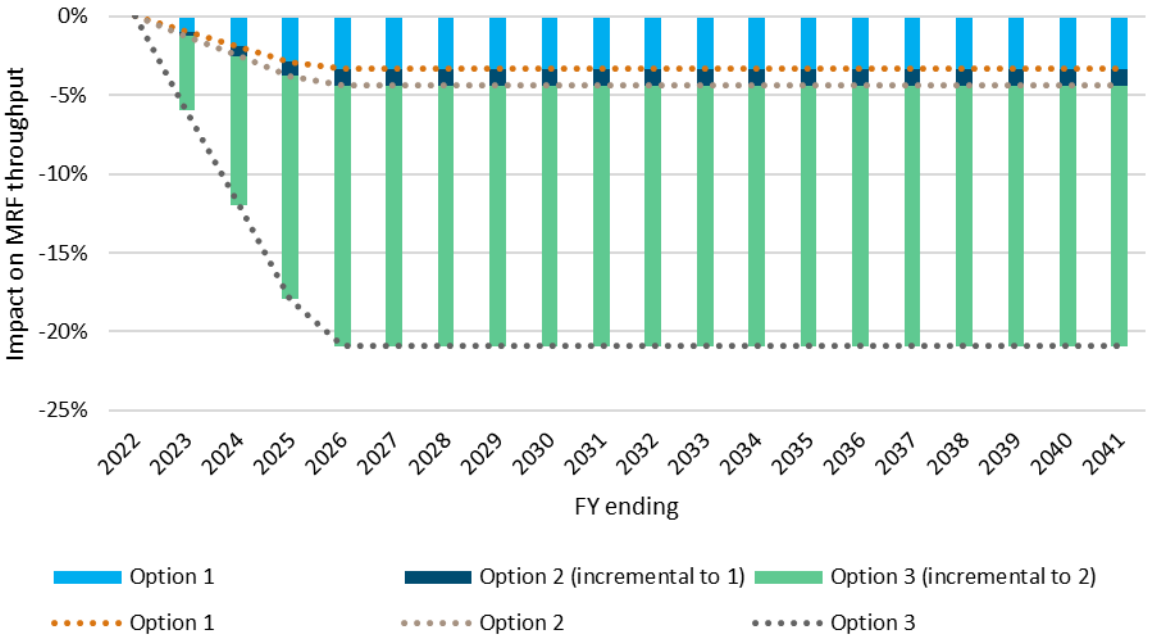


For Option 3, throughput of plastic waste to MRFs via kerbside recycling bins is expected to decline by 20.9%, which is comprised of the following containers:

- Wine: unchanged
- Spirits: unchanged
- Large juice: -3.3%

- Plain milk: -16.5%
  - Of which around 87% of these plain milk containers are made from HDPE and the remaining 13% made from PET.
  - The above percentages apply only to those plain milk containers made from plastic. Some plain milk containers are made from Tetra Pak/Liquid paperboard or glass.
- All other containers: -1.1%

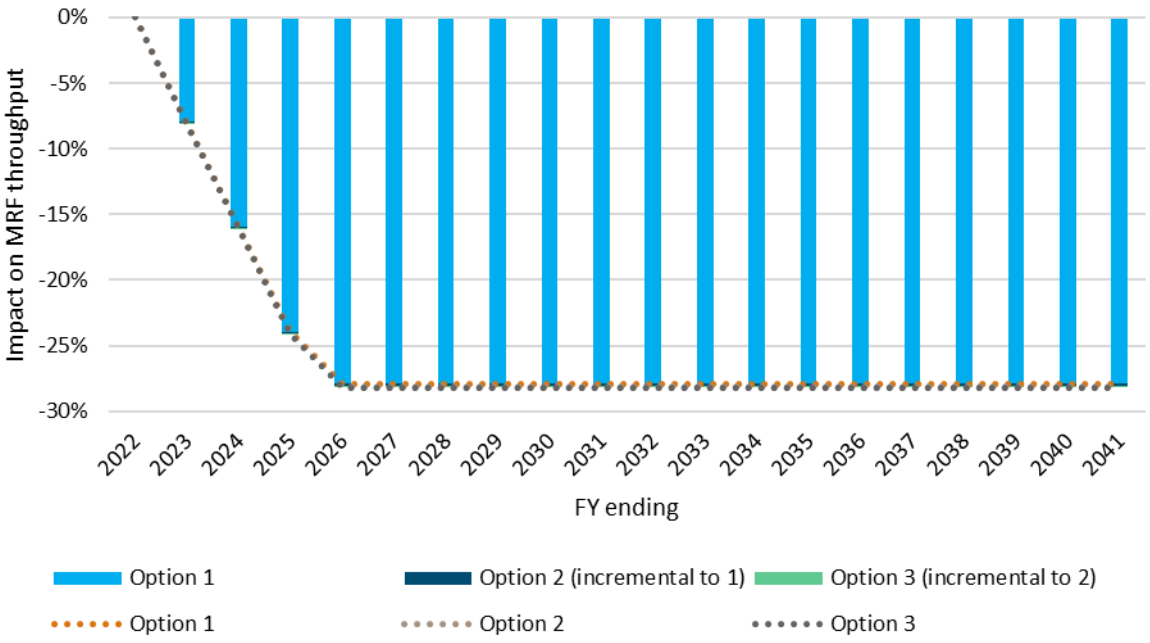
Figure 22: Impact on MRF throughput, relative to base case – Plastic



For Option 3, throughput of glass waste to MRFs via kerbside recycling bins is expected to decline by 28.2%, which is comprised of the following containers:

- Wine: -23.2%
- Spirits: -4.6%
- Large juice: -0.1%
- Plain milk: -0.1%
- All other containers: -0.2%

Figure 23: Impact on MRF throughput, relative to base case – Glass



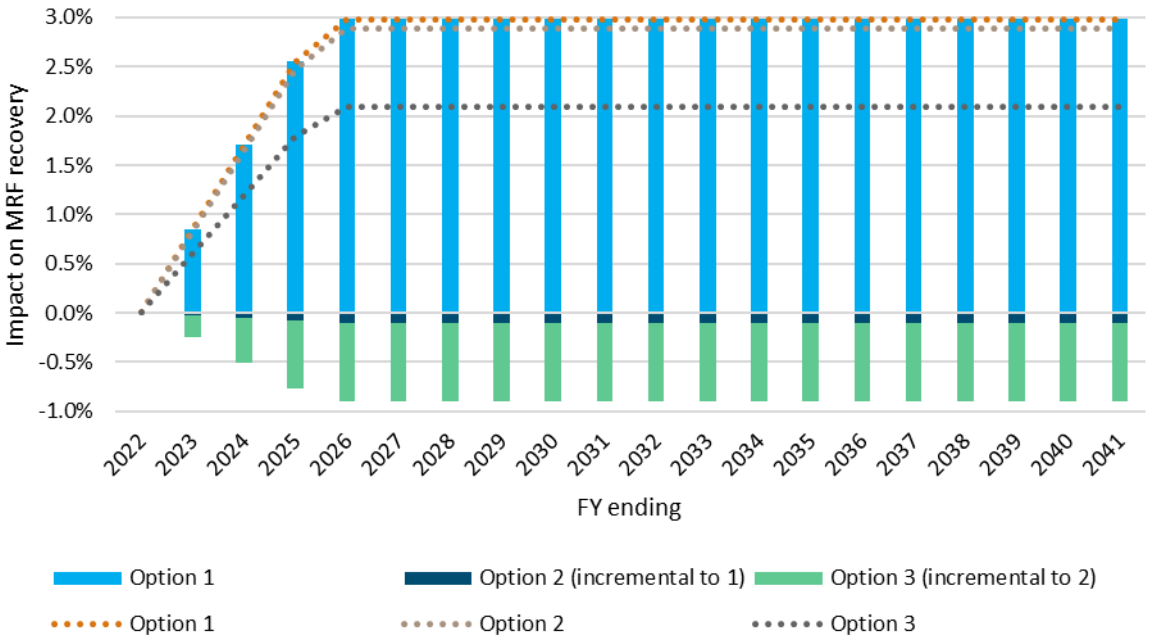
3.8.2 Impacts on recovery at MRFs

Changes in recovery of material at MRFs, from waste collected via kerbside recycling bins, are expected to follow similar trends to the changes in throughput (above). However, reduced contamination leading to improved recovery rates means (i) recovery of paper/cardboard is expected to increase by proportionately more than the anticipated increase in throughput, recovery of plastic and glass is expected to decrease by proportionately less than the anticipated increase in throughput. These changes to recovery of paper/cardboard, plastic, glass, and metal are shown in Figure 24 to Figure 26. There is expected to be effectively no change to the recovery of metal to MRFs resulting from the policy options.

For Option 3, recovery of paper/cardboard at MRFs, from waste collected via kerbside recycling bins, is expected to increase by 2.1%, which is comprised of the following containers:

- Wine: unchanged
- Spirits: unchanged
- Large juice: +3%
- Plain milk: -0.8%
- All other containers: -0.1%

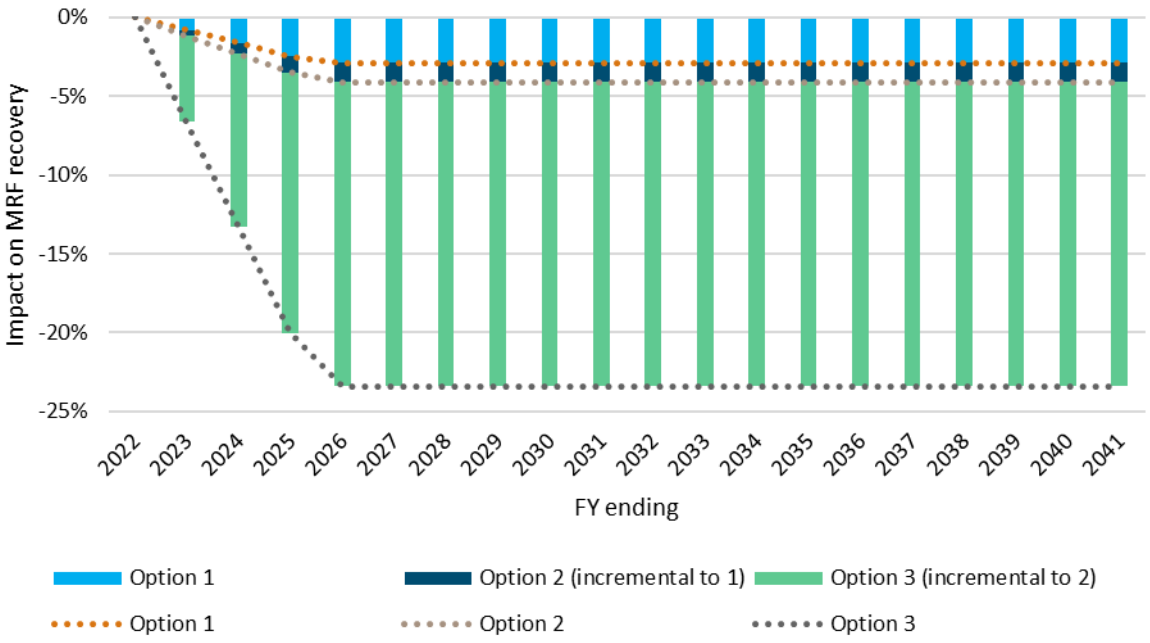
Figure 24: Impact on recovery of material from MRFs, relative to base case – Paper/Cardboard



For Option 3, recovery of plastic at MRFs, from waste collected via kerbside recycling bins, is expected to decrease by 23.4%, which is comprised of the following containers:

- Wine: unchanged
- Spirits: unchanged
- Large juice: -2.9%
- Plain milk: -19.3%
  - Of which around 87% of these plain milk containers are made from HDPE and the remaining 13% made from PET.
  - The above percentages apply only to those plain milk containers made from plastic. Some plain milk containers are made from Tetra Pak/Liquid paperboard or glass.
- All other containers: -1.2%

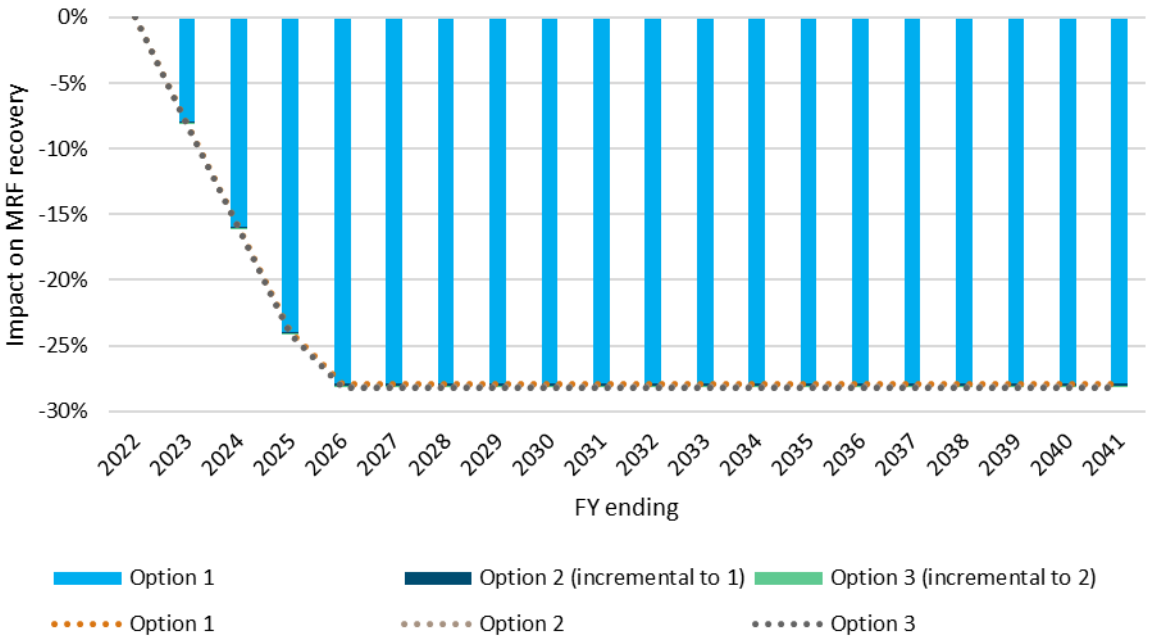
Figure 25: Impact on recovery of material from MRFs, relative to base case – Plastic



For Option 3, recovery of glass at MRFs, from waste collected via kerbside recycling bins, is expected to decrease by 28.2%, which is comprised of the following containers:

- Wine: -23.2%
- Spirits: -4.6%
- Large juice: -0.1%
- Plain milk: -0.1%
- All other containers: -0.2%

Figure 26: Impact on recovery of material from MRFs, relative to base case – Glass



3.9 Litter impacts under the base case and options

Reducing beverage container litter was a key objective underpinning the introduction of the NSW CDS. Since the introduction of the CDS in December 2017, beverage container litter has fallen by up to 57% of pre-scheme levels. Available data indicates that wine, spirits, and large juice bottles comprise only a small fraction of the current litter stream. For this reason, Options 1 to 3 are expected to have only minimal direct impact on reducing litter rates compared to the base case. However, this potential impact has not been quantified or valued, so, to the extent that litter rates would decrease for Options 1 to 3, this effect would improve the CBA results for these options. As noted in Section 1.1, expanding the scope of beverage containers that are eligible for the CDS, thus removing confusion about which container types are eligible, has the potential to remove a disincentive to participate in the CDS and, therefore, increase the capture of containers that are common in the litter stream. This potential indirect litter impact for Options 1, 2, and 3 has not been modelled.

Additionally, the CDS is assumed to maintain its effectiveness over the analysis period, which might require an increase in the nominal refund amount per container at some point during the analysis period. This is because, in the analyst's view, inflationary pressures are likely to decrease the effectiveness of the nominal 10c refund by reducing its value in real terms, thus also reducing the strength of the incentive for households and businesses to participate in the scheme.

Option 4 is not expected to have any material impact on litter rates.

4. Results

In this section, the results of the cost-benefit analysis (CBA) are compared using two key metrics: Net Present Value (NPV) and Benefit Cost Ratio (BCR).

4.1 CBA results

4.1.1 Results overview

The central results of the CBA, based on a 7% discount rate and 20-year analysis period, are presented in Table 13.

Table 13: Results, Options 1 to 4, 20-year analysis period ($ million PV at 7% discount rate)

Costs and benefits	Option			
	20 years			
	1	2	3	4
Costs	**147.4**	**153.3**	**181.5**	**482.3**
State government and local councils				
Additional collection and transport – Glass only bin	0.0	0.0	0.0	330.5
Capital cost of bins – Glass only bin	0.0	0.0	0.0	151.8
Additional container approvals	0.3	0.3	0.4	0.0
Industry				
Additional collection and transport – CDS collection points	13.2	13.8	16.5	0.0
Additional CDS collection and sorting costs	77.8	79.7	95.0	0.0
Additional participation costs – CDS	3.1	3.2	3.9	0.0
Additional container approvals	1.1	1.1	1.2	0.0
Additional compliance – re-labelling (refund marking requirements)	4.5	5.0	5.5	0.0
Additional compliance – reporting	5.1	5.8	6.3	0.0
Entering into Supply Arrangements	0.4	0.5	0.6	0.0
Households				
Additional participation costs – CDS	41.9	43.8	52.3	0.0
Benefits	**203.6**	**211.0**	**256.4**	**522.2**

Costs and benefits	Option			
State government & local councils				
Avoided collection and transport – Garbage (red) bin	3.4	3.8	4.5	17.8
Avoided collection and transport – Comingled recycling (yellow) bin	78.4	80.2	97.4	247.3
Avoided landfill disposal costs	22.2	22.7	23.9	50.6
Industry				
Increased value of recyclate	64.7	68.8	84.5	174.2
Avoided MRF processing costs	25.5	25.9	35.1	19.6
Avoided collection and transport – C&I waste disposal	3.9	4.0	4.9	0.0
Community				
Avoided landfill externalities	5.5	5.6	6.0	12.6
Net Benefit ($m NPV)	**56.2**	**57.7**	**74.9**	**39.8**
BCR	**1.38**	**1.38**	**1.41**	**1.08**

Information in Table 13 permits a comparison of the performance of the options using two key metrics:

- Net Present Value (NPV), which is the Present Value (PV) of benefits delivered by the policy less the PV of costs incurred; and
- Benefit Cost Ratio (BCR), which is the ratio of the PV of benefits to PV of costs.

The NPV measures the expected benefit (or cost) to society of implementing the policy, expressed in monetary terms. The option with the higher NPV is expected to deliver greater net benefits to society, while the option with the higher BCR is expected to provide greater benefit per unit of cost.

As shown in Table 13, all options have positive net present values and benefit cost ratios (BCRs) greater than 1. This indicates that all options are expected to deliver a net community benefit.

With an NPV of $74.9 million over 20 years, Option 3 has the highest NPV of the four options.

Based on these results, expanding the scope of containers eligible for the CDS (similar results for Options 1, 2, and 3) is preferred because the NPV and BCR results are higher than the introduction of a fourth kerbside bin to collect glass containers (Option 4). We note, however, that Option 4 will generate substantially greater recovery of materials than Options 1 to 3.

Table 14 provides summary results for all options, comparing 10- and 20-year analysis periods. All options have lower NPVs and lower BCRs over the 10-year analysis period than over the 20-year

analysis period. This outcome reflects the impact of upfront costs, but also indicates that ongoing costs and benefits are quite evenly distributed over time.

Table 14: Summary of results, Options 1 and 2 (comparison of 10- and 20-year analysis periods)

		Analysis period	
Option		10	20
1	NPV ($ million)	28.2	56.2
	BCR	1.33	1.38
2	NPV ($ million)	28.7	57.7
	BCR	1.33	1.38
3	NPV ($ million)	37.9	74.9
	BCR	1.36	1.41
4	NPV ($ million)	12.4	39.8
	BCR	1.04	1.08

4.2 Key factors influencing results

4.2.1 Additional value of recovered materials (recyclate)

The key benefit driving the results for all options is the increased quantity and quality of recovered materials (recyclate) resulting from improved sorting and reduced contamination of other waste materials. As discussed in Section 3.4, the recycling rate for MSW is estimated to remain steady at 43.9% under the base case, while gradually increasing to 44.1% under Option 1, 44.1% under Option 2, 44.2% under Option 3, and 44.3% under Option 4 by 2026-27.

These improvements in recycling outcomes are achieved through a combination of (i) improved source separation of waste material – which also results in lower contamination rates – by households (via kerbside disposal or disposal at CDS collection points) and C&I sources (via disposal at CDS collection points) and (ii) greater proportions of higher value recyclates being recovered at MRFs. For example, a key source of contamination to potentially recyclable material is embedded glass. All four options will remove some degree of glass waste from kerbside comingled recycling bins, thus reducing contamination rates for material disposed via this pathway. Further, by nature of aggregation and collection methods, waste streams going through CDS collection points will be substantially better separated and have lower contamination rates than waste streams going through kerbside comingled bins and somewhat better separated, with lower contamination rates than material going through glass recycling bins.

The additional value of recovered materials is estimated to be approximately $65 million PV over 20 years for Option 1, $69 million PV for Option 2, $85 million PV for Option 3, and $174 million PV for Option 4 (Table 15).

Table 15: Additional value of recovered materials ($ million PV at 7% discount rate, over 20 years)

	Option 1		Option 2		Option 3		Option 4	
Material	Nominal	PV	Nominal	PV	Nominal	PV	Nominal	PV
Glass	81.1	41.0	82.4	41.6	82.6	41.7	164.1	83.8
Paper	26.1	13.2	30.2	15.3	31.4	15.8	82.3	42.0
Plastics	20.8	10.5	23.5	11.9	53.4	27.0	70.3	35.9
Metals[33]	0.0	0.0	0.0	0.0	0.0	0.0	24.5	12.5
Total	**128.0**	**64.7**	**136.1**	**68.8**	**167.4**	**84.5**	**341.1**	**174.2**

4.2.2 Avoided landfill costs

Increased recovery of materials under the options will also reduce landfill disposal and externality costs. Landfill costs – encompassing both disposal and externality costs – are estimated to be reduced by about $28 million PV over 20 years for Option 1, $28 million PV for Option 2, $30 million PV for Option 3, and $63 million PV for Option 4 over the same period.

4.2.3 Reduced MRF processing costs

For Options 1 to 3, reduced quantities of material throughput will result in reduced MRF processing costs. However, it is expected that unit processing costs at MRFs will increase, reflecting the degree of sorting required for CDS materials[34]:

- For comingled materials, MRF processing costs are estimated to be $70 per tonne;
- For CDS materials (including beneficiation costs for sorted glass), these processing costs are estimated to be $95 per tonne[35].

Overall, the effect of reducing throughput (tonnes) at MRFs is expected to more than offset the additional processing cost per tonne, meaning the overall impact is a reduction in MRF processing costs for Options 1 to 3, estimated at about $26 million PV over 20 years for Option 1, $26 million PV for Option 2, $35 million PV for Option 3, and $20 million PV for Option 4 over the same period.[36]

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[33] For Options 1 to 3, it is assumed that by 2025-26, 70% of in-scope (mostly glass) containers will be diverted from disposal via the comingled recycling bin (base case) to disposal via CDS collection points. However, glass contamination does not materially impact recovery of metal from comingled recycling waste, so no additional recovery of metal is expected.
For Option 4, it is assumed the introduction of a fourth kerbside bin will result in positive behavioural change for a small proportion of households who currently (base case) dispose of recyclable waste in the garbage bin. Therefore, for Option 4, it is assumed there will be an increase in the quantity of metal waste disposed via the comingled recycling bin incremental to the base case, which drives an increase in the value of metal recovered under Option 4.

[34] Increased time/effort is expended to separate containers that are eligible for the 10c refund.

[35] The additional costs for sorted/higher value materials will, in some cases, require capital costs for processing plant upgrades. This will generate additional revenue; however, these costs and revenue have not been modelled.

[36] Note: Reduced processing costs for MRFs will be accompanied by an associated reduction in revenue from the materials, but also improved recovery rates and an increase in container deposit revenue. A separate detailed analysis of the impact of options on the financial position of MRFs would be needed to determine the overall financial impact of options on MRFs.

4.2.4 Collection and transport costs

For Option 4 (glass only bin), it is expected that there will be no significant change in the total quantity of waste material disposed at the kerbside. However, there will be a redistribution such that some material that was disposed of in the garbage (red) bin under the base case will be redirected to the comingled recycling (yellow) and glass only bins under Option 4. This redistribution has the effect of increasing overall collection and transport costs because waste from recycling bins is more costly to collect than waste from garbage bins, on a cost per tonne basis. The net impact on collection and transport costs for Option 4 is estimated to be an additional cost of about $65 million PV over 20 years.

The reverse of the above outcome is expected for Options 1 to 3, whereby transport and collection costs are estimated to decrease by about $86 million PV over 20 years for Option 1, $88 million PV for Option 2, and $107 million PV for Option 3 over the same period. This outcome is expected because collection and transport costs for material disposed to CDS collection points[37] ($22/tonne) is substantially less than for kerbside garbage bins ($95/tonne) and recycling bins ($150/tonne for comingled, $180/tonne for glass). Over the 20-year analysis period, about 1.1 million tonnes of additional material – glass wine, spirits, and juice bottles – are expected to be disposed via the CDS for Option 1 incremental to the base case. For Option 2, the additional material disposed via the CDS increases slightly to 1.2 million tonnes, with the relatively small increase in mass due to paper/cardboard and plastic being much lighter than glass for the same container type. For Option 3, the additional material disposed via the CDS is expected to be 1.4 million tonnes over the 20-year analysis period.

Financial payments from councils to industry for collection and disposal/processing are not included in the cost-benefit analysis because these payments are financial transfers rather than economic costs or benefits. However, we acknowledge that options are expected to impact on the disposal pathways for household waste (kerbside garbage bins, kerbside recycling bins, and CDS collection points). As a result, councils might need to re-negotiate collection and disposal/processing contracts for their waste services. These contract re-negotiations might have distributional impacts for councils and industry, but these impacts are not relevant for the cost-benefit analysis.

4.2.5 Direct and indirect costs to industry of administering and participating in the CDS

A range of direct and indirect costs are incurred by industry as a result of expanding the scope of containers eligible for the CDS. Most of this cost burden falls on new entrants (alt: First Suppliers) to the scheme (e.g., wine and spirits, and plain milk suppliers).

The following costs are relevant to new entrants (suppliers) to the CDS:

- Direct costs such as Scheme Contributions, container approval fees, and refund marking requirements
- Indirect costs such as administration in complying with reporting obligations to the Scheme Coordinator

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[37] Trucks used for collecting CDS material and transferring to aggregation points are different to kerbside garbage and recycling trucks. Importantly, they are collecting much larger volumes from many fewer collection sites and do not need to stop every few seconds to pick up bins from the kerbside, as happens with kerbside collections. This saves a lot of time and reduces fuel costs.

and entering into Supply Arrangements.

No industry consultation was undertaken to inform this study, due to its confidential nature. Instead, the direct and indirect costs have been estimated based on a range of sources including prior analysis and consultation by Marsden Jacob on the NSW and Victorian CDSs, detailed analysis of labelling costs undertaken for Food Standards Australia New Zealand, and IPART analysis.

Table 16 describes these costs in more detail.

Table 16: Direct and indirect costs to industry of administering and participating in the CDS

Cost	Value	Unit	Notes	Source
Compliance – re-labelling (refund marking requirements)	5,000	$/supplier	This is the cost per supplier rather than per container type/product line. This value is for an average sized supplier but the cost for any individual supplier will depend on their number of stock keeping units (SKUs) (i.e., barcodes) and the degree of change required to their labelling. A slight change to existing text and no change in the label's internal layout, shape or size is estimated to cost $451 per SKU. For an indicative small supplier with 5-10 SKUs, this is a one-off cost of $2,255-4,510. For an indicative larger supplier with 50-100 SKUs, this is a one-off cost of $22,550-45,100.	Marsden Jacob Associates for Food Standards Australia New Zealand (2021)
Container approvals	43 + 13.7 = 56.7	$/container type	Assumes one hour of industry time per container type at an FTE cost of $85,000 per year *plus* the cost of government time to review and approve the application. This cost to government is passed on to	MJA, NSW EPA and DELWP[38] analysis of NSW scheme; IPART (2018)

[38] Department of Environment, Land, Water and Planning (2022). Regulatory impact statement - Container deposit scheme.

Cost	Value	Unit	Notes	Source
			suppliers as a container approval fee. IPART (2018) recommended the container approval fee be reduced to $13.70 per container. This value remains current, as at October 2022. This is a one-off cost per new container type. For the cost-benefit analysis, the cost of government time to review and approve applications is included as an economic cost to government rather than an economic cost to industry.	
Scheme contributions	0.1171	$/container	This value is the weighted average for supplier contributions for the NSW CDS and is effective from August 2022 to January 2023 (current pricing). Although this is a direct cost to industry/suppliers, it is considered an economic (wealth) transfer, so is not included as a cost in the CBA.	Exchange For Change Supplier Pricing schedule: Supplier Pricing (exchangeforchange.com.au)
Compliance – reporting	516	$/supplier/year	Assumes one hour per supplier per month at an FTE cost of $85,000 per year.	MJA estimate
Entering into Supply Arrangements with the Scheme Coordinator	500	$/supplier	Assumes five hours per supplier at an FTE cost of $200,000 per year.	MJA estimate

Industry costs

We estimate there are around 800 suppliers of wine and spirits containers to the NSW market, of which there are 5-10 large suppliers who account for around 40% of containers supplied. This leaves 790-795 smaller suppliers each accounting on average for 0.1% of the market. Further, we estimate there are approximately 12,000 in-scope container types/product lines.[39]

We estimate there are around 100 suppliers of plain milk containers to NSW, of which there are around 5 large suppliers who account for around 50% of containers supplied. This leaves around 95 smaller suppliers each accounting on average for 0.5% of the market. Further, we estimate there are approximately 1,000 in-scope container types/product lines.[40]

We estimate there are around 850 suppliers of other beverage container types (water, pure juice, etc.) to the NSW market, of which there are 5-10 large suppliers who account for around 70% of containers supplied. This leaves 840-845 smaller suppliers each accounting on average for a very small percentage of the market. [41] However, most, if not all, of these suppliers are likely to already be participating in the CDS due to some of their product lines already being eligible for the CDS. As such, we conservatively assume that only one-third of these smaller suppliers are new entrants to the CDS while none of the large suppliers are new entrants.

Based on the above assumptions, the additional cost to industry due to time spent on container approvals plus compliance costs associated with refund marking requirements (re-labelling) and reporting are estimated at about $11 million PV over 20 years for Option 1, $13 million PV for Option 2, and $14 million PV for Option 3 over the same period. Around $10 million PV of the cost for Option 1 (over 20 years) is expected to be incurred by wine and spirits suppliers.

The cost impact on MRFs is not discussed in detail here because the confidential nature of this analysis precludes collection of sufficient data to undertake a financial impact analysis. However, we note that for Option 4, MRFs are anticipated to financially benefit because of the combined impacts of increased throughput, and improved recovery rates and material values due to reduced contamination in the kerbside waste stream. For Options 1 to 3, the expected impacts on MRFs are increased recovery for paper/cardboard and lower recovery for plastic and glass (see Section 3.8). For Options 1 to 3, overall recovery of material at MRFs is expected to decrease (due to redirection of some beverage containers to CDS collection points instead of kerbside disposal) but this impact will be offset financially by MRFs being eligible to claim processing refunds for containers included in the CDS for Options 1 to 3.

Indicative costs for new entrant suppliers

Below, we present estimated indicative costs for suppliers that are new entrants to the CDS (for Options 1, 2, or 3). In other words, suppliers that do not supply any containers that are currently

[39] Based on analysis undertaken by Marsden Jacob for DELWP (2022) then recalibrated to NSW.
[40] Based on Marsden Jacob analysis of Dairy Australia data including from Dairy Australia Limited (2020) In Focus 2020: The Australian Dairy Industry.
[41] Based on analysis undertaken by Marsden Jacob for DELWP (2022) then recalibrated to NSW.

eligible for the CDS. This includes suppliers of wine and spirits, and plain milk. However, we note that some of these suppliers might already be scheme participants due to supply of containers already eligible under the base case. For existing suppliers, the additional cost for Options 1, 2, or 3 will be lower than described below.

- For an indicative ***small*** new entrant supplier with only 5 container types/product lines and turnover of product lines at a rate of one every two years (average of 0.5 per year), the estimated costs of inclusion in the CDS are around $3,550 in the first year and around $550 in each subsequent year, which is comprised of:
  - $284 for container approvals in the first year, and $28 on average in each subsequent year.
  - $2,255 for re-labelling (refund marking requirements) incurred only in the first year. In future years, it is assumed that timing of changes to labelling would not differ between the base case and option cases, so the incremental cost is zero.
  - Monthly reporting costs totalling $516/year for each of the first year and all subsequent years.
  - $500 for entering into Supply Arrangements with the Scheme Coordinator. This cost is incurred only in the first year.
- For an indicative ***large*** new entrant supplier with 50 container types/product lines and turnover of product lines at a rate of 5 per year, the estimated costs of inclusion in the CDS are around $26,400 in the first year and around $800 in each subsequent year, which is comprised of:
  - $2,835 for container approvals in the first year, and $284 on average in each subsequent year.
  - $22,550 for re-labelling (refund marking requirements) incurred only in the first year. In future years, it is assumed that timing of changes to labelling would not differ between the base case and option cases, so the incremental cost is zero.
  - Monthly reporting costs totalling $516/year for each of the first year and all subsequent years.
  - $500 for entering into Supply Arrangements with the Scheme Coordinator. This cost is incurred only in the first year.

Finally, each supplier will incur costs in the form of Scheme Coordinator contributions, which are currently priced at $0.1171 per container. For a small supplier that supplies on average 300,000 containers per year, scheme contributions would cost $35,130 per year. For a large supplier that supplies on average 50 million containers per year, scheme contributions would cost $5.86 million per year. However, we note that much of this cost is likely to be passed on to consumers in the form of higher retail prices for CDS eligible containers. For example, IPART (2018) found the average price increase due to the CDS was 10.1 cents for non-alcoholic beverages and 5.1 cents for alcoholic beverages. As such, for suppliers, the incremental cost impost from Scheme Coordinator contributions is likely to be substantially less than described above.

4.3 Sensitivity analysis

Reflecting uncertainties associated with key assumptions, a range of sensitivity analyses have been undertaken. Sensitivity analysis has been undertaken for:

- discount rate;
- volumes of glass waste disposed;
- proportion of in-scope glass containers disposed via household/kerbside pathways (Options 1 to 3);
- values of recovered materials;
- proportions of recovered materials that are sorted and, therefore, attract premium prices;
- collection and transport costs;
- MRF processing costs;
- CDS collection and sorting costs
- kerbside bin capital costs;
- number of glass only bins rolled out;
- participation costs for the CDS; and

The results of the sensitivity analysis are summarised in Table 17. The sensitivity analysis indicates that ranking of options is not sensitive to changes to key assumptions.

The results of the analysis are quite sensitive to changes in assumed material values (recyclate) and the assumed improvements in sorting of recovered materials (and the resulting impact on the value of recovered materials). These results highlight the importance of achieving good outcomes from the options in terms of both the quantity and quality of material recovered.

The options are moderately sensitive to assumed processing/sorting costs, while the Options 1 to 3 are moderately sensitive to assumed CDS participation costs, and Option 4 is very sensitive to assumed capital costs for kerbside bins, and the number of bins rolled out.

Table 17: Sensitivity of results to changes to values of key variables

	NPV ($m)				BCR			
	1	2	3	4	1	2	3	4
Central case (7% discount rate)	56.2	57.7	74.9	39.8	1.38	1.38	1.41	1.08
Discount rate (3%)	84.0	86.5	111.5	98.0	1.40	1.40	1.43	1.15
Discount rate (10%)	42.8	43.9	57.1	12.0	1.37	1.36	1.40	1.03
Quantity of all waste material disposed (-20% of central estimate)	45.5	46.8	60.3	39.7	1.38	1.37	1.41	1.08

	NPV ($m)				BCR			
Quantity of all waste material disposed (+20% of central estimate)	66.9	68.7	89.4	40.0	1.38	1.38	1.42	1.08
Proportion of in-scope containers disposed via household/kerbside pathways (Low)	57.1	55.9	77.6	36.7	1.37	1.34	1.41	1.08
Proportion of in-scope containers disposed via household/kerbside pathways (High)	55.5	59.2	72.7	42.2	1.39	1.41	1.42	1.09
Material values (Low)	48.0	49.2	63.3	14.6	1.33	1.32	1.35	1.03
Material values (High)	64.4	66.2	86.4	65.1	1.44	1.43	1.48	1.13
Proportion of recovered material sorted (Low)	48.1	48.6	64.5	-27.1	1.33	1.32	1.36	0.94
Proportion of recovered material sorted (High)	64.3	66.9	85.2	106.6	1.44	1.44	1.47	1.22
Collection and transport costs (Low)	48.9	50.3	65.8	46.4	1.34	1.33	1.37	1.10
Collection and transport costs (High)	63.5	65.2	83.9	33.3	1.43	1.42	1.46	1.06
Processing/sorting costs (Low)	61.4	63.1	80.8	37.9	1.44	1.43	1.47	1.08
Processing/sorting costs (High)	51.0	52.4	68.9	41.8	1.33	1.32	1.36	1.09
Kerbside bin capital cost (Low)	56.2	57.7	74.9	70.2	1.38	1.38	1.41	1.16
Kerbside bin capital cost (High)	56.2	57.7	74.9	9.5	1.38	1.38	1.41	1.02
Number of glass only bins rolled out (Low)	56.2	57.7	74.9	61.5	1.38	1.38	1.41	1.13
Number of glass only bins rolled out (High)	56.2	57.7	74.9	9.5	1.38	1.38	1.41	1.02
Participation cost for CDS (Low)	65.2	67.1	86.1	39.8	1.47	1.47	1.51	1.08
Participation cost for CDS (High)	47.2	48.3	63.6	39.8	1.30	1.30	1.33	1.08

4.4 Conclusions from the analysis

Results of the CBA indicate that all of the assessed options, if implemented (in isolation), are expected to generate a net community benefit based on the assumptions detailed in this report.

Based on the central assumptions, expanding the scope of containers eligible for the CDS (Options 1 to 3) is preferred because their NPV and BCR results are higher than introducing a fourth kerbside bin

to collect glass containers (Option 4). With slightly higher expected net benefits, Option 3 is preferred to Options 1 and 2. However, these differences in NPV are relatively small and could be within the error bounds of the modelling, meaning there is not a strong preference order for the Options 1 to 3 (expanding the scope of containers eligible for the CDS).

It should be noted that the results for the CDS expansion options (Options 1 to 3) assume no capital expenditure is required to facilitate additional throughput at CDS collection points. If any significant augmentation of existing infrastructure or the construction of additional collection points is required (such as to permit redemption of larger plastic bottles), the net benefits each of Options 1 to 3 will be lower. Further, no direct or indirect costs to industry associated with scheme compliance, including re-labelling containers/bottles, have been included for Options 1 to 3. Any costs associated with scheme compliance are not expected to materially alter the conclusions of this analysis, and these costs can be mitigated by providing sufficient lead time to industry prior to expanding the scope of containers eligible for the CDS. It should also be noted that Option 4 is expected to deliver substantially greater benefits in terms of avoided landfill and value of recovered material than Options 1 to 3.

Results for all options are sensitive to changes to key assumptions; in particular, assumptions regarding improvements to both the quantity and quality of material recovered in MRFs. This result highlights the importance of ensuring that, in implementing any of the options, particular attention is paid to ensuring good service outcomes not only in terms of the quantity of materials recovered but also the quality of materials/high level of sorting.

For Option 4, the result is very sensitive to assumed capital costs for kerbside bins, so, if this option is to be implemented, careful consideration should be given when determining the number of glass only bins to provide to residential dwellings. It is reasonable to assume that every detached and semi-detached house will be provided with a new kerbside bin. However, for multi-unit dwellings (MUDs), glass only bins might be provided at a rate that is proportionately less than for comingled recycling bins. For example, 3 glass bins per 5 comingled recycling bins, where this ratio could be determined based on the relative waste volumes of paper/cardboard and plastic (which would continue to be disposed via the comingled recycling bin) and glass (which would be disposed in the new glass only bin).

The issue of constrained space could be mitigated by there being fewer comingled and/or garbage bins required in future due to some kerbside waste being redirected to the glass only bin. Thus, there might be an avoided bin replacement cost as the mix of kerbside bins is optimised over time. This potential benefit has not been modelled but its inclusion as a benefit for Option 4 would not be anticipated to change the order of options.

It is important to note that the CBA has not been accompanied by a distributional impacts analysis that assesses impacts of options on stakeholder groups such as MRFs, other sections of the waste industry, and local councils. Considering the impacts of options on MRFs, Options 1 to 3 are expected to result in a reduction to their revenue due to reduced overall throughput of materials. However, MRFs will also benefit from improved material recovery rates and an increase in container deposit

revenue. A separate detailed analysis would be needed to determine the overall financial impact of options on MRFs and other stakeholders.

Finally, a key risk facing both CDS scope expansion and fourth bin options is the potential absence of markets for the additional materials recovered – both sorted and unsorted materials – or, at least, markets that are sufficiently strong to maintain prices for recovered materials. This risk is greatest for Option 4 due to the greater volume of recovered material expected to be achieved under that option. Reflecting this risk, prices for recovered materials assumed in the analysis are quite conservative. Additionally, this risk should be significantly mitigated by policy initiatives being implemented through state and federal governments, such as investments in processing infrastructure.

4.5 Limitations and uncertainties

4.5.1 Unquantified costs and benefits

The results are not additive across the options, because each of the options have been assessed incremental to the base case.

Several categories of benefit and cost items have not been quantified in the analysis. These include:

- litter impacts, such as littering rates for in-scope items decreasing following their inclusion in the CDS;
- possible capital expenditure required to facilitate additional throughput at CDS collection points, which might involve augmentation of existing infrastructure or the construction of additional collection points;
- potential flow-on benefits from expanding the scope of beverage containers that are eligible for the CDS, such that disincentives to participate in the scheme are potentially reduced and there is greater capture of containers that are common in the litter stream;
- whether the propensity to participate in the CDS would reduce over the analysis period if the refund value is not changed, which would mean the value of the refund amount in real terms would decrease over time due to inflation;
- potential direct and indirect costs to industry associated with scheme compliance, including the re-labelling of wine and spirits bottles, and other container types which have a long shelf life;
- intangible environmental and health benefits that would arise from reduced levels of materials stockpiling, which could eventuate as a consequence of implementing either of the options; and
- benefits and costs attributable to Australian processors of recycled materials.

The analysis is based on conservative assumptions, which helps mitigate possible impacts of these assumptions being subsequently quantified and altering the conclusions.

4.5.2 Data uncertainties

Data underpinning the analysis are, in some cases, subject to considerable uncertainties. Noting this, sensitivity analysis has been undertaken to test the sensitivity of results to changes of key assumptions. Assumptions tested include discount rates, material values, proportions of recovered materials that have been sorted (and, therefore, attract a premium price), processing/sorting costs, and CDS collection and transport costs. The sensitivity analysis is discussed in the following section.

Further, the environment within this analysis has been undertaken precludes stakeholder consultation, which would typically be undertaken to sense check assumptions and source additional data. We note that stakeholder consultation might be undertaken in future if additional analysis is required.

4.5.3 Key areas for additional in-depth analysis if a more detailed study were undertaken

Table 18 summarises the key areas for additional in-depth analysis if a more detailed study were undertaken. However, as noted above, it will not necessarily be the case that additional in-depth analysis will materially change the results or conclusions of this CBA, and we also note that comprehensive sensitivity testing has been undertaken.

Table 18: Key areas for additional in-depth analysis

Key area for additional in-depth analysis	Relevant option(s)
Analysis of distributional impacts of the options on households, industry, government, community, etc.	All
Government regulatory and administrative costs. These costs are expected to be higher for Options 1 to 3 than Option 4; however, they are unlikely to be of sufficient magnitude to significantly change the results and conclusions of the analysis. For Options 1 to 3, the additional cost to government due to time spent on container approvals has been included in the cost-benefit analysis. However, no other regulatory and administrative costs have been modelled.	All
Capital expenditure (if any) to facilitate additional throughput at CDS collection points.	1, 2, 3
Potential direct and indirect costs to industry associated with scheme compliance, including the re-labelling of containers. The following industry costs have been modelled for Options 1 to 3: • Direct costs such as Scheme Contributions, container approval fees, and refund marking requirements • Indirect costs such as administration in complying with reporting obligations to the Scheme Coordinator, and entering into Supply Arrangements However, assumed unit costs have not been tested with industry stakeholders due to the confidential nature of the analysis. Similarly, estimates of the number of new entrant suppliers and associated number of container types/product lines are based only on public data, and these estimates likely could be improved through consultation with industry peak bodies.	1, 2, 3

Key area for additional in-depth analysis	Relevant option(s)
Finally, we note that some of these costs can be mitigated by providing sufficient lead time to industry prior to expanding the scope of containers eligible for the CDS.	
Number of kerbside glass bins that need to be provided / degree of bin sharing. This will be especially relevant to provision of bins to MUDs.	4
Opportunity cost of space for MUDs and (potentially) detached and semi-detached houses. Additional bins take up space that could be used for other purposes.	4
Refinements to estimates used in the material flows analysis / modelling. For example, the quantities of glass items disposed, the splits between disposal via kerbside or C&I disposal pathways, and assumed growth rates. We have a reasonable degree of confidence in the estimated total quantities for disposal of wine and spirits bottles because multiple data sources were used, and similar estimates were generated from each analysis. However, we have less confidence in the assumed splits between kerbside and C&I disposal of these containers.	All
Modelling of the extent to which expanding the CDS scope might remove a disincentive to participate in the scheme and, therefore, increase the capture of containers that are common in the litter stream. While it has not been modelled in this CBA, we expect the impact would be minor. The impact is expected to be largest for Option 3 and smallest for Option 1.	1, 2, 3
Direct litter impacts from avoided littering of in-scope glass containers following their inclusion in the expanded CDS. Although not modelled in this CBA, we expect the impact would be minor.	1, 2, 3
Intangible environmental and health benefits that would arise from reduced levels of materials stockpiling, which could eventuate as a consequence of implementing either of the options. Although not modelled in this CBA, we expect the impact would be minor.	All
Analysis of the strength / size of markets for additional materials recovered. We expect that existing markets are of a size and maturity to be able to accommodate any increase in material recovery; however, it might be worthwhile to undertake analysis to confirm or rebuke this expectation.	All

5. Detailed assumptions

5.1 Material flows analysis assumptions

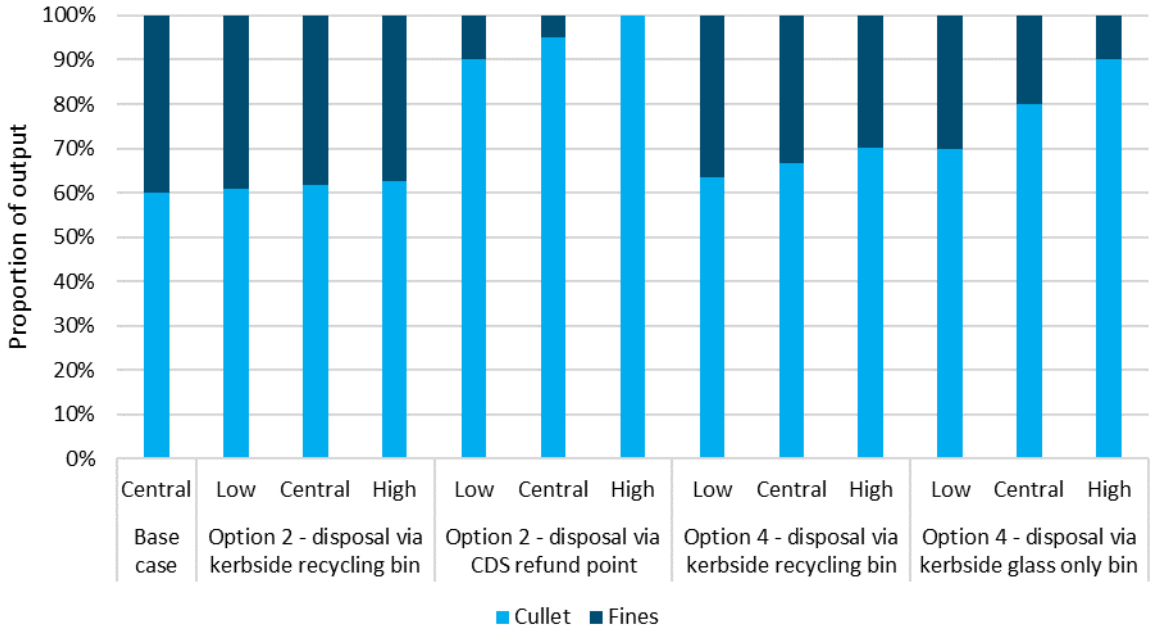
5.1.1 Sorting improvements at MRFs

The expanded CDS scope options (Options 1 to 3) and fourth glass bin option (Option 4) are expected to result in improved sorting of recyclable materials at MRFs, which will lead to higher value recyclates constituting a higher proportion of MRF output. Figure 27 to Figure 29 show the assumed sorting improvements at MRFs, based on disposal pathway, where improvements are due to lower rates of contamination in each waste stream. For Option 4, it is assumed that lower rates of sorting will occur for non-glass containers disposed in the glass only bin.

For conciseness, proportional splits of material (e.g., cullet vs. fines) are presented only for Options 2 and 4. The reason for this is because a reduction of glass contamination in kerbside waste streams is the main source of differences between the base case and option cases, and this impact is almost identical for Options 1, 2, and 3.[42]

The assumed sorting improvements described below are based on an analysis of confidential waste data from multiple Australian jurisdictions.

Figure 27: Glass – Proportion of sorted material, by option/disposal pathway



[42] Marginally higher recovery of higher quality outputs (i.e., sorted paper/cardboard, HDPE and PET plastic, and glass cullet) has been assumed for Options 2 and 3 incremental to Option 1.

Figure 28: Paper/Cardboard – Proportion of sorted material, by option/disposal pathway

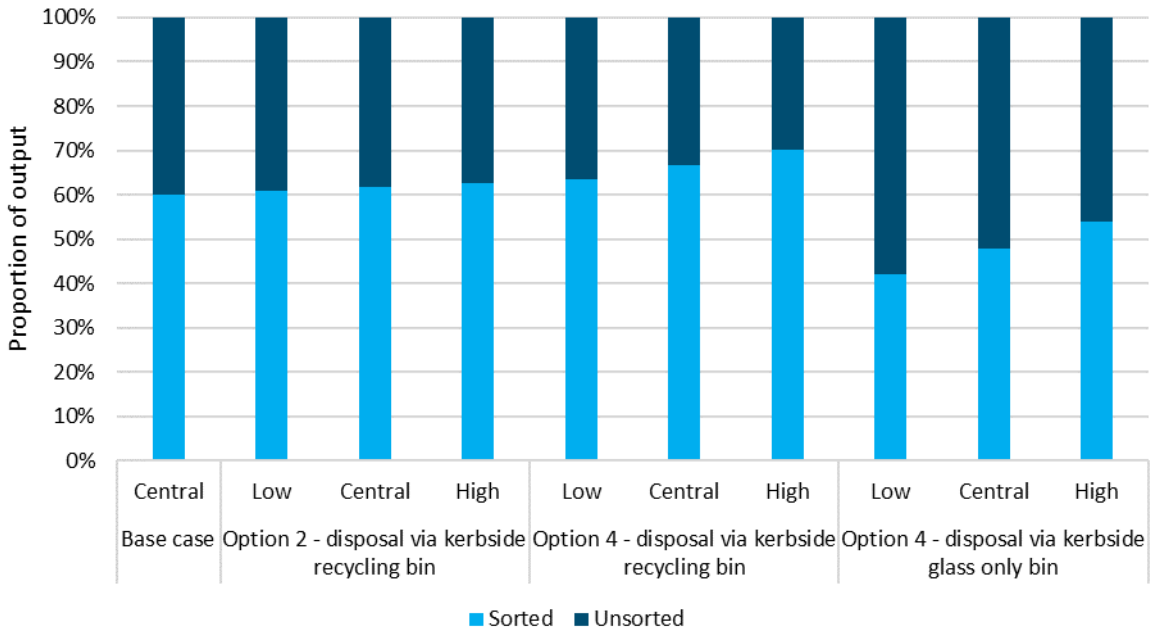
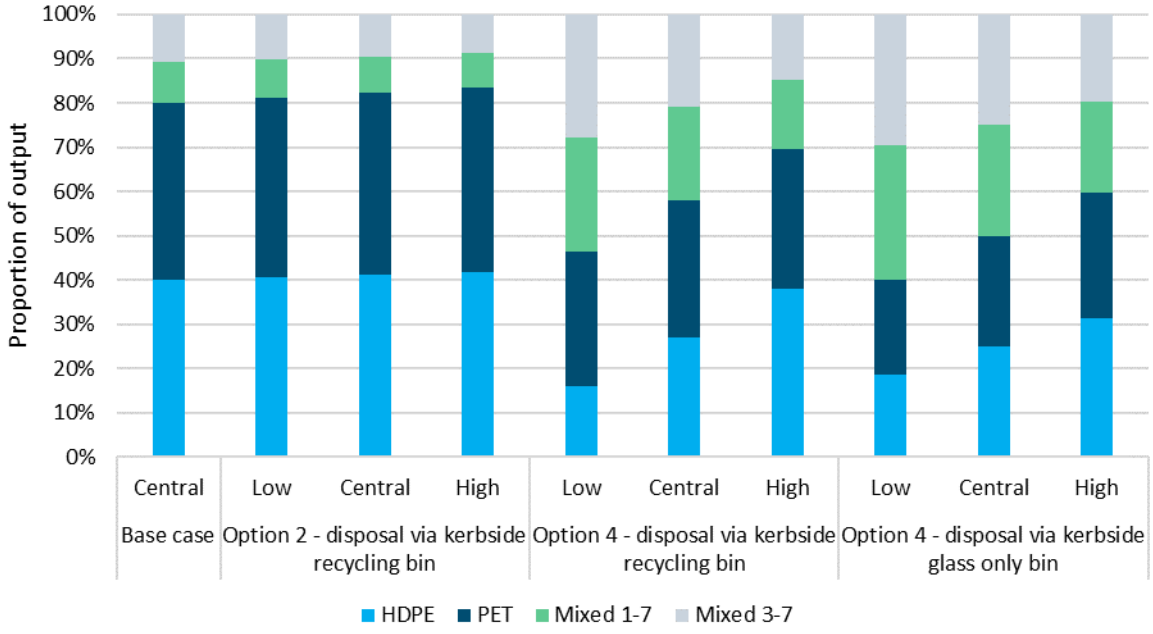


Figure 29: Plastics – Proportion of sorted material, by option/disposal pathway



5.1.2 Recovery rates

The expanded CDS scope (Options 1 to 3) and fourth glass bin options considered in this analysis are expected to reduce the scale of contamination in both kerbside recycling bins and C&I waste disposal by incentivising improved source separation of glass containers, with even lower contamination rates for containers disposed via CDS collection points. This will lead to improved recycling and recovery

outcomes for NSW across all dry recycling material types (paper/cardboard, plastics, metals, glass). The expected impacts of the options on recovery rates are shown in Figure 30 to Figure 33.

Figure 30: Glass – Material recovery rates

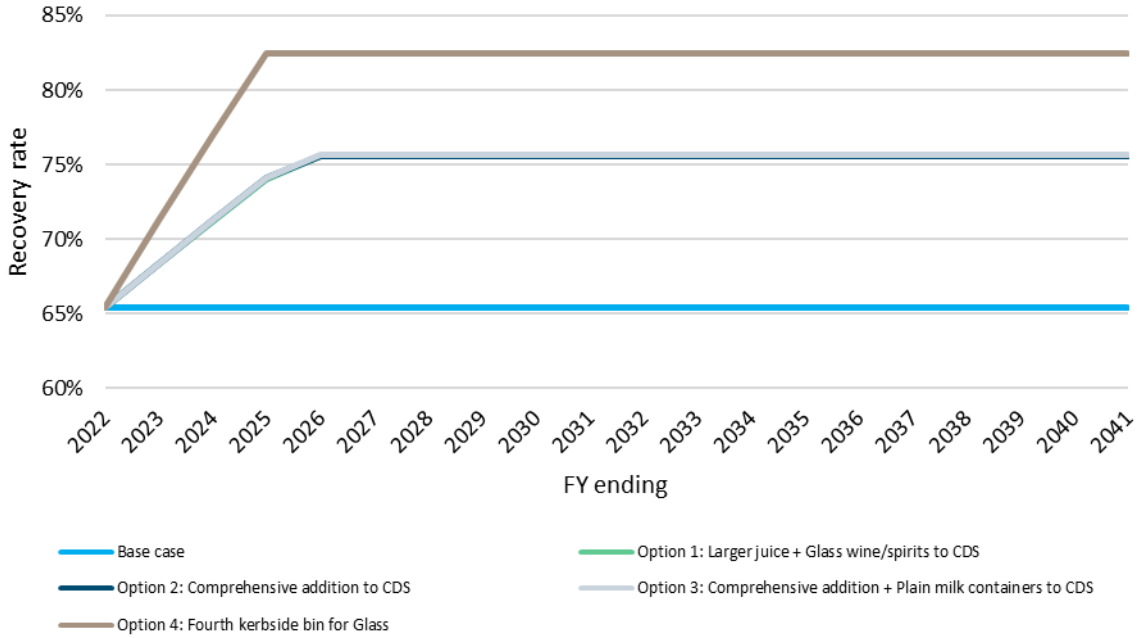


Figure 31: Paper/Cardboard – Material recovery rates

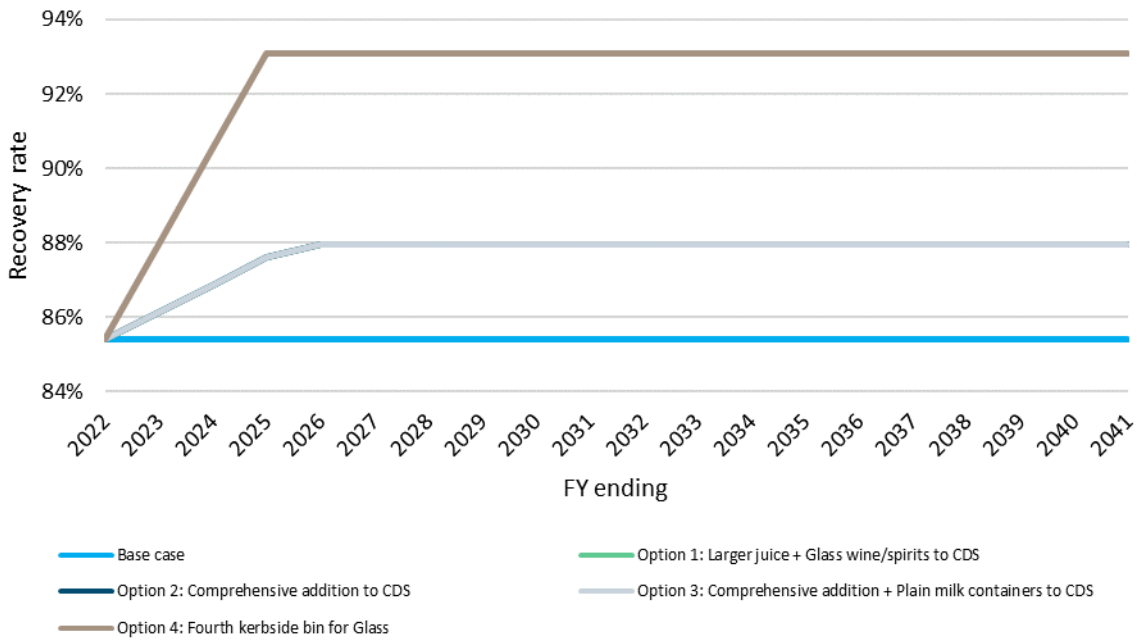


Figure 32: Plastics – Material recovery rates[43]

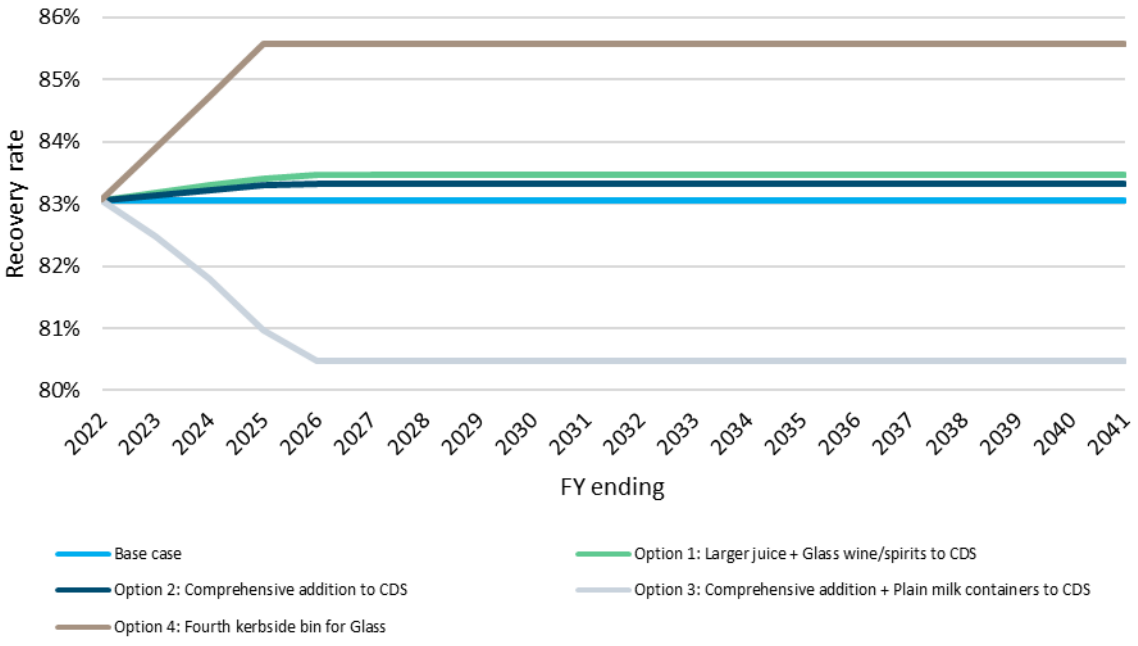
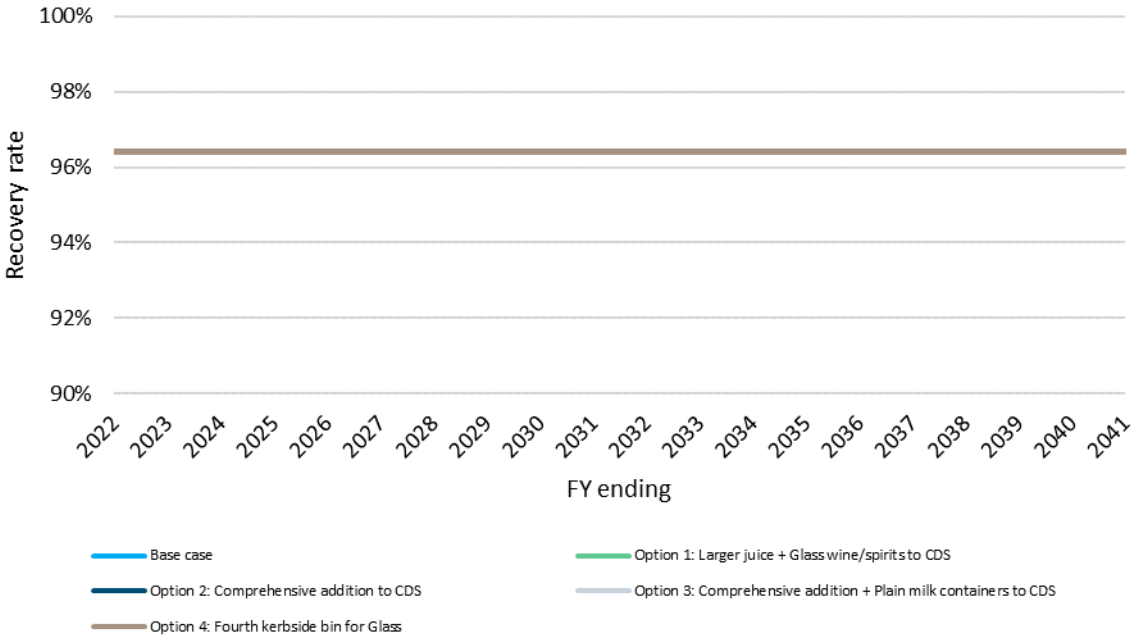


Figure 33: Metals – Material recovery rates[44]



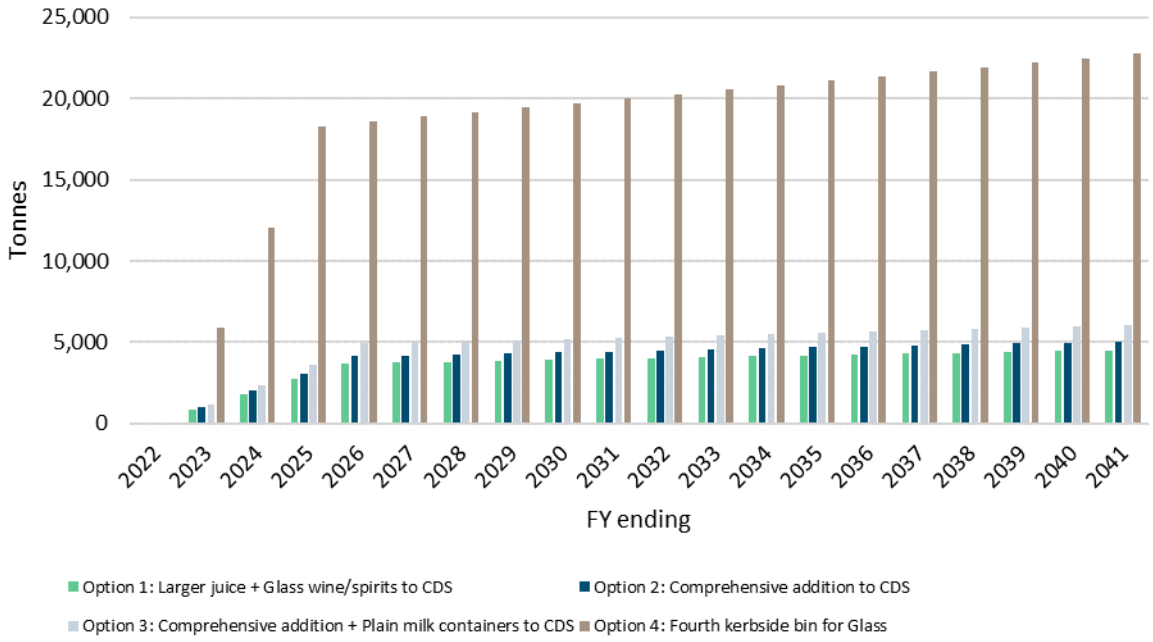
[43] Plain milk containers are currently recovered at very high rates by MRFs and contribute relatively high volumes to throughput at MRFs. Removing a significant proportion of plain milk containers from the kerbside waste stream is expected to decrease the plastic recovery rate, which is the weighted average recovery rate for the containers that continue to be disposed via kerbside recycling bins.

[44] Material recovery rates are assumed to be identical across all scenarios because contamination – or reduction of contamination – does not materially impact the recovery of metal.

5.1.3 Household behavioural change

Each of the options are expected to result in increased volume of recyclables going through pathways where they could potentially be recovered (i.e., kerbside recycling bins or CDS collection points), following changes in household behaviour to correctly dispose of recyclables in the recycling bin (comingled or glass only) or at CDS collection points. Figure 34 shows the additional quantities of recyclable material disposed through pathways where they could potentially be recovered, incremental to the base case. In other words, the quantities of recyclables that are no longer disposed in the kerbside garbage bin.

Figure 34: Change in household behaviour to correctly dispose of recyclables



5.1.4 Waste disposal pathways

Most of the impact of the options is on the disposal pathways for glass waste. For Options 1 to 3, a subset of total glass disposed is redirected to the CDS, so only the disposal pathways for these items are impacted. For Option 4, it is expected that disposal pathways for all types of glass waste – regardless of eligibility for the CDS – will be impacted by the introduction of a glass only bin. It is for this reason that the modelled changes are larger for Option 4 compared to Options 1 to 3.

Assumed changes in disposal pathways for kerbside/household and C&I[45] glass waste are shown in Figure 35 to Figure 38 below. A comparison of Option 2 and Option 4 is provided in Figure 35. The differences in expected impacts of Options 1 and 2 are so small that they are almost indistinguishable. For this reason, Figure 36 is included to illustrate the incremental impact of Option 2 compared to Option 1. Similarly, Figure 37 is included to illustrate the incremental impact of Option 3 compared to Option 2.

[45] C&I waste is in-scope for Options 1, 2, and 3 only.

Much larger changes in the disposal pathways are expected for Option 4 due to all glass container waste being in-scope rather than a subset of total glass disposed, which is the case for Options 1 and 2 (Figure 35). It is for this reason (i.e., significantly cleaner/more separated waste streams) that assumed recovery rates are significantly higher under Option 4 than Options 1 to 3, although the modelled changes to the quantities of glass material to MRFs is similar across all options (Figure 38).

For Options 1 to 3, some disposal is redirected from kerbside comingled recycling and garbage bins (i.e., negative bars in Figure 35) to CDS collection points (i.e., positive bars in Figure 35). For Option 4, some disposal is redirected from kerbside comingled recycling and garbage bins (i.e., negative bars in Figure 35) to kerbside glass bins (i.e., positive bar in Figure 35).

Figure 35: Change in glass disposal pathways (Left bar = Option 2, Right bar = Option 4)

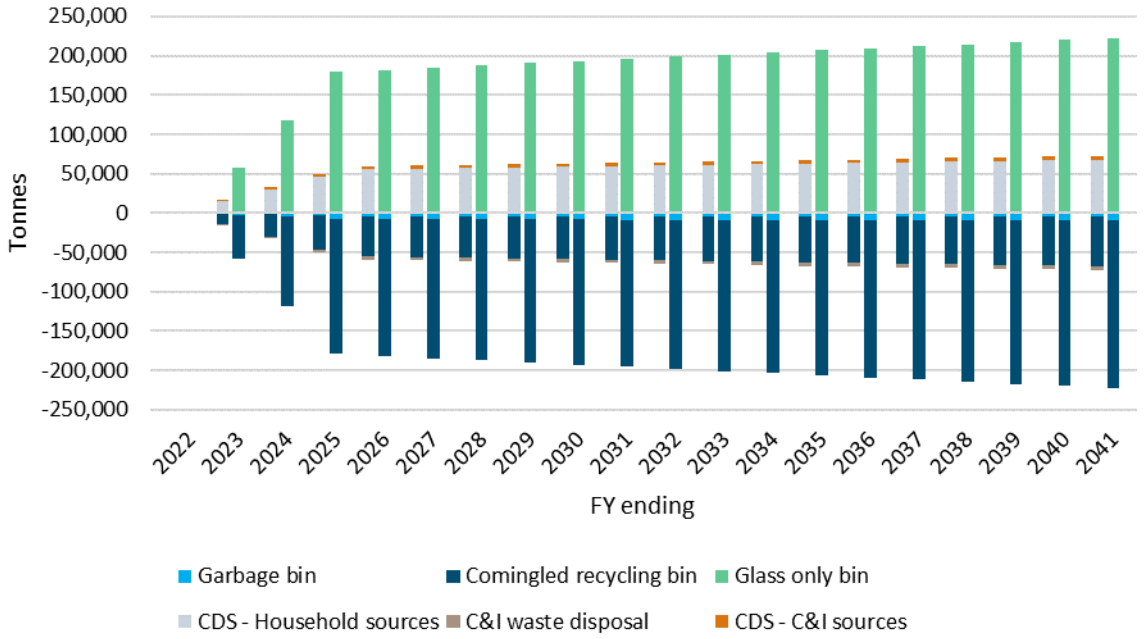


Table 19: Change in glass disposal pathways (tonnes) – Option 2

Disposal pathway	2025-26	2030-31	2035-36	2040-41
Household – Garbage bin	-3,600	-3,900	-4,200	-4,400
Household – Comingled recycling bin	-51,500	-55,400	-59,200	-63,000
Household – CDS	55,100	59,300	63,400	67,400
C&I – Waste disposal service	-4,100	-4,400	-4,700	-5,100
C&I – CDS	4,100	4,400	4,700	5,100

Table 20: Change in glass disposal pathways (tonnes) – Option 4

Disposal pathway	2025-26	2030-31	2035-36	2040-41
Household – Garbage bin	-7,900	-8,500	-9,100	-9,700

Disposal pathway	2025-26	2030-31	2035-36	2040-41
Household – Comingled recycling bin	-174,200	-187,300	-200,200	-213,100
Household – Glass bin	182,200	195,800	209,400	222,800

Figure 36: Change in glass disposal pathways (Option 2 incremental to Option 1)

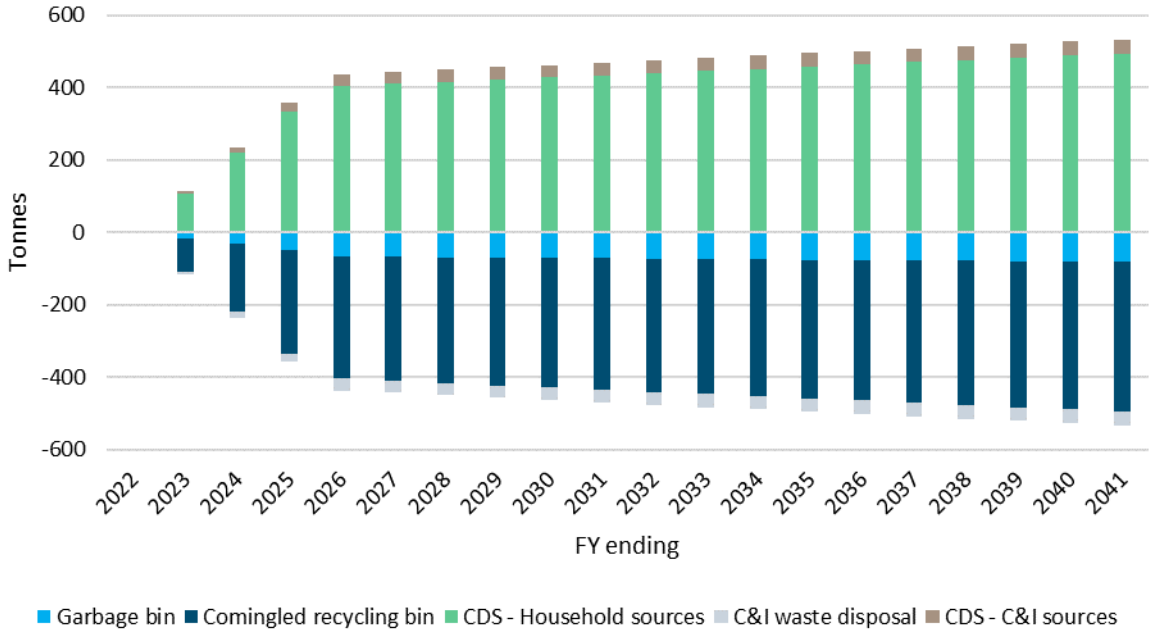


Figure 37: Change in glass disposal pathways (Option 3 incremental to Option 2)

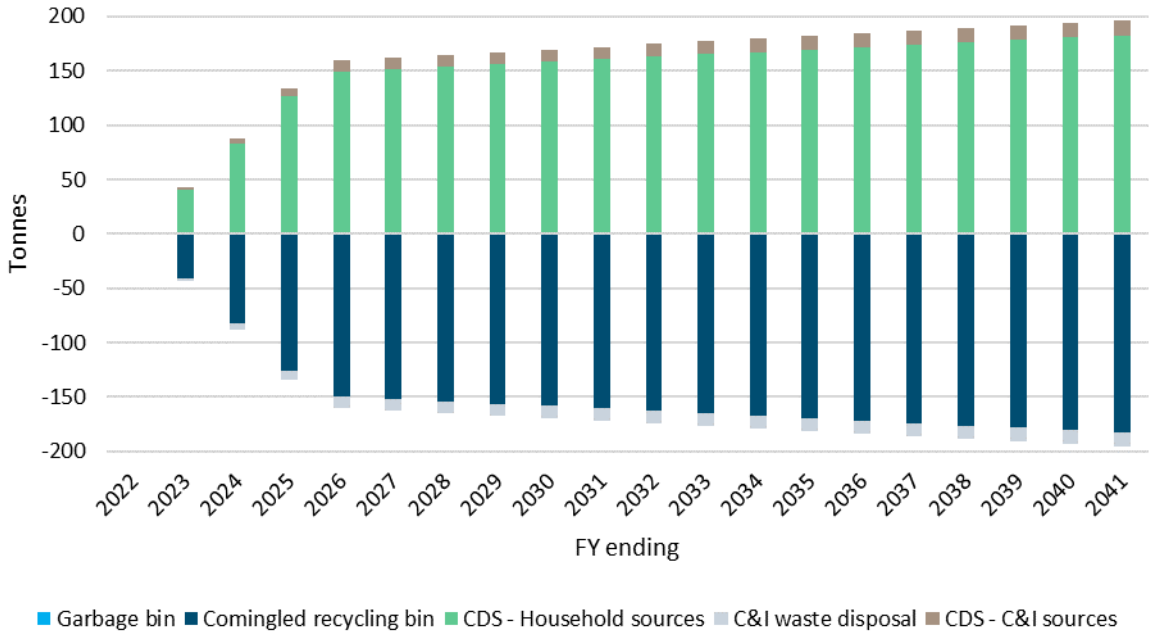
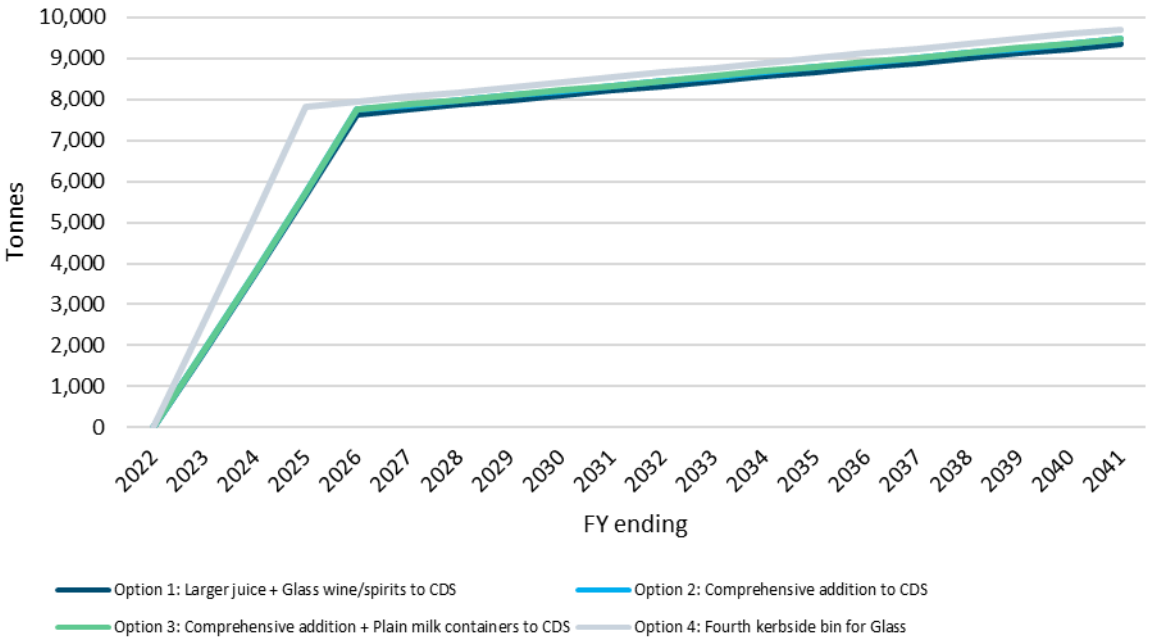
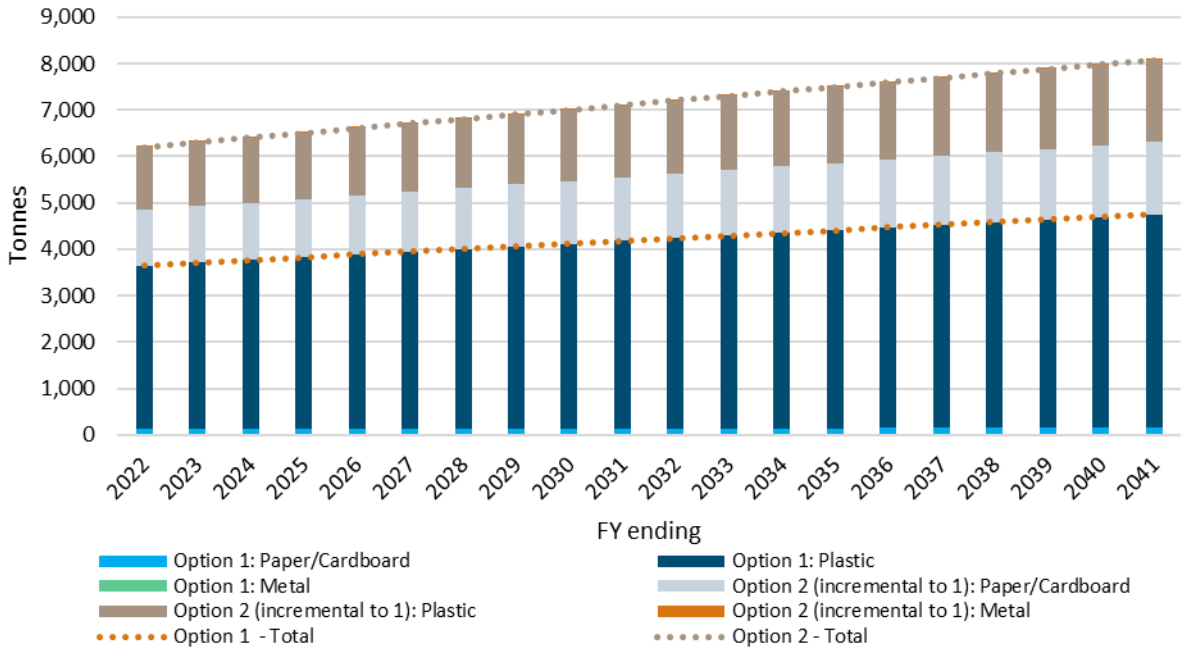


Figure 38: Change in glass delivered to MRFs (via kerbside recycling bins) or CDS collection points



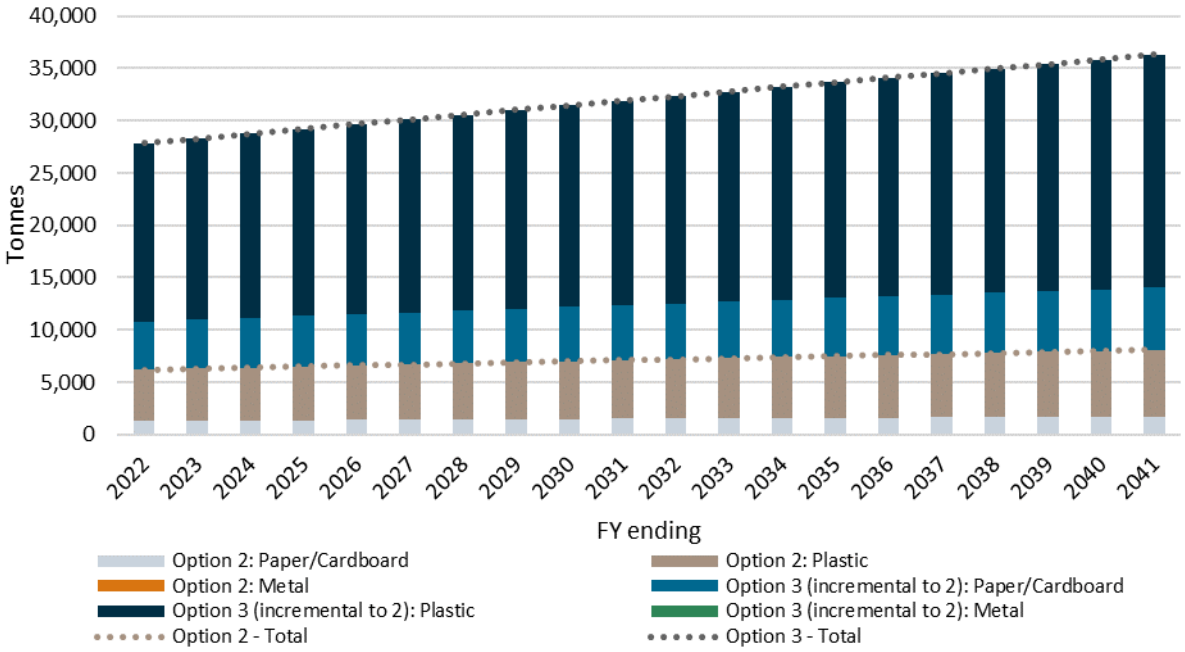
The magnitude of in-scope containers for material types other than glass differs substantially between Options 1 and 2. For Option 1, only large juice containers are in-scope while for Option 2, the range of in-scope containers is extended to include water, pure juice, flavoured milk, concentrated fruit and vegetable juice, and several other container types (Figure 39).

Figure 39: In-scope non-glass containers (Options 1 and 2)



The difference in quantities of in-scope containers between Options 2 and 3 is more noticeable, due to the substantial number of plain milk containers disposed each year (Figure 40).

Figure 40: In-scope non-glass containers (Options 2 and 3)



5.2 Cost and benefit assumptions

5.2.1 General assumptions

Table 21 outlines the assumptions that are common to all options analysed.

Table 21: General assumptions

Variable/Parameter	Central value	Sensitivity value(s)
Discount rate	7%	3%, 10%
Analysis period	20 years	10 years
Proportion of in-scope glass containers disposed of via household/kerbside pathways (Options 1 to 3)	80%	70%, 90%

5.2.2 Cost and benefit assumptions

Table 22 details the key cost and benefit assumptions used in the analysis.

Table 22: Cost and benefit assumptions

Variable	Low	Central	High	Source
Collection and transport – garbage	$86/tonne	$95/tonne	$105/tonne	MJA analysis of collection and disposal cost data from multiple Australian jurisdictions (confidential)
Collection and transport – comingled recycling	$135/tonne	$150/tonne	$165/tonne	

Variable	Low	Central	High	Source
Collection and transport – glass recycling	$162/tonne	$180/tonne	$192/tonne	
Collection and transport – CDS	$20/tonne	$22/tonne	$24/tonne	
Collection and transport – C&I	$135/tonne	$150/tonne	$165/tonne	MJA estimate
Processing costs – Sorted via CDS collection point	$117/tonne	$130/tonne	$143/tonne	MJA analysis of CDS processing cost data from multiple jurisdictions (confidential)
MRF processing costs – Sorted (Options 1 to 3)	$86/tonne	$95/tonne	$105/tonne	MJA analysis
MRF processing costs – Unsorted/mixed (Options 1 to 3)	$63/tonne	$70/tonne	$77/tonne	MJA analysis
MRF processing costs – Sorted (Option 4)	$78/tonne	$87/tonne	$96/tonne	MJA analysis
MRF processing costs – Unsorted/mixed (Option 4)	$56/tonne	$62/tonne	$68/tonne	MJA analysis
Kerbside bin capital cost (120L bin) [levelised cost]	$2.8/bin/yr	$4.2/bin/yr	$6.3/bin/yr	Cost estimates provided by DPIE in 2020 and cross-checked against data from confidential NSW EPA projects in 2021
Kerbside bin capital cost (120L bin) [unit cost]	$20/bin	$25/bin	$30/bin	
Kerbside glass bin useful life	10 years	8 years	6 years	MJA estimate agreed with NSW EPA
Kerbside glass bins rolled out initially[46]	1.91 million	2.15 million[47]	2.45 million	MJA estimate agreed with NSW EPA
Participation costs for the CDS	$60/tonne	$75/tonne	$90/tonne	Previous MJA analysis, and assuming 90% of trips to

[46] It is assumed that all glass bins are rolled out over the first three years of the analysis period (Year 1 = 2021-22), then replaced when they reach the end of their useful life. The number of bins rolled out initially – which also determines the magnitude of bin replacements in subsequent years – depends on the degree of bin sharing assumed (e.g., for MUDs).

[47] The central case assumes kerbside glass bins are provided at an average rate of 3 persons/bin. For the low case, this rate is 3.5 persons/bin, and for the high case, this rate is 2.5 persons/bin. As such, the central case value assumes a greater degree of bin sharing for the glass bin (especially for MUDs) than currently occurs for comingled recycling (yellow) bins.

Variable	Low	Central	High	Source
				collection points are parts of multi-purpose trips
Economic cost of landfill disposal		$70/tonne		MJA analysis of landfill disposal cost data
Economic cost of landfill externalities		$17/tonne		Based on an emissions factor of 1.2t CO_2/t waste for MSW and a carbon price of $41/tonne; includes disamenity, leachate, dust
Paper/Cardboard – Sorted	$80/tonne	$120/tonne	$160/tonne	MJA analysis of 'Recovered Resources Market Bulletin February 2022' and previous editions, to estimate long run values for each recyclate type
Paper/Cardboard – Unsorted	-$50/tonne	$0/tonne	$50/tonne	
Plastics – HDPE	$600/tonne	$750/tonne	$900/tonne	
Plastics – PET	$300/tonne	$400/tonne	$500/tonne	
Plastics – Mixed 1-7	$80/tonne	$120/tonne	$160/tonne	
Plastics – Mixed 3-7	$0/tonne	$40/tonne	$80/tonne	
Metals – Aluminium	$1,200/tonne	$1,400/tonne	$1,600/tonne	
Metals – Steel	$120/tonne	$160/tonne	$200/tonne	
Glass – Cullet (via CDS or glass only bin)	$45/tonne	$60/tonne	$75/tonne	
Glass – Cullet (via comingled recycling bin)	-$15/tonne	$0/tonne	$15/tonne	
Glass – Fines	-$80/tonne	-$65/tonne	-$50/tonne	

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