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PACKAGING MATERIAL FLOW ANALYSIS 2019-20

APCO

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1 Introduction

1.1 Background

This report describes material flow modelling undertaken to trace the flow of packaging materials in Australia from consumption to recovery at end of life. The study is based on the latest packaging consumption and recovery data for the 2019-20 financial year.[1]

In Section 1 we introduce the assumed system model representing the Australian packaging system, including the processes and packaging materials considered. Section 2 provides the modelling results tracing the flow of packaging through the system, as well as an evaluation of the system performance. A scenario analysis is presented in Section 3 to evaluate possible system changes for achieving Australia's 2025 National Packaging Targets (70% of plastic packaging recycled or composted).

1.2 Modelling approach

A Material Flow Analysis (MFA) was performed on the flows of packaging through the Australian packaging consumption and resource recovery system over the 2019-20 financial year period. Table 1 lists the packaging materials that were analysed.

MFA is an approach used to quantitatively assess the state and change of flows and stocks of materials within a system. The approach is based on the principle of the conservation of mass. By balancing material inputs and outputs, the material flows within a system can be quantified and analysed.

Table 1. Packaging categories quantified in this study

Packaging category	Packaging material
Paper	Polymer coated paperboard Paperboard and carton board Old corrugated cardboard Other fibre packaging
Glass	All glass and colours
Plastic (rigid and flexible)	PET HDPE LDPE PVC PP PS/EPS Other polymers (including bioplastic - compostable)
Metal	Aluminium Steel
Wood	Softwood and hardwood packaging

Used packaging eligible for Container Deposit Scheme (CDS) collection in applicable jurisdictions was also quantified as a subset of total packaging placed on the market (PoM). For 2019-20 financial year this included all Australian jurisdictions apart from Tasmania, Victoria and Western Australia. Packaging materials eligible for CDS collection are listed in Table 2. Redemption of CDS material is assumed to occur via two pathways: direct collection (e.g., reverse vending machines (RVMs), depot drop-offs etc) and material recovery facility (MRF) redemption (i.e., sorted CDS-eligible material that is redeemed through the CDS system).

[1] APCO (2021), Australian packaging consumption & recovery data 2019-20

Table 2. Container deposit scheme material categories in scope for this study

Packaging category	Packaging material (CDS eligible)[2]
Paper	Polymer coated paperboard (PCPB)
Glass	All glass and colours
Plastic	PET HDPE
Metal	Aluminium Steel

The flows of reusable packaging were also quantified and analysed. Table 3 lists the reusable packaging categories and the materials analysed. For this study, the amount of single-use packaging avoided through reusable packaging is quantified following the method described in *Australian Packaging consumption and recycling data 2019-20.*[3] This approach uses assumed packaging material avoided per rotation of reusable packaging, and number of rotations per year.

Table 3. Reusable packaging categories quantified in this study

Reusable packaging types	Materials
Kegs (beer and cider)	Steel – stainless steel
Drums (200-205L)	Steel – mild steel; Plastic – HDPE
Rigid intermediate bulk containers (IBCs)	Steel – mild steel; Plastic – HDPE; Plastic – other
Reusable pallets – plastic	Plastic - HDPE
Reusable pallets – timber	Steel – mild steel; Wood – hardwood; Wood – softwood
Plastic crates – non-collapsible Plastic crates – collapsible (RPCs)	Plastic – PP; Plastic – HDPE; Plastic – PP
Reusable shopping bags – LDPE	Plastic – LDPE
Reusable shopping bags – non-woven PP	Plastic – PP
Cups/mugs	Glass – flint; Plastic – LDPE; Plastic – PP; Plastic – other; Steel – stainless steel

1.3 System specification

Figure 1 shows the system diagram representing the packaging consumption and resource recovery system in 2019-20 used for this analysis. Descriptions of each labelled process and flow can be found in the Appendix (Table 41). Overall, 9 main processes were defined, representing collection, transformation (e.g., sorting, reprocessing) and accumulation (e.g., stockpiling and landfilling) of used packaging, as well as 37 material flows. Material flows are estimated based on three main types of data, represented by different colours in Figure 1:

- raw data input (green);
- estimation via parameters (orange) - modelled using parameters from the literature (e.g., average material sorting rates for MRFs and pre-sorted waste streams) or derived from the data (e.g., average reprocessor recovery rates); and
- estimation via mass-balance (purple), i.e., by back-calculation to ensure mass balance is retained.

[2] Eligibility of these materials is limited to certain beverages and container sizes.

[3] APCO (2021), Australian packaging consumption & recovery data 2019-20

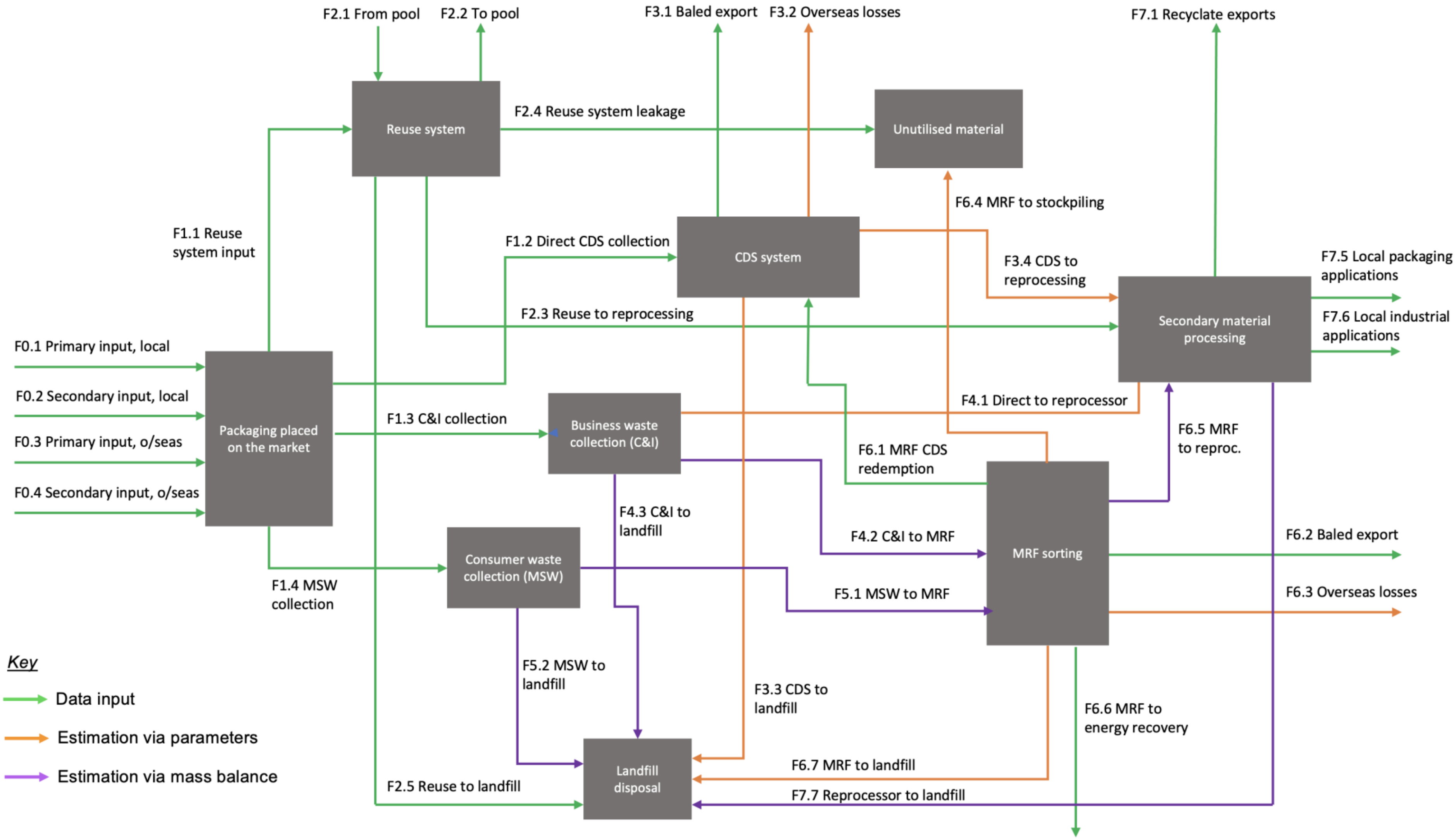

Figure 1. System diagram representing the packaging resource recovery system in Australia. Descriptions of each flow and how they are estimated can be found in Table 41 in the Appendix

1.4 System performance indicators

To characterise the resource recovery system performance, five key performance indicators were defined, as shown in Table 4. These indicators allow comparison between packaging systems (e.g., comparing the recovery rate of paper versus plastic), and highlight where opportunities exist in the packaging system to improve performance. The indicators are not independent, and we observe a reduction in performance rates from collection to circularity, highlighting that all indicators are limited by the collection efficiency.

Table 4. Packaging recovery system performance indicators

Performance indicator	Definition	Significance
Collection efficiency	Used packaging that is collected (not directed to landfill), divided by total packaging PoM [in the gate for CDS and MRF divided by PoM]	This indicator describes the performance of the collection system. Low efficiency means a high proportion of packaging isn't separated from material flows at the household or business and is directed to landfill, e.g., owing to loss by design, limited source separation and/or poor disposal practices.
Sorting efficiency	Waste destined for re-processing/downstream recovery, divided by total packaging PoM [out the gate for CDS and MRF divided by PoM]	This indicator describes the performance of the system for sorting used packaging by CDS and Material Recovery Facilities (MRFs). A decline in the efficiency from collection to sorting highlights opportunities to reduce contamination of collected materials received and/or improve sorting processes at the MRF/sorters, e.g. by investing in automated sorting, increasing manual sorting, or reducing the rate of throughput at MRFs
Post-consumer recovery rate (excl. stockpiling)	Total waste recovered (excluding stockpiling), divided by total packaging PoM (excl. pre-consumer scrap derived packaging). Here, only secondary material recovery, energy recovery, and exports of secondary materials are considered as recovery. Materials that are directly exported from MRFs are considered by assuming reprocessing losses occurring overseas based on local estimates [out the gate for reprocessors and MRF exports overseas divided by PoM]	This indicator describes the performance of the whole system for recovering used packaging material. Stockpiling is excluded, as we assume that this material is not utilised.
Local secondary material utilisation rate	Secondary material produced (excluding stockpiled amounts) to be utilised locally for manufacturing or other industrial applications, divided by total packaging onto the market [out the gate of reprocessors for local utilisation and energy recovery divided by POM]	This indicator describes the performance of the local secondary material utilisation system. Low material utilisation rates indicate that a high proportion of waste is either not recovered, exported, or stockpiled.
Packaging circularity rate	Secondary material utilised locally for packaging [local packaging utilisation divided by PoM]	This indicator describes the circularity of the packaging system. High circularity indicates a higher proportion of used packaging is recovered to be used as recycled content for manufacturing new packaging.

1.5 Data sources and limitations

Multiple data sources were used to define and establish the system model, and to estimate known flows of packaging material. Primary data for the 2019-20 financial year, derived from survey responses from national CDS service operators, packaging manufacturers and material reprocessors, are the key data sources for this analysis. This data was used to estimate packaging PoM in 2019-20, disposal to landfill, flows of CDS-eligible material through dedicated collection, flows of reusable packaging, and packaging recovery. Proxy data was used where primary data gaps were identified, notably where MRF sorting and reprocessing data was not available. The proxy data was sourced from life cycle assessment data describing the MRF and reprocessing efficiencies,[4] consistent with previous MFA studies.[5] Table 5 summarises the data sources used, and a description of how the data has been used in the context of this study.

Table 5. Key data sources

Data source	Remark
APCO packaging consumption and recycling study – CDS service operator response data	Data contains quantity of CDS-eligible packaging PoM in 2019-20 by material category and jurisdiction, and estimates of collection of material by collection system (e.g., CDS dedicated collection, MSW kerbside collection, etc.)
APCO packaging consumption and recycling data for all packaging materials 2019-20	Data contains total packaging PoM by material type, and origin of the packaging (e.g., local vs. imported, virgin vs. secondary derived material); material reprocessor quantities received and recovered, and quantities destined for overseas processing
LCA data on MRF and reprocessor efficiencies[6]	This study includes sorting and reprocessing efficiency rates for recyclable waste streams, based on a life cycle assessment study of MRFs in the United States. This data was used in the estimation of sorting and reprocessing losses and is applicable to the Australian system because the sorting and recovery processes and the packaging materials are similar.
State waste reports (e.g. SA,[7] Qld,[8] and NSW[9])	State and territory waste reports summarise high-level flows of municipal (and some commercial) waste collected by jurisdiction. This data is used to calibrate flows including flows of used packaging to waste recovery

4 Pressley, P.N.; Levis, J.W.; Damgaard, A.; Barlaz, M.A.; DeCarolis, J.F. (2015). Analysis of material recovery facilities for use in life-cycle assessment. *Waste Management* 35, pp. 307-317

5 Madden, B. and Florin, N. (2019). Characterising the material flows through the Australian waste packaging system, Institute for Sustainable Futures, University of Technology Sydney

6 Pressley, et al. (2015).

7 Green Industries SA (2019). South Australia's Kerbside Waste Performance Report 2017-18

8 Queensland Government (2020). Recycling and waste in Queensland, https://www.qld.gov.au/__data/assets/pdf_file/0033/129669/recycling-waste-report-2019.pdf

9 NSW EPA (2021). NSW Local Government Waste and Resource Recovery Data Report, 2019-20

1.6 Uncertainty analysis

Uncertainty on estimated material flows resulting from variability in data and parameters was evaluated using a Latin hypercube sampling-based Monte-Carlo simulation approach. Latin hypercube sampling is a convenient way to generate random samples of multiple parameters or data points evenly over a sample space.[10] Data input and parameter values were successively drawn from a sample space and used to generate a distribution of estimated material flows for the modelled system from which uncertainty can be evaluated. In this report, each data input and parameter is assumed to be random variables drawn from a known probability distribution. Probability distributions were chosen empirically where possible (i.e., from uncertainty ranges estimated from survey data) or using a qualitative assessment of the underlying data quality to derive quantitative estimates of variability.

1.7 Scenario analysis

A scenario analysis was performed to investigate future packaging flows for 2024-25. The scenarios analysed do not represent an exhaustive list of possible future interventions. A range of potential changes in packaging flows and system performance are tested including those that are likely to be implemented by 2024-25, considering e.g., export bans and expanded CDS collections. For this study, five future 2024-25 scenarios were defined and modelled, based on 2024-25 projected packaging placed on the market and expected recovery quantities in the APCO data.[11]

- Scenario 1: Business-as-usual, 2024-25
- Scenario 2: CDS expanded to include all glass packaging
- Scenario 3: Increased collection and recovery of rigid plastic packaging
- Scenario 4: Increased separate collection and recovery of flexible plastic packaging
- Scenario 5: Meeting the 70% plastics recovery target.

Modelled material flows for each scenario were used to estimate performance indicators for 2024-25, and to compare against 2019-20 performance. Table 6 lists major assumptions for each scenario.

Table 6. Major assumptions used for 2024-25 scenario analysis

Scenario	Assumptions	Materials in focus
Scenario 1 – business-as-usual, 2024-25	**Packaging PoM** - PoM projections for 2024-25 provided by APCO (2021) (includes phase out of targeted materials: rigid PVC, PS/EPS, oxo-degradable polymers, lightweight HDPE shopping bags) **Reuse system** - Reuse pool size for 2024-25 based on 2019-20 pool size, and average yearly net change in pool size (average yearly net change = 2018-19 to 2019-20 net change) - Quantity of new reusable packaging placed on the market to remain at same proportion of PoM as 2019-20 (~2% of PoM) - Quantity of end-of-life reusable packaging to remain at 2019-20 proportions of reuse system input - Composition of reuse system for plastic packaging types to remain at same proportions as the 2019-20 system **Collection systems:**	All packaging material

[10] McKay, M.D.; Beckman, R.J.; Conover, W.J. (1979). A comparison of three methods for selecting values of input variables in the analysis of output from a computer code, Technometrics: American Statistical Association 21(2), 239-245

[11] APCO (2021), Australian packaging consumption & recovery data 2019-20

	CDS - CDS system to be expanded to include Victoria, Tasmania and WA CDS systems coming online by 2024-25 - Proportion of PoM that is eligible for CDS in new jurisdictions to be equal to national average - Redemption rates of CDS eligible material to be equal to national average **Recovery** - Recovery projections for 2024-25 provided by APCO (2021) - Restrictions on baled exports in effect for plastic packaging - Stranded exports in 2024-25 (from CDS and MRF) calculated based on proportion of baled exports to total recovery in 2019-20 - Stranded exports to be diverted to local reprocessing - Recovery via packaging and industrial grade application at same proportions as 2019-20 system	
Scenario 2 – CDS expanded to all glass	**Assumptions consistent with BAU except where stated** ***CDS*** - CDS system further expanded to include all glass packaging - Redemption rates of CDS eligible glass to be equal to state/national average redemption rates for glass packaging	Glass only (amber, flint and green colours)
Scenario 3 – Increased collection and recovery of rigid plastic	**Assumptions consistent with BAU except where stated** ***CDS*** - CDS eligibility expanded to include HDPE milk bottles - Redemption rates for CDS eligible milk bottles to be equal to state/national average redemption rates for HDPE packaging ***Kerbside collection*** - Increase in rigid PP collection via existing kerbside pathways to be in line with projected rigid HDPE recovery rate	Plastic packaging only (focus on rigid HDPE, PP)
Scenario 4 – Increased separate collection of soft plastics	**Assumptions consistent with BAU except where stated** ***Soft plastics collection*** - Separate collection of B2C soft plastics (e.g., via REDCycle) to increase by 400% over BAU levels (approx. 2% of flexible HDPE, LDPE and PP PoM in 2019-20) - Increase in B2B flexible LDPE collection via C&I pathway to increase, also at a rate of 400% above BAU levels	Plastic packaging only (focus on flexible HDPE, LDPE and PP)

Scenario 5 – meeting the 70% plastic packaging recovery target	**Assumptions consistent with BAU and scenarios 3 & 4 except where stated**
	
	Recovery
	- Rigid and flexible polymer recovery set such that total plastic packaging recovery achieves the 70% target
	    - For rigid polymers, HDPE and PP are targeted (rigid PET, PVC and PS/EPS are projected to meet recovery rates under BAU)
	    - For flexible polymers, all polymer types are targeted (flexible polymer packaging recovery is ~13% in BAU)
	
	Collection systems
	- CDS and separate collection of soft plastics capped at Scenario 3 & 4 levels, with required packaging volumes to meet expected recovery levels under this scenario assumed to be from increased kerbside collections
		Plastic packaging (all polymer types)

2 Baseline 2019-20 MFA results

2.1 Packaging placed on the market in 2019-20

Table 7 summarises packaging placed on the market in 2019-20 by packaging category (see Table 42 in the Appendix for data by packaging material type). Approximately 6.3 million tonnes of packaging material were PoM in 2019-20. Paper packaging accounted for approximately 53% of all packaging PoM. Metal packaging had the smallest share of packaging, contributing approximately 4% to total packaging PoM in 2019-20.

Table 7. Summary of packaging placed on the market in 2019-20

Material category	Packaging placed on the market in 2019-20 [tonnes]
Paper packaging	3,277,267
Glass packaging	1,155,801
Plastic packaging	1,123,850
Metal packaging	247,845
Wood packaging	461,651
Total packaging	**6,266,414**

2.1.1 Sources of packaging placed on the market

Figure 2 shows a summary of primary versus secondary packaging placed on the market in 2019-20. Of the quantity of packaging PoM, approximately 2.9 million tonnes, or 47% of packaging PoM, was derived from local and overseas sourced recycled content (post-consumer and pre-consumer). Approximately 36% of all packaging PoM was derived from post-consumer recycled content (39% excluding wood). Paper packaging had the highest proportion of PoM derived from post-consumer secondary material, accounting for approximately 54% of paper packaging PoM. Glass packaging also had a significant share of post-consumer recycled content, contributing approximately 37% to glass packaging PoM. Plastic packaging had the lowest proportion of post-consumer recycled content (excluding wood packaging), at approximately 3% of plastic packaging PoM. PET packaging had the highest proportion of post-consumer recycled content amongst plastic packaging, at approximately 13%. Flexible plastic packaging, making up just over half of plastic packaging PoM, had an average recycled content rate of 4% from post-consumer and pre-consumer sources, predominately from flexible LDPE packaging types.

Of the 6.3 million tonnes of packaging material placed on the market in 2019-20, approximately 47% of this was derived from recycled content (post-consumer and pre-consumer), and 36% from post-consumer recycled content (39% excluding wood).

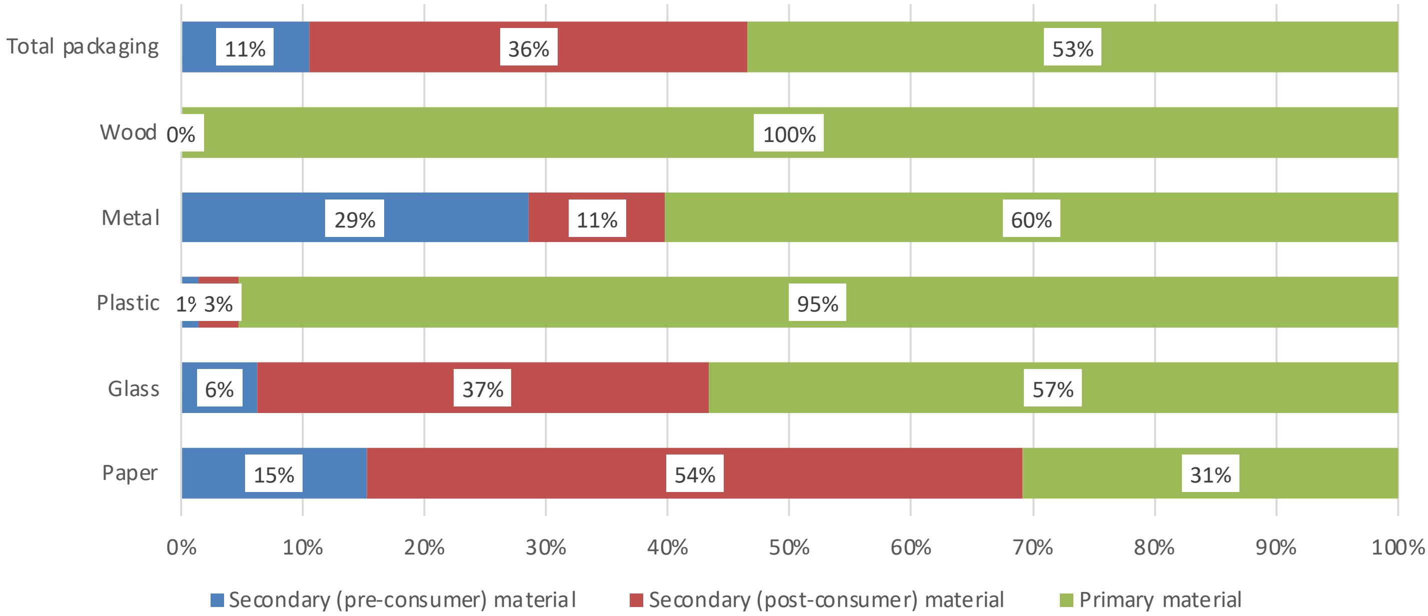

Figure 2. Summary of primary vs. secondary material sources for packaging PoM in 2019-20

2.1.2 Eligible CDS packaging and reusable packaging placed on the market

Table 8 and Figure 3 summarise quantities of each material category of eligible CDS packaging and reusable packaging placed on the market in 2019-20 (see Table 43 in the Appendix for a breakdown by packaging material). CDS eligible packaging made up approximately 7% of total packaging PoM (approximately 463,400 tonnes). The share of CDS eligible packaging PoM is expected to grow over time, as CDS expands nationwide to all jurisdictions. A broader range of packaging formats is also being considered for inclusion in CDS within the next few years.[12]

Glass packaging had the highest proportion of CDS eligible packaging placed on the market, at approximately 32% of glass PoM. Excluding wood packaging (which is not eligible for CDS), paper packaging had the smallest proportion of CDS eligible material PoM, at approximately 0.2%. Only a single paper packaging material was eligible for CDS (some polymer coated paperboard [PCPB] formats), which represents approximately 6% of all PCPB packaging PoM. Approximately 260,000 tonnes of CDS eligible containers were redeemed in 2019-20 through CDS collections or via MRF sorting. Results on the performance of CDS eligible packaging in 2019-20 are examined further in Section 2.4.1.

Table 8: Eligible container deposit scheme packaging and reusable packaging placed on the market in 2019-20

Material category	Eligible CDS packaging PoM [tonnes]	Reusable packaging PoM [tonnes][13]
Paper packaging	5,942	0
Glass packaging	367,511	155
Plastic packaging	51,634	36,729
Metal packaging	38,291	19,669
Wood packaging	0	99,458
Total packaging	**463,378**	**156,011**

12 EPA SA (2021), Improving South Australia's recycling makes cents, available at https://www.epa.sa.gov.au/files/14100_epa_cds_review.pdf

13 This is new packaging coming into the reuse pool in 2019-20 only.

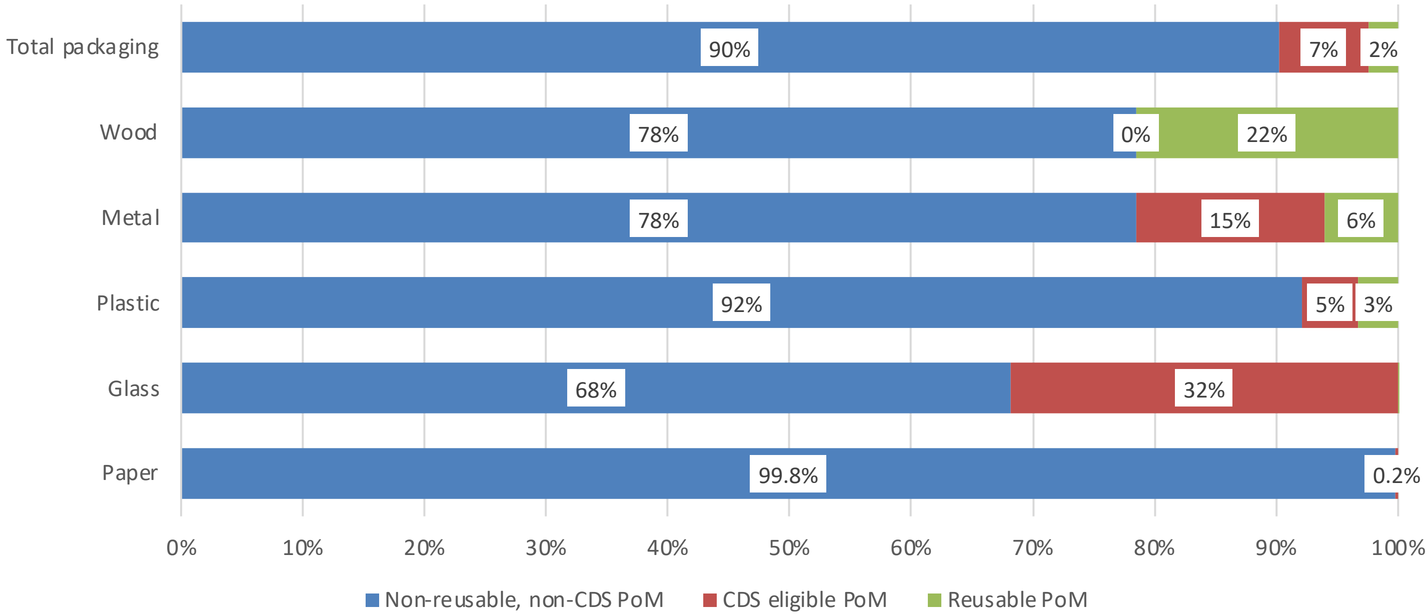

Figure 3. CDS eligible and reusable packaging as a proportion of total packaging placed on the market

Table 9 shows the composition of the estimated reusable packaging PoM in 2019-20. Note that there are small differences between the data in Table 9 and the reusable packaging data reported in the APCO report.[14] In this analysis approximately 156,000 tonnes of new reusable packaging material were estimated to be added to the reusable packaging pool in 2019-20. This volume accounts for approximately 2% of all packaging PoM, contributing to an approximate total pool size of 1.2 million tonnes. Reusable pallets made from timber comprised approximately 67% of all reusable packaging types entering the reuse system in 2019-20. Other significant reusable packaging materials included reusable HDPE and PP shopping bags (11% and 5% of reusable packaging entering the system respectively), steel drums (7%) and reusable HDPE pallets (6%). Results for the performance of the reuse system in 2019-20 are examined further in Section 2.4.2.

[14] APCO (2021), Australian packaging consumption & recovery data 2019-20.

The APCO data for new reusable packaging entering the market and outflows from the reuse system were adjusted to ensure that mass balance constraints of the MFA model were met when considering steel packaging received in-the-gate at reprocessors. The discrepancy between the APCO data and the data in Table 9 is approximately 10,000 tonnes of steel packaging in the 'drums (200-205L)' and 'rigid intermediate bulk containers' reusable packaging types.

Table 9. Summary of reusable packaging placed on the market in 2019-20

Reusable packaging types	Glass [tonnes]	HDPE rigid [tonnes]	LDPE rigid [tonnes]	PP rigid [tonnes]	Other rigid polymers [tonnes]	Flexible polymers [tonnes]	Steel [tonnes]	Wood [tonnes]	Total [tonnes]
Kegs (beer and cider)	0	0	0	0	0	0	417	0	**417**
Drums (200-205L)	0	990	0	0	0	0	12,818	0	**13,808**
Rigid intermediate bulk containers	0	1,497	0	0	79	0	3,853	0	**5,429**
Reusable pallets – plastic	0	8,744	0	0	0	0	0	0	**8,744**
Reusable pallets – timber	0	0	0	0	0	0	2,550	99,458	**102,008**
Plastic crates – non-collapsible	0	562	0	562	0	0	0	0	**1,125**
Plastic crates – collapsible	0	0	0	893	0	0	0	0	**893**
Reusable shopping bags – LDPE	0	0	0	0	0	15,925	0	0	**15,925**
Reusable shopping bags – PP	0	0	0	0	0	7,282	0	0	**7,282**
Cups/mugs	155	0	71	86	37	0	32	0	**380**
Total reusable packaging	**155**	**11,794**	**71**	**1,541**	**116**	**23,207**	**19,669**	**99,458**	**156,011**

2.2 Australian Packaging System performance

Figure 4 shows material flow estimates for the overall Australian packaging system in 2019-20. Material flows estimated in Figure 4 were used to calculate the five system performance indicators (see Table 4) presented in Figure 5 by material category. Table 44 in the Appendix summarises performance indicators for all packaging materials. Results for the collection, sorting (including CDS and reuse), and recovery systems have been examined in further detail in sections 2.3 to 2.6.

The recovery rate for total packaging in 2019-20 was approximately 55% of packaging, or 3.4 million tonnes. Approximately 34% (2.2 million tonnes) of packaging PoM was recovered and utilised locally, primarily for packaging applications. As such, the packaging circularity rate is estimated at approximately 24% of PoM (or 1.5 million tonnes recovered as local packaging).

Highest recovery rates are observed for the glass and paper packaging categories, with recovery rates of 60% or above for both systems. Of the paper packaging materials, old corrugated cardboard (OCC) achieved the highest performance, with a recovery rate of 79% and local packaging circularity rate of 43%. Glass packaging had a higher local utilisation rate compared with paper packaging (58% vs. 37%), however only approximately half of the locally utilised recovered glass was utilised in packaging applications, compared to 100% of the locally recovered paper utilised in packaging applications.

Recovery rates were lowest for plastic packaging, with an overall recovery rate of 16%. Rigid PET packaging had the best performance compared to other plastic packaging materials with a recovery rate of approximately 42%. Flexible polymers made up approximately 47% of all plastic packaging PoM yet achieved recovery rates of only 4% owing to a lack of dedicated collection and recovery pathways and limited end markets. An estimated 7% of plastic packaging PoM was recovered and utilised locally, and 3% was recovered for use in local packaging applications.

Metal packaging had relatively high rates of recovery at 56% of PoM, with 7% of PoM recovered and utilised locally in 2019-20, however no recovered metal was used for local packaging applications. This is owing to high overseas demand for recovered metal.[15]

[15] APCO (2021), Australian packaging consumption & recovery data 2019-20

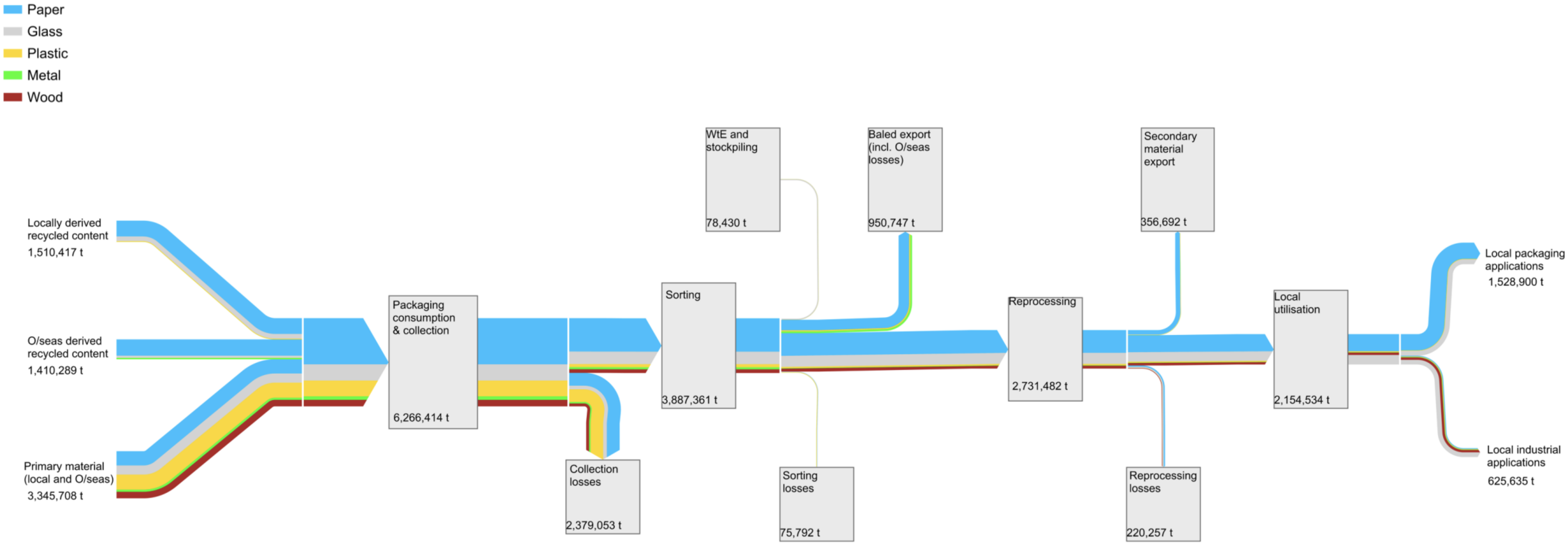

Figure 4. Summary material flows for Australian packaging system in 2019-20

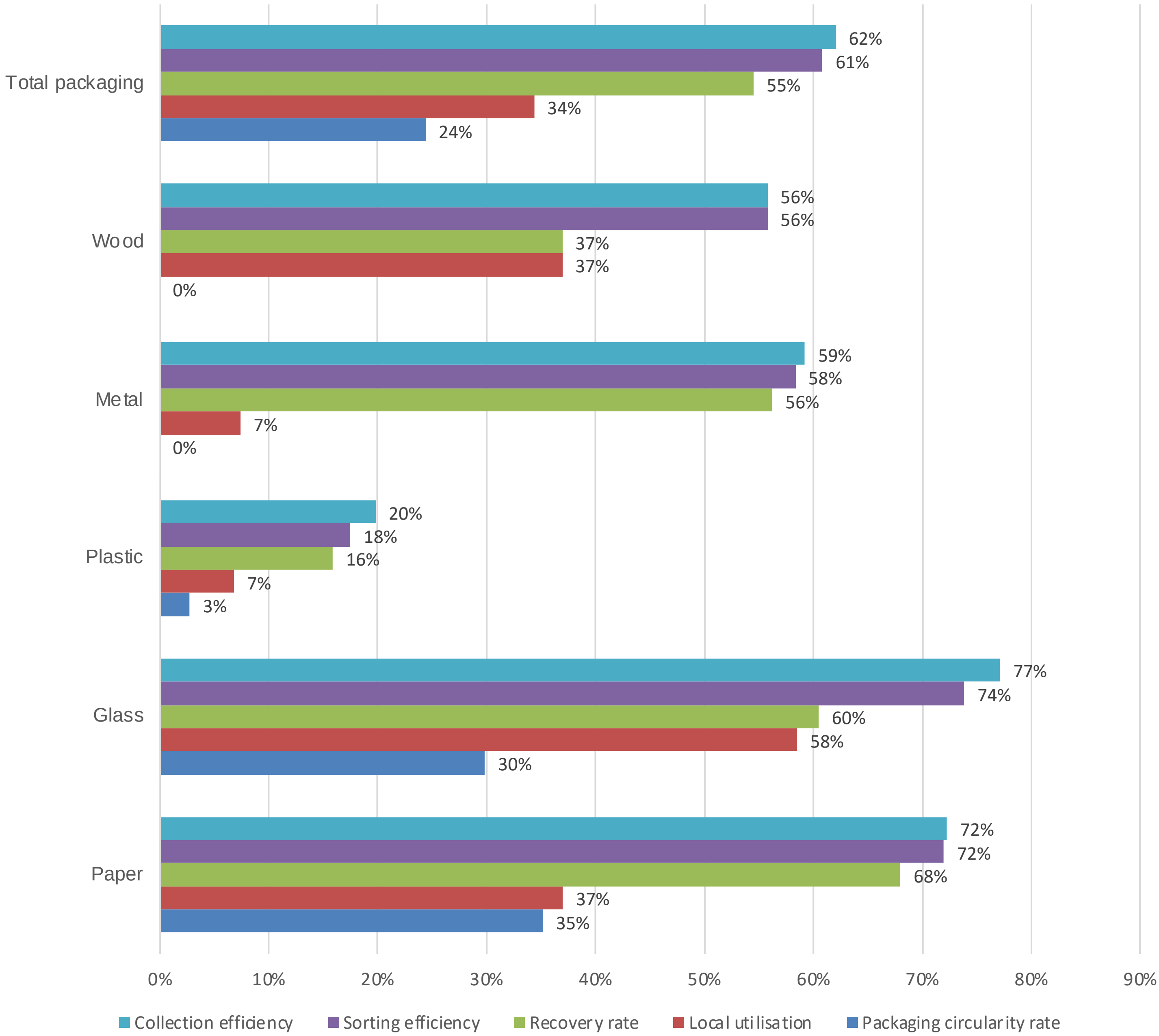

Figure 5. Summary of Australian packaging system performance indicators for 2019-20

2.2.1 Comparison with 2018-19 system performance

Table 10 shows a comparison between system performance indicators for 2018-19[16] and 2019-20 (change in % points). Generally, system performance has improved compared to 2018-19, with total packaging recovery increasing by approximately 5% points, and packaging circularity increasing by approximately 3%-points in 2019-20. Glass packaging saw the largest improvements in performance, with an increase in the recovery rate of 15%-points. This significant increase is largely owing to a reduction in reported consumption and a decline in glass stockpiling in 2019-20 compared to 2018-19, making additional material available for recovery. Plastic packaging saw a decrease in recovery by 2%-points compared to 2018-19. This is likely owing to an increase in the estimated amount of flexible plastic packaging types PoM in 2019-20, which increased from 34% of plastic packaging PoM in 2018-19, to 47% of plastic packaging PoM in 2019-20.

Table 10. Comparison between 2018-19 and 2019-20 system performance indicators

Material category	Collection efficiency [difference to 2018-19]	Sorting efficiency [difference to 2018-19]	Recovery rate [difference to 2018-19]	Local utilisation rate [difference to 2018-19]	Packaging circularity rate [difference to 2018-19]
Paper	5%	7%	5%	8%	6%
Glass	12%	22%	15%	15%	5%
Plastic	0%	-1%	-2%	2%	0%
Metal	1%	2%	0%	-1%	0%
Wood	1%	1%	1%	1%	0%
Total packaging	**4%**	**7%**	**5%**	**7%**	**3%**

16 Results from the MFA on the 2018-19 packaging management and recovery system have not been made public

2.3 Collection system material flows

Figure 6 shows material flow estimates for each packaging category for the 2019-20 collection system, and Figure 7 summarises packaging collection via collection pathway (see Table 45 in the Appendix for a breakdown of collection by packaging material).

In Section 2.2, glass and paper packaging achieved the highest collection efficiencies, at 77% and 72% PoM respectively (see Figure 5)., while the poorest collection rates were reported for plastic packaging at 20% of packaging PoM. By packaging material, the highest collection efficiencies were achieved for OCC (84%) and aluminium (82%), and the lowest for PCPB (7%) and flexible polymers (8%).

Business waste collection (including business-to-business (B2B) and business-to-consumer (B2C) packaging consumed away from home) via commercial and industrial (C&I) collection was the dominant pathway for discarded packaging collection, with approximately 3.4 million tonnes, or 54% of packaging PoM collected through this pathway. Collections via C&I were greatest for wood and paper packaging, accounting for 78% and 75% of all collections respectively. Notably for these packaging categories, a large proportion of discarded B2B packaging (primarily wood packaging and OCC) is directed to reprocessing directly from C&I collection, bypassing sorting.

Municipal solid waste (MSW) collection (including both commingled packaging collected for recycling and residual waste disposed to landfill) made up approximately 39% of all collections of packaging PoM, with the majority of plastic, glass, and metal packaging collected via this pathway. MSW collections were greatest for plastic, with 77% of all plastic PoM collected via this pathway.

Dedicated CDS collections made up 4% of all packaging PoM, or approximately 259,400 tonnes collected via this pathway. CDS collection was most significant for packaging categories glass (18% of collection) and metal (9% of collection).

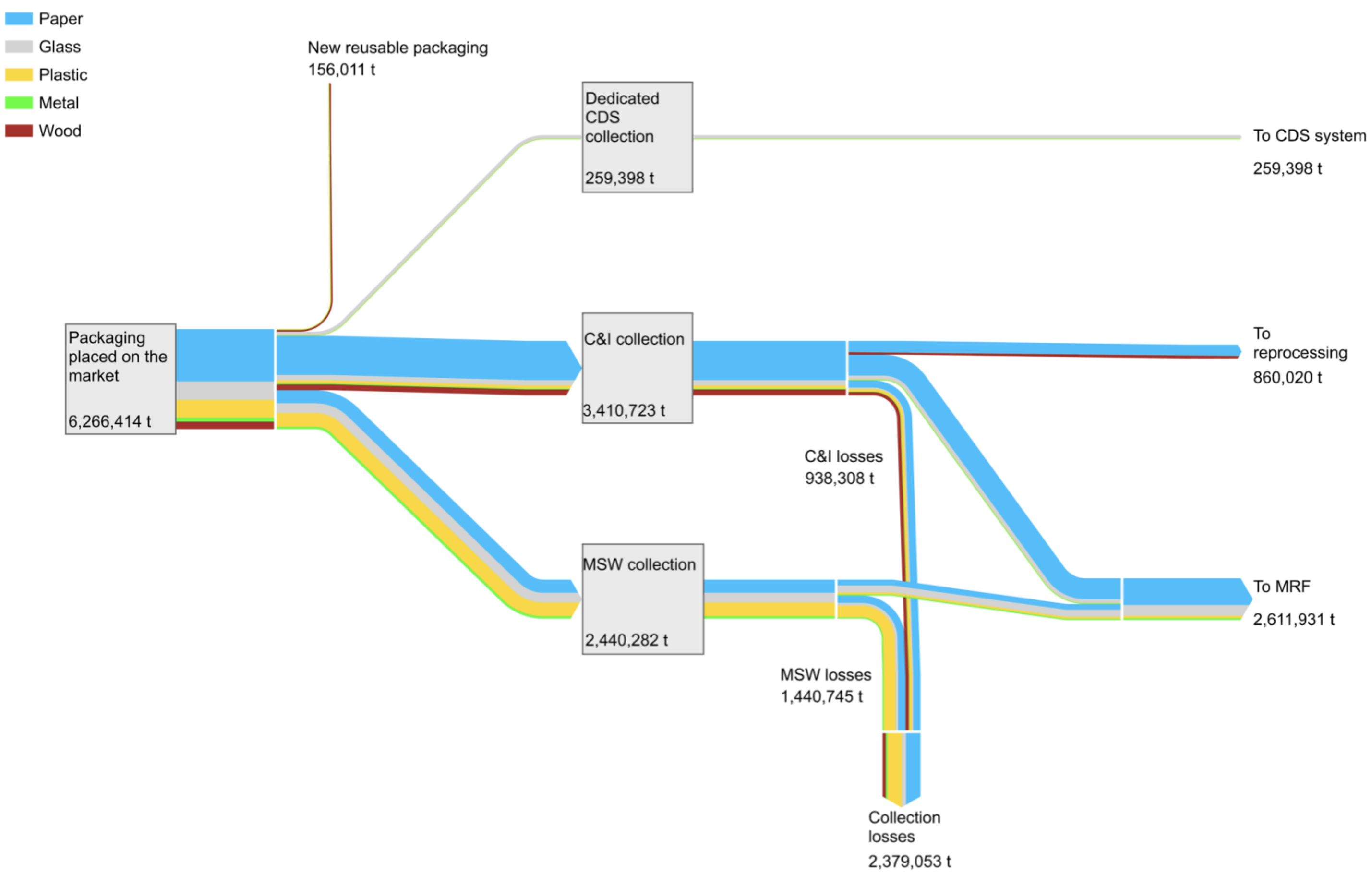

Figure 6. Estimated material flows for the 2019-20 packaging collection system[17]

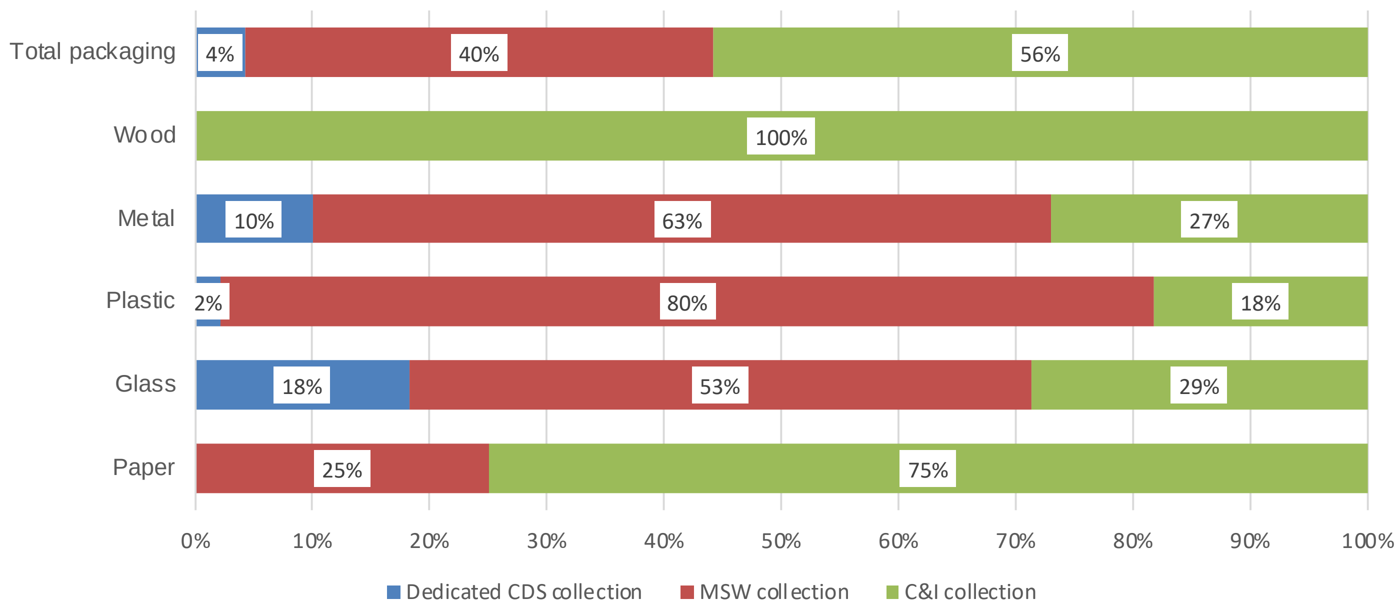

Figure 7. Summary of collection of packaging PoM via collection pathway for 2019-20. Percentages in the figure represent proportion of total collection

17 New reusable packaging PoM entering the reuse system made up 2% of packaging PoM, or approximately 156,000 tonnes

2.4 CDS, reuse and MRF sorting system material flows

Figure 8 shows estimated material flows for the CDS, reuse and MRF sorting systems. For this analysis, we consider the CDS and reuse system to be included with MRF sorting, as for CDS and reuse it is assumed that collection losses are bypassed. As such, losses occurring through the CDS and reuse systems are classified as 'sorting losses' for this analysis.

Approximately 3 million tonnes of packaging entered sorting systems in 2019-20. Approximately 860,000 tonnes of material (primarily wood and paper packaging, with some glass and soft plastics) bypassed the sorting system and were transported directly to reprocessing. Of the quantity entering this stage, 88% was destined for MRF sorting via kerbside collections; 9% destined for the CDS system; and 3% consisted of end-of-life reusable packaging. Approximately 72,300 tonnes of packaging were stockpiled (i.e., sorted but unutilised)—predominately glass packaging sorted at MRFs (approximately 65,600 tonnes), and plastic, metal and wood packaging from reuse (system leakages).

Recovery flows from sorting include approximately 950,700 tonnes of baled exports from the CDS and MRF systems (approximately 898,900 tonnes of this quantity was recovered overseas, owing to assumed recovery efficiencies overseas); and flows to local energy recovery (approximately 6,100 tonnes). Recovery flows will be discussed in further detail in Sections 2.5 and 2.6.

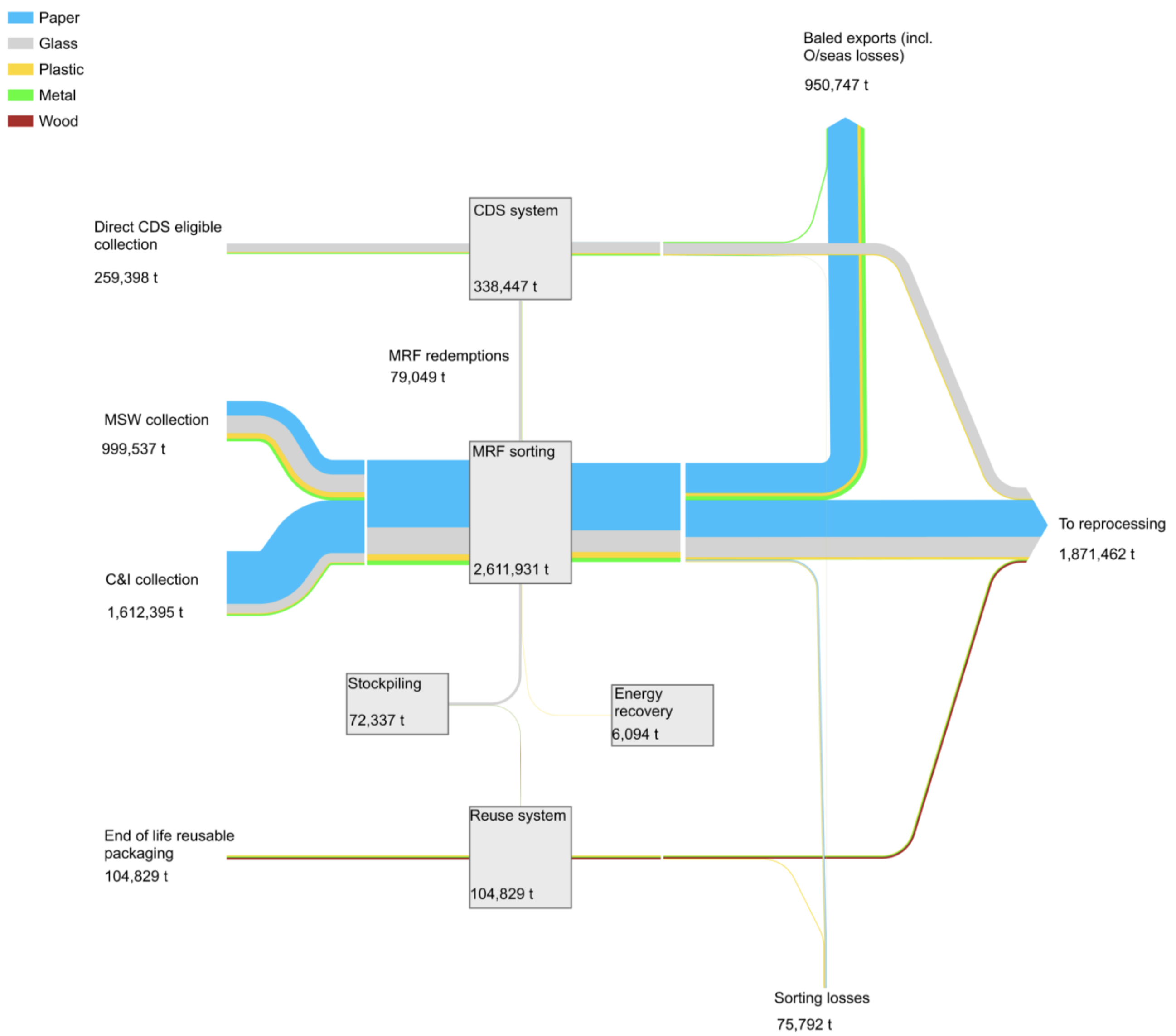

Figure 8. Estimated material flows for the 2019-20 CDS, MRF and reuse sorting systems

2.4.1 Redemption of CDS-eligible packaging

Table 11 shows a summary of CDS eligible packaging redemption in 2019-20 by redemption channel. Table 46 in the Appendix includes redemption rates by packaging categories and materials. Approximately 73% of all CDS eligible containers placed on the market were redeemed in 2019-20. Redemption rates were highest for glass and metal (aluminium) containers. Of the eligible plastic container materials, the redemption rate was highest for PET packaging at 59%. Redemption rates were lowest for paper (PCPB) packaging, with a rate of 27%. Redemption via dedicated CDS collections (e.g., drop-offs, reverse vending machines (RVMs) etc.) made up approximately 80% of all redemptions. Approximately 341,200 tonnes of redeemed and non-redeemed CDS eligible material were recovered, both overseas via baled exports and by local reprocessors. This equates to a recovery rate of 74% of CDS eligible packaging.

Where recovery rates are greater than redemption rates, this is due to a high level of non-redeemed recovery, where CDS-eligible packaging is collected via kerbside and sorted at MRF[18]. Where recovery rates are lower than redemption rates, this is due to high redemption rates of CDS-eligible packaging and downstream losses at reprocessing and sorting of non-redeemed packaging impacting the overall recovery rate.

Table 11. Summary of CDS eligible packaging redemption by material

Material category	CDS-eligible PoM [tonnes]	CDS-eligible redeemed via dedicated collection [tonnes]	CDS-eligible redeemed via MRFs [tonnes]	Redemption rate [-]	CDS-eligible recovered (redeemed and non-redeemed) [tonnes]	Recovery rate (CDS-eligible basis) [-]
Paper packaging	5,942	1,586	0	27%	1,574	26%
Glass packaging	367,511	210,869	70,501	77%	276,328	75%
Plastic packaging	51,634	23,999	5,428	57%	30,765	60%
Metal packaging	38,291	22,944	3,120	68%	32,563	85%
Total packaging	**463,378**	**259,398**	**79,049**	**73%**	**341,229**	**74%**

Table 12 summarises CDS eligible redemption by jurisdiction. South Australia and Northern Territory had the highest rates of CDS eligible redemption, which is expected given the maturity of these schemes. NSW had the greatest amount of CDS eligible material redeemed, at approximately 150,000 tonnes, followed by Queensland, at approximately 127,000 tonnes. ACT had the lowest rates of CDS redemption. Total recovery of CDS eligible containers was approximately 341,200 tonnes, at a recovery rate of 74% of CDS eligible packaging PoM.

18 The main discrepancy between redemption rates and CDS-eligible recovery rates is observed for metals, which may suggest uncertainty on reported bulk redemption rates via MRFs in the primary data (APCO, 2021)

Table 12. Summary of CDS eligible packaging redemption by jurisdiction

Jurisdiction	CDS-eligible PoM [tonnes]	CDS-eligible redeemed via dedicated collection [tonnes]	CDS-eligible redeemed via MRFs [tonnes]	Redemption rate [-]	CDS-eligible recovered (redeemed and non-redeemed) [tonnes]	Recovery rate (CDS-eligible basis) [-]
ACT	9,391	2,777	1,981	51%	6,012	64%
NSW	214,374	119,634	40,912	75%	158,297	74%
NT	7,541	6,582	0	87%	6,309	84%
Queensland	184,781	91,132	35,694	69%	132,102	71%
SA	47,292	39,272	463	84%	38,509	81%
Tasmania						
Victoria	No CDS system active during study period					
WA						
Australia	**463,378**	**259,398**	**79,049**	**73%**	**341,229**	**74%**

2.4.2 Reusable packaging management

Table 13 summarises reusable packaging flows for 2019-20.[19] Approximately 156,000 tonnes of new reusable packaging materials were added to the reusable packaging system in 2019-20, contributing to a total pool size of approximately 1.2 million tonnes. Reusable pallets made from timber made up approximately 65% of all reusable packaging types entering the reuse system in 2019-20, and approximately 82% of the total reusable packaging pool. Other significant reusable packaging types included reusable LDPE and PP shopping bags (10% and 5% of reusable packaging entering the system respectively), and reusable HDPE pallets 6% of reusable packaging entering the system).

The pool of reusable packaging on the market (i.e., reusable packaging that accumulates in the system) increased on a net basis, with approximately 50,900 tonnes of reusable packaging added in 2019-20. Approximately 51,000 tonnes of reusable wooden pallets were added to the reuse pool in 2019-20, in addition to 5,100 tonnes of reusable PP shopping bags, and 4,400 tonnes of plastic reusable pallets. This quantity entering the reuse pool was balanced by approximately 11,000 tonnes of packaging material retiring from the reuse pool and entering the waste management system; namely kegs, steel drums and rigid intermediate bulk containers (IBCs).

[19] Note that the APCO data for outflows from the reuse system were adjusted to ensure that mass balance constraints of the MFA model were met when considering steel packaging received in-the-gate at reprocessors. The discrepancy between the APCO data and the data in Table 13 is approximately 20,000 tonnes of steel packaging in the 'drums (200-205L)' and 'rigid intermediate bulk containers' reusable packaging types.

Table 13. Summary of modelled reuse packaging system flows for 2019-20

Reusable packaging type	Material entering reuse system in 2019-20 [tonnes]	Reusable material directed to reprocessing [tonnes]	Reusable material disposed to landfill [tonnes]	Reuse system leakage [tonnes]	Size of reusable pool, and change of pool size [tonnes]
Kegs (beer and cider)	417	506	0	56	16,067 (-146)
Drums (200-205L)	13,808	11,472	0	3,772	58,262 (-1,435)
Rigid intermediate bulk containers	5,429	13,915	282	0	39,407 (-8,767)
Reusable pallets – plastic	8,744	4,153	0	219	87,435 (4,372)
Reusable pallets – timber	102,008	48,454	0	2,550	1,020,078 (51,004)
Plastic crates – non-collapsible	1,125	1,012	0	112	11,250 (0)
Plastic crates – collapsible (RPCs)	893	254	0	13	8,928 (625)
Reusable shopping bags – LDPE	15,925	1,911	14,014	0	919 (0)
Reusable shopping bags – PP	7,282	239	1,931	0	4,340 (5,113)
Cups/mugs	380	0	237	0	1,012 (143)
Total reusable packaging	**156,011**	**81,917**	**16,464**	**6,722**	**1,247,698 (50,908)**

Table 14 shows the quantities of single use packaging avoided by each reusable packaging type in 2019-20. Data in the table is reproduced from the APCO data report.[20] Avoided packaging is estimated based on assumed single-use packaging avoided per rotation of reusable packaging, and an assumed number of rotations per year by reusable packaging type. In total, approximately 2.9 million tonnes of single-use packaging were avoided through reuse in 2019-20. Single-use wood packaging material was the material category that achieved the greatest level of avoidance, with approximately 2.4 million tonnes of single-use wooden pallet waste avoided via reusable plastic and wooden pallets. Glass and paper packaging material avoidance was also substantial, at approximately 214,000 tonnes and 183,600 tonnes, respectively.

Approximately 2.1 million tonnes of single-use packaging were avoided through reusable timber pallets. Steel beverage keg reuse also led to significant avoidance, responsible for approximately 286,400 tonnes of paper, glass and metal packaging avoided. Reusable LDPE shopping bags had the lowest estimated single-use avoidance in 2019-20, with approximately 12,000 tonnes of flexible HDPE single-use packaging avoided.

20 APCO (2021), Australian packaging consumption & recovery data 2019-20

Table 14. Summary of estimated single-use avoided from reuse for 2019-20

Reusable packaging type	Paper packaging [tonnes]	Glass packaging [tonnes]	Plastic packaging [tonnes]	Metal packaging [tonnes]	Wood packaging [tonnes]	Total avoided [tonnes]
Kegs (beer and cider)	48,186	214,018	0	24,237	0	286,441
Drums (200-205L)	0	0	2,476	20,974	0	23,451
Rigid intermediate bulk containers	0	0	8,939	10,669	0	19,607
Reusable pallets – plastic	0	0	0	0	249,815	249,815
Reusable pallets – timber	0	0	0	0	2,127,592	2,127,592
Plastic crates – non-collapsible	61,361	0	0	0	0	61,361
Plastic crates – collapsible (RPCs)	46,596	0	928	0	0	47,524
Reusable shopping bags – LDPE	0	0	11,952	0	0	11,952
Reusable shopping bags – PP	0	0	68,552	0	0	68,552
Cups/mugs	27,420	0	8,154	0	0	35,574
Total reusable packaging	183,562	214,018	101,000	55,880	2,377,407	2,931,868

2.4.3 CDS, reuse and MRF sorting losses

Estimated sorting losses from CDS, reuse and MRF systems in 2019-20 are summarised in Table 15 and Figure 9. Wood packaging is not included in the figure or the table, as outflows of wood packaging are not associated with sorting processes, consistent with the primary data.[21] Sorting system losses by packaging material are listed in Table 47 of the Appendix.

Compared to collection losses, the losses during sorting are relatively low, at approximately 75,800 tonnes compared to approximately 2.4 million tonnes lost to landfill at collection. Sorting losses by source are generally in proportion to throughput of each sorting sub-system. Overall, MRF losses contribute the most to overall sorting losses at 71%, which is expected given that approximately 86% of sorting system throughput occurs via MRFs. The discrepancy between these proportions is owing to differences in average sorting efficiency for the CDS, reuse and MRF systems.

For the CDS system, glass packaging accounted for 81% of losses, reflecting both the large volumes of glass packaging collected via CDS, and the higher likelihood of breakages for glass packaging. For paper packaging, 99.8% of losses occur at the MRF, with kerbside collections (and thus MRF sorting) the primary pathway for collection. For plastic, 35% of losses occurred at the MRF and 63% occurring in the reuse system due to disposal of reusable LDPE and PP shopping bags. Of plastic losses occurring at MRFs, flexible polymers incorrectly disposed made up 20% of these losses.

[21] APCO (2021), Australian packaging consumption & recovery data 2019-20

Table 15. Summary of CDS, reuse and MRF system losses for 2019-20

Material category	CDS system losses [tonnes]	Reuse system losses [tonnes]	MRF sorting losses [tonnes]	Total sorting system losses [tonnes]
Paper packaging	32	0	9,735	9,767
Glass packaging	4,217	96	33,706	38,020
Plastic packaging	480	16,209	9,113	25,802
Metal packaging	459	159	1,586	2,204
Total packaging	**5,188**	**16,464**	**54,140**	**75,792**

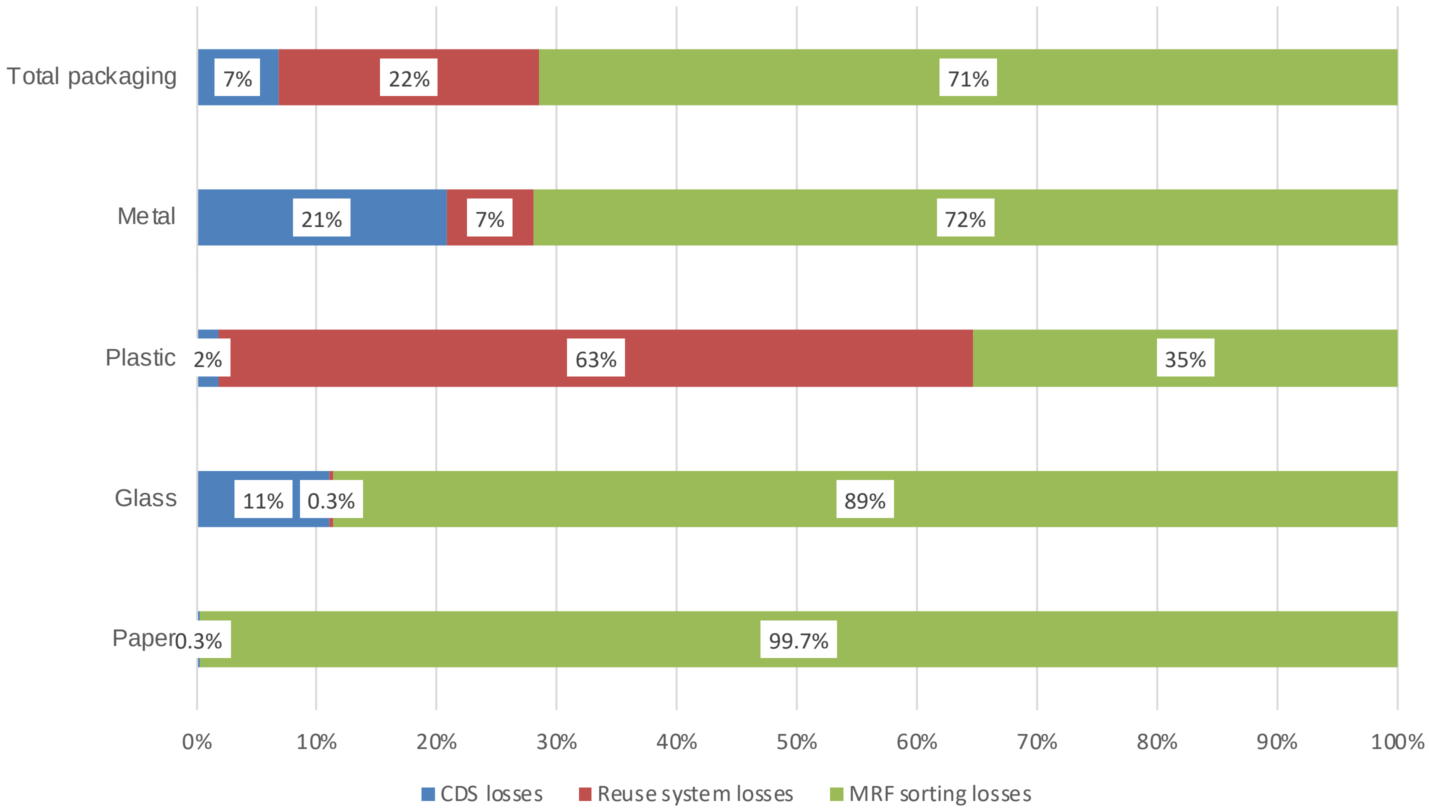

Figure 9. Summary of sorting system losses and source for 2019-20

Table 16 summarises estimated sorting system throughputs and efficiencies for each sorting pathway. The CDS system had the highest average sorting efficiency at 98.0%, followed by MRF sorting at 97.9%, with the reuse system having poorest sorting efficiency at 89.4%, owing to large quantities of reusable shopping bags (LDPE and PP) destined for landfill from the reuse system.

Table 16. Summary of CDS, reuse and MRF system sorting efficiencies 2019-20

	CDS system	Reuse system	MRF system
Estimated throughput	259,398	156,011	2,611,931
Estimated sorting losses	5,188	16,464	54,140
Estimated sorting efficiency	98.0%	89.4%	97.9%

2.5 Local reprocessing system material flows

Figure 10 shows estimated material flows entering the local reprocessing system. Approximately 2.7 million tonnes of used packaging entered local reprocessors in 2019-20, with paper making up the majority of this system (59%). Local utilisation of recovered material from reprocessors was the dominant recovery pathway, with approximately 79% of reprocessor outputs destined for local utilisation (both packaging and industrial applications). Overall reprocessing losses were approximately 220,300 tonnes, contributing to an overall reprocessor recovery rate of 92%. Paper packaging had the highest reprocessor efficiency, with 95% of material entering reprocessing recovered. Of the paper material types, PCPB had the poorest reprocessing efficiency, with only 37% of material entering reprocessing facilities recovered. Overall plastic reprocessing efficiency was approximately 92%, with rigid PET and rigid HDPE having the highest efficiency amongst the plastic materials (93% and 94% respectively). Rigid PS/EPS and flexible plastics had the poorest reprocessor efficiencies at 84%. Flexible plastic materials had an average reprocessor efficiency of approximately 90%.

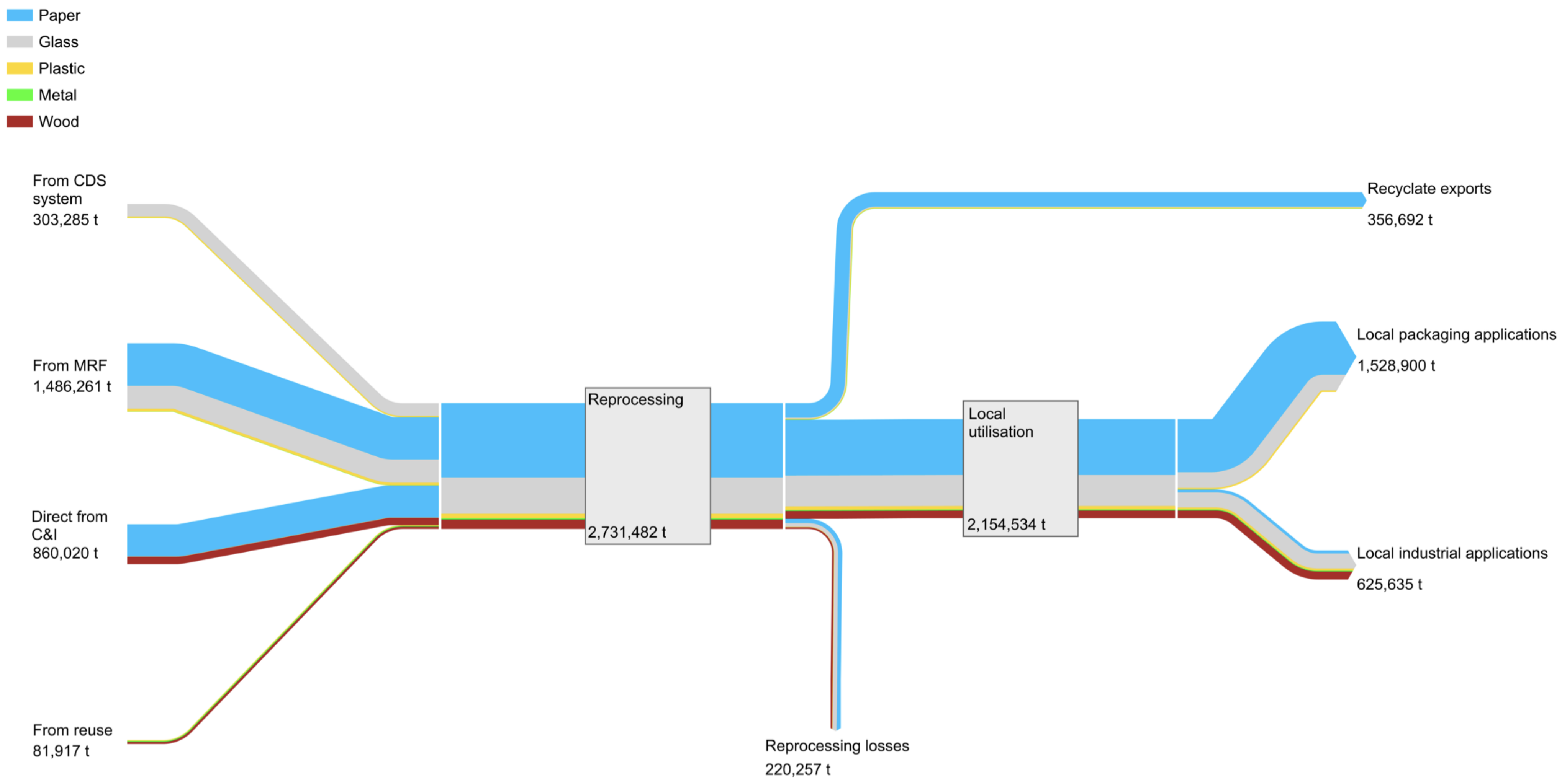

Figure 10. Estimated local reprocessor material flows, 2019-20

Table 17 and Figure 11 summarise throughputs to local reprocessors by source for each packaging category. Table 48 in the Appendix summarises reprocessor throughput by packaging material types. An estimated 54% of all reprocessor packaging throughput was sourced from MRFs. Other than wood packaging, which was not sorted at MRFs, metal packaging had the smallest proportion of input derived from MRFs (17%), with the majority of metal packaging entering local reprocessing from the reuse system (primarily steel). For aluminium packaging however, approximately 52% of reprocessor input was derived from MRFs, although quantities are small (approximately 1,100 tonnes), owing to exports at the CDS/MRF being the primary recovery pathway for metal packaging. Inputs from CDS was highest for glass and plastic packaging, at 35% and 25% of total reprocessor throughput respectively. All paper packaging collected via CDS was destined for overseas recovery. Reprocessor inputs direct from collection were significant for wood and paper at, 77% and 43% of reprocessor throughput respectively.

Table 17. Summary of reprocessor throughputs by source

Material category	Direct from C&I collection [tonnes]	From CDS system [tonnes]	From reuse system [tonnes]	From MRF [tonnes]	Total reprocessor throughput [tonnes]
Paper packaging	692,864	0	0	920,058	1,612,922
Glass packaging	6,412	277,153	0	504,306	787,871
Plastic packaging	2,650	25,077	16,668	57,865	102,261
Metal packaging	0	1,055	18,006	4,032	23,093
Wood packaging	158,094	0	47,242	0	205,336
Total packaging	**860,020**	**303,285**	**81,917**	**1,486,261**	**2,731,482**

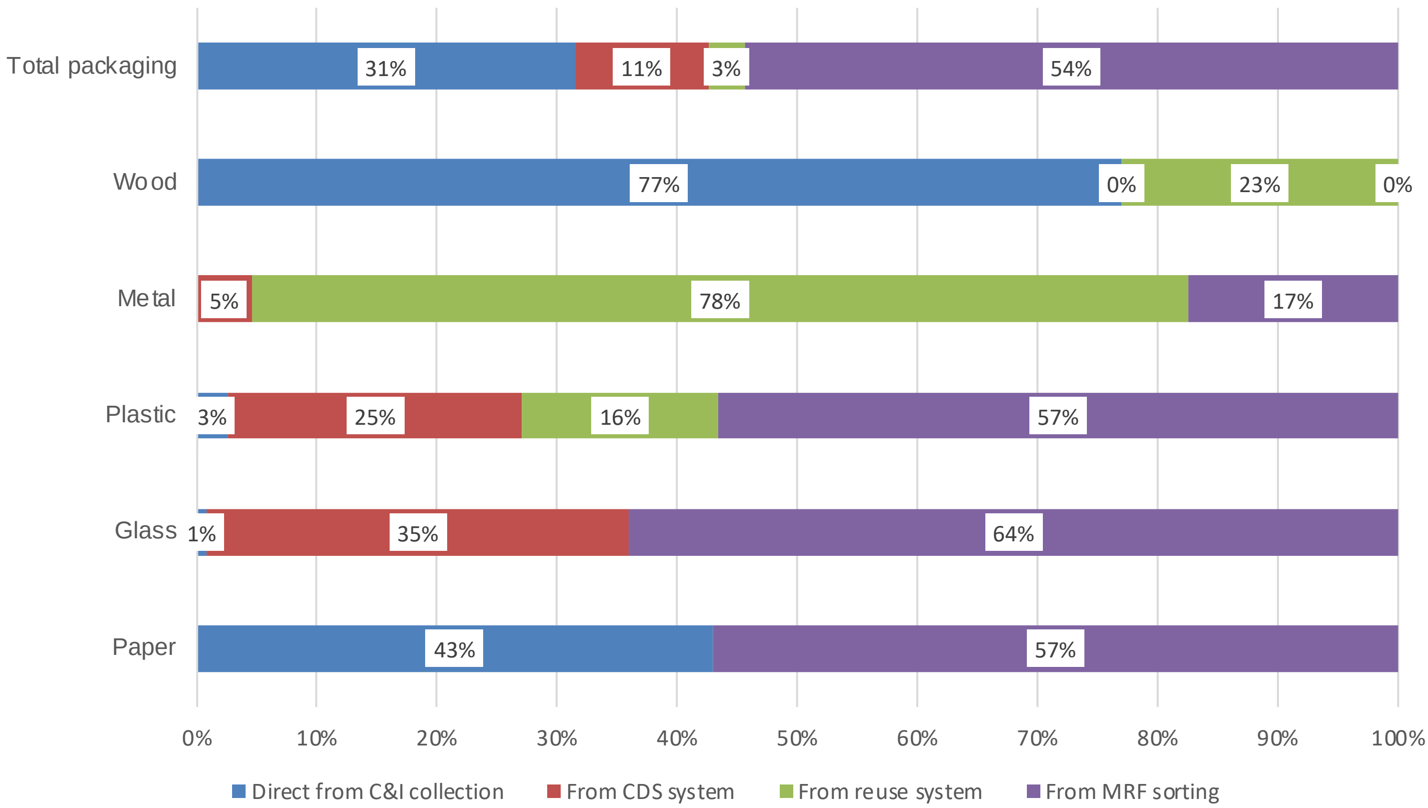

Figure 11. Breakdown of source of local reprocessor throughput by material category

2.6 Summary of total packaging recovery and disposal material flows

2.6.1 Packaging recovery

Table 18 and Figure 12 summarise total estimated packaging recovery by recovery pathway for 2019-20. Local packaging-to-packaging (i.e., local packaging applications) recovery accounted for approximately 45% of total packaging recovered, and was the primary recovery pathway for paper and glass packaging, at 52% and 49% of recovery respectively. Local packaging-to-packaging recovery accounted for 17% of total plastic packaging recovered. Packaging-to-packaging recovery was highest for rigid PET amongst the plastic packaging materials, with 30% of total recovered PET being utilised in new packaging applications. For rigid HPDE, only 11% of recovered materials were processed back into packaging. For flexible packaging types, local packaging-to-packaging accounted for 15% of total recovered volumes, with approximately 3,000 tonnes of flexible HDPE, LDPE and PP recovered locally for packaging.

Baled exports from CDS and MRFs accounted for 26% of packaging recovery, highest for metal and plastic packaging materials. Baled exports accounted for 84% of metal recovery with a high overseas demand for recyclable metal materials. With waste export bans coming into effect, approximately 782,300 tonnes of exported paper and plastic material will potentially become stranded, requiring further local reprocessing to be suitable for export. The implications of waste export bans are examined through scenario analysis in Section 4.

Local utilisation for industrial applications (i.e., non-packaging applications) accounted for 18% of total packaging recovered. Established markets for timber mulch and the difficulties in utilising recycled timber in new packaging (e.g., for pallets) resulted in 100% of recovered wood packaging being utilised via this pathway. For glass packaging, local industrial use accounted for 47% of recovery.

Table 18. Summary of packaging recovery by recovery pathway for 2019-20

Material category	Baled exports (CDS and MRF) [tonnes]	Recyclate export [tonnes]	Local industrial applications (incl. WtE) [tonnes]	Local packaging applications [tonnes]	Total packaging recovered [tonnes]
Paper packaging	704,237	311,590	60,037	1,152,660	2,228,525
Glass packaging	0	23,051	331,026	345,087	699,164
Plastic packaging	78,065	17,671	51,706	31,152	178,595
Metal packaging	116,601	4,379	18,385	0	139,365
Wood packaging	0	0	170,574	0	170,574
Total packaging	**898,903**	**356,692**	**631,729**	**1,528,900**	**3,416,223**

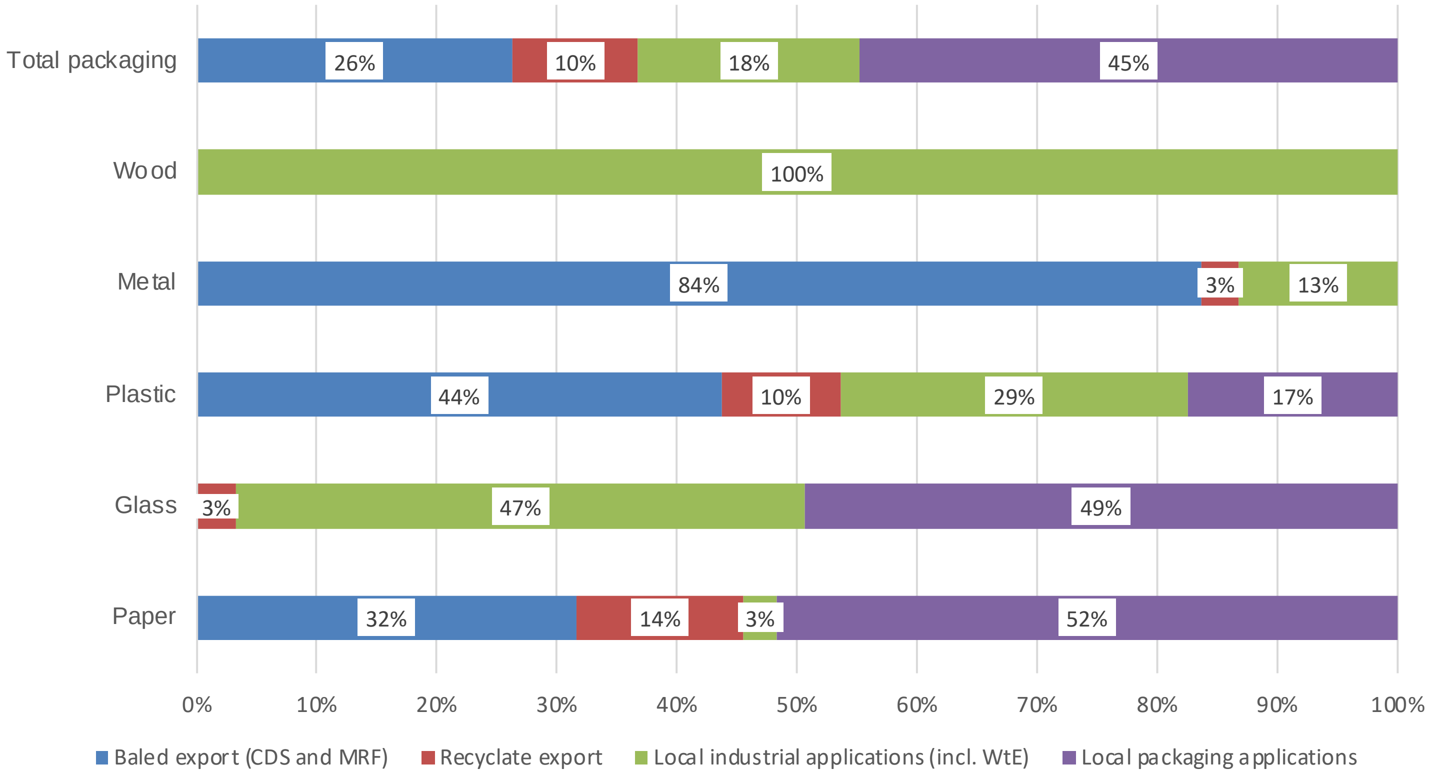

Figure 12. Breakdown of packaging recovery by material and recovery pathway for 2019-20

2.6.2 Packaging disposal

The breakdown of packaging losses to landfill across the whole recovery chain by packaging category is shown in Table 19 and Figure 13. A breakdown of losses by packaging material type is found in Table 50 in the Appendix. Total packaging loss to landfill for 2019-20 was approximately 2.7 million tonnes, or approximately 43% of all packaging PoM. Losses at collection are significant across all packaging categories, representing the main source of packaging material losses to landfill in 2019-20. Compared to other packaging material categories, glass sees more significant losses during sorting and reprocessing, such that the share of collection losses is low compared to other categories. Plastic packaging had the highest proportion of losses occurring at collection, associated with soft plastics and difficult-to-recycle plastics (e.g., PVC, PS/EPS) that made up approximately 60% of all plastic packaging PoM in 2019-20.

Following collection, material loss from sorting are relatively small at approximately 5% of packaging PoM. Sorting losses were most significant for the glass packaging and paper packaging categories. Assumed sorting efficiency for glass is lower than other materials as glass is prone to breakages during handling and MRF sorting. In the case of paper, mixed paper and PCPB entering the MRF have lower assumed sorting efficiency than OCC and paperboard, based on assumptions from the literature.[22]

[22] Pressley et al. (2015)

Table 19. Summary of estimated packaging losses over the packaging recovery chain

Material category	Collection losses [tonnes]	Sorting losses [tonnes]	Reprocessing losses [tonnes]
Paper packaging	908,480	9,767	88,634
Glass packaging	264,238	38,020	88,706
Plastic packaging	901,193	25,802	7,825
Metal packaging	101,043	2,204	329
Wood packaging	204,099	0	34,762
Total packaging	**2,379,053**	**75,792**	**220,257**

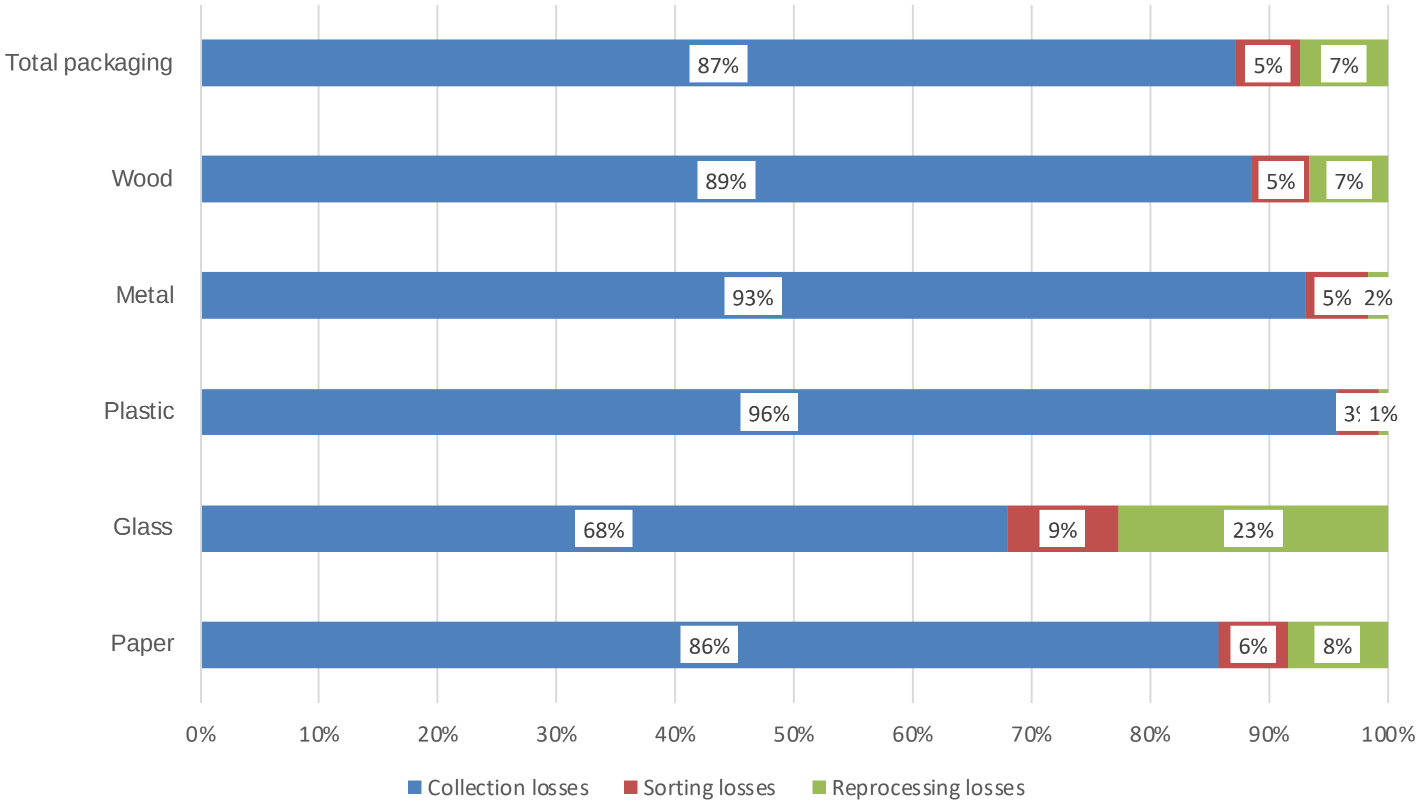

Figure 13. Breakdown of packaging losses over the packaging recovery chain

3 Analysis of data uncertainty and impact on findings

Table 11 summarises results for the uncertainty analysis, highlighting the impact that modelling uncertainty may have on reported performance indicators. Note that uncertainty ranges in Table 11 are expressed on a %-point difference basis. Uncertainty was generally highest relative to the calculated performance indicators for plastic and metal packaging. In the case of plastic packaging, variance on primary packaging PoM data[23] was highest amongst the packaging materials at approximately 20%, which has a significant impact on variance on downstream flows. In the case of metals, variance was high on primary packaging recovery data[24], at 17%. In terms of calculated material flows, uncertainty was highest for flows associated with C&I and MSW kerbside collection where data is limited; direct C&I flows to reprocessors and stockpiling, where data is also limited; and CDS and MRF losses, where proxy data[25] was utilised to characterise losses. Future work could address uncertainty around these flows through expanded collection and analysis of up-to-date proxy data (e.g., Australian state and territory government waste management reports, international academic papers); or expanded collection of primary data, e.g., on MRF operations. Reducing this uncertainty will improve the characterisation of the Australian packaging system, and is important for informing more targeted system interventions for improving recovery by material category.

Table 20. Summary of uncertainty ranges on calculated system performance indicators (N.B.: uncertainty ranges are presented as %-point differences to the estimated performance metric value)

Packaging category	Collection efficiency [%-PoM basis]	Sorting efficiency [%-PoM basis]	Recovery rate [%-PoM basis]	Local utilisation [%-PoM basis]	Packaging circularity rate [%-PoM basis]
Paper	73%±3%	72%±3%	68%±3%	37%±1%	37%±1%
Glass	77%±5%	74%±6%	60%±6%	58%±6%	30%±3%
Plastic	20%±4%	17%±3%	16%±2%	5%±2%	2%±1%
Metal	58%±6%	57%±6%	56%±7%	7%±4%	0%±0%
Wood	55%±3%	55%±7%	37%±4%	37%±4%	0%±0%
Total packaging	**62%±4%**	**61%±4%**	**55%±3%**	**34%±2%**	**25%±1%**

23 APCO (2021), Australian packaging consumption & recovery data 2019-20

24 APCO (2021)

25 Pressley, P.N.; Levis, J.W.; Damgaard, A.; Barlaz, M.A.; DeCarolis, J.F. (2015). Analysis of material recovery facilities for use in life-cycle assessment. *Waste Management* 35, pp. 307-317

4 Scenario analysis

This section presents results for the scenario analysis performed for 2024-25 to evaluate possible changes required to achieve the 2025 National Packaging Targets. Note that scenarios analysed are not intended to represent an exhaustive set of technical and policy interventions. Some of the changes considered are expected to be implemented by 2024-25 and these are reflected in the BAU scenario. In total we analysed 5 scenarios for 2024-25:

- Scenario 1: Business-as-usual (BAU), 2024-25
- Scenario 2: CDS expanded to include all glass packaging
- Scenario 3: Increased collection and recovery rigid plastic packaging
- Scenario 4: Increased separate collection and recovery of flexible plastic packaging
- Scenario 5: Meeting the 70% plastics recovery target.

Figure 14 gives an overview of the scenarios, scope of evaluation (by material category), and key assumptions.Table 6 in Section 1.7 provides a detailed description of all assumptions defining the scenarios.

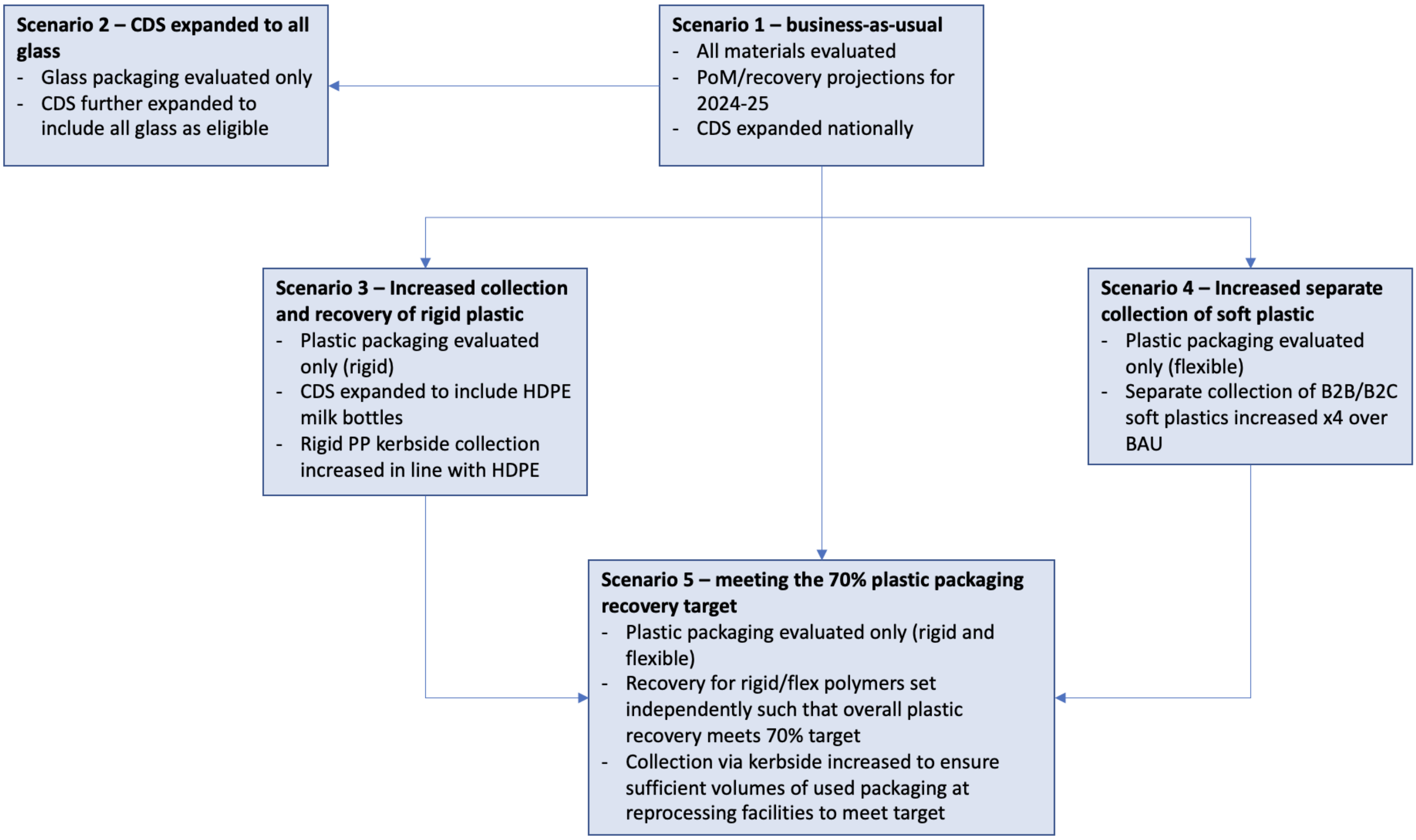

Figure 14. Overview of the 2024-25 scenario analysis performed

Section 4.1 summarises projected changes in packaging PoM in 2024-25 that impact all scenarios analysed. Section 4.2 presents the results for each scenario owing to the assumed system changes, compared with BAU performance (Scenario 1). Section 4.3 discusses the performance of each scenario against the 2025 National Packaging Targets (2025 Targets), the contribution of local packaging grade recovery to meeting recycled content targets, estimated reprocessing capacity gaps, and possible impacts of increased reuse on packaging PoM. Conclusions from the scenario analysis are presented in Section 5.

4.1 Projected packaging placed on the market, 2024-25

Table 21 summarises projected packaging PoM by major packaging categories for 2024-25 and provides a comparison with 2019-20 PoM.[26] It is projected that approximately 6.9 million tonnes of packaging will be placed on the market in 2024-25. Given known system changes, the represents a net increase of approximately 11% from 2019-20. Compared to 2019-20, paper packaging PoM is projected to increase by 16% by 2024-25, the largest projected increase of all packaging categories. Of the paper packaging materials considered, corrugated cardboard is projected to see an increase of approximately 400,000 tonnes (or 16%) by 2024-25.

Table 21. Estimated packaging placed on the market in 2024-25 (business-as-usual), compared to 2019-20

Packaging category	Packaging placed on the market in 2019-20 [tonnes]	Estimated packaging placed on the market in 2024-25 (Scenario 1) [tonnes]	(% change to 2019-20 PoM)
Paper	3,277,267	3,811,455	16%
Glass	1,155,801	1,241,715	7%
Plastic	1,123,850	1,108,916	-1%
Metal	247,845	267,348	8%
Wood	461,651	505,729	10%
Total packaging	**6,266,414**	**6,935,163**	**11%**

Plastic packaging is projected to decrease by 1%, a decrease of approximately 20,000 tonnes (Table 21). This is partly owing to the expected phase out of problematic materials, with PS/EPS consumption projected to fall by approximately 50%, or around 20,000 tonnes. Changes in rigid and flexible polymer packaging PoM compared to 2019-20 are shown in Table 22 and Figure 15. Flexible HDPE PoM is also projected to decrease significantly, owing to the phase out of lightweight HDPE shopping bags. Rigid and flexible PET and LDPE PoM are expected to increase by 11% and 10% respectively, a total increase of approximately 43,900 tonnes[27], likely owing to shifts towards packaging made from more recyclable polymers. Overall, other polymer packaging (including PIC 7 polymers and unidentified polymers) saw the largest increase in packaging placed on the market, with a 13% increase over 2019-20 PoM. This increase is mainly owing to increases in bioplastic-compostable packaging (PIC 7) PoM, increasing from 8,500 tonnes in 2019-20 to 13,800 tonnes in 2024-25, an increase of 61%.

Table 22: Summary of projected rigid and flexible polymer packaging PoM in 2024-25. Figure *15* compares 2024-25 estimated PoM with 2019-20 PoM for flexible and rigid packaging

Plastic packaging materials	Rigid packaging PoM, 2024-25 [tonnes]	Flexible packaging PoM, 2024-25 [tonnes]	Total plastic packaging PoM, 2024-25 [tonnes]
PET	142,332	38,570	180,901
HDPE	206,237	35,469	241,706
PVC	4,131	11,538	15,669
LDPE	11,376	290,533	301,910
PP	128,031	67,473	195,504
PS/E-PS	20,444	0	20,444
Other polymers	57,281	95,501	152,782
Total plastic packaging	**569,831**	**539,084**	**1,108,916**

26 Based on APCO (2021), p. 93

27 APCO (2021), Australian packaging consumption & recovery data 2019-20

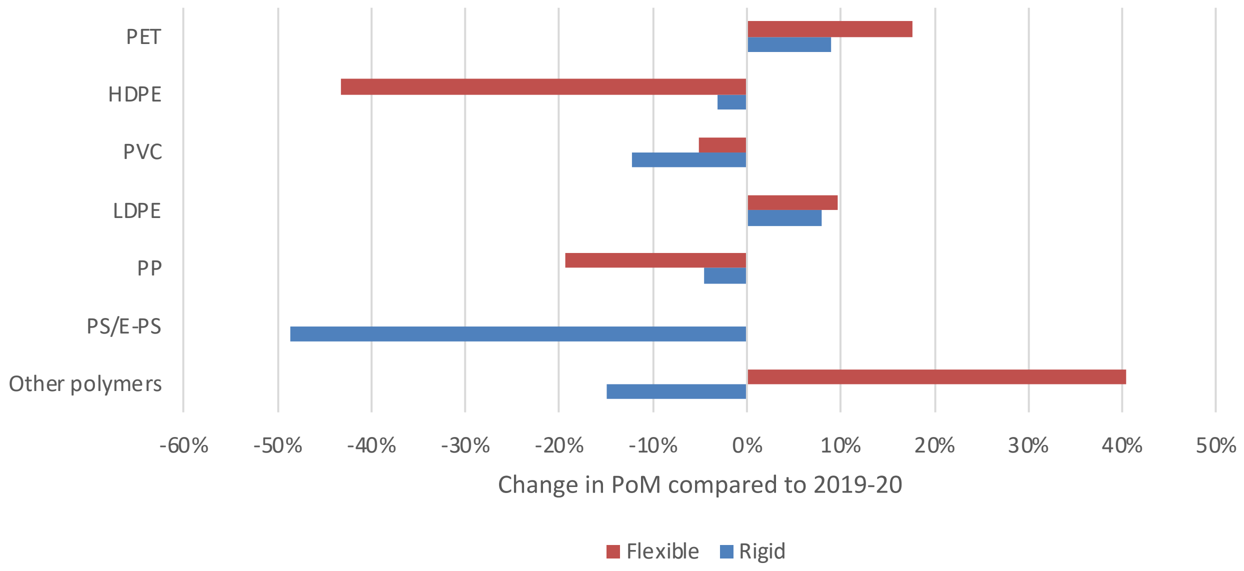

Figure 15. Summary of changes in rigid and flexible polymer packaging PoM between 2019-20 and 2024-25

4.2 Scenario analysis results

4.2.1 Scenario 1: Business-as-usual (BAU), 2024-25

Figure 16 summarises packaging collection via collection pathway for 2024-25 BAU (Scenario 1). Considering all packaging, the majority of collection is from C&I, owing to the very high C&I collections for paper and wood packaging via this stream. The most significant change in collection pathways between 2019-20 and 2024-25 is due to the expansion of CDS collection systems nationally, which results in an increase of the share of total packaging collected via this pathway from 4% of total packaging in 2019-20 to 6% by 2024-25. Glass packaging is projected to experience the greatest change in CDS collection, from 18% of PoM in 2019-20 to 30% in 2024-25, as a result of CDS expansion. The CDS share of collection for plastic and metal packaging are both projected to increase by approximately 1% point. New reusable packaging PoM is assumed to make up the same proportion of total packaging PoM as 2019-20. Reuse and single-use avoidance in 2024-25 are further discussed in Section 4.3.

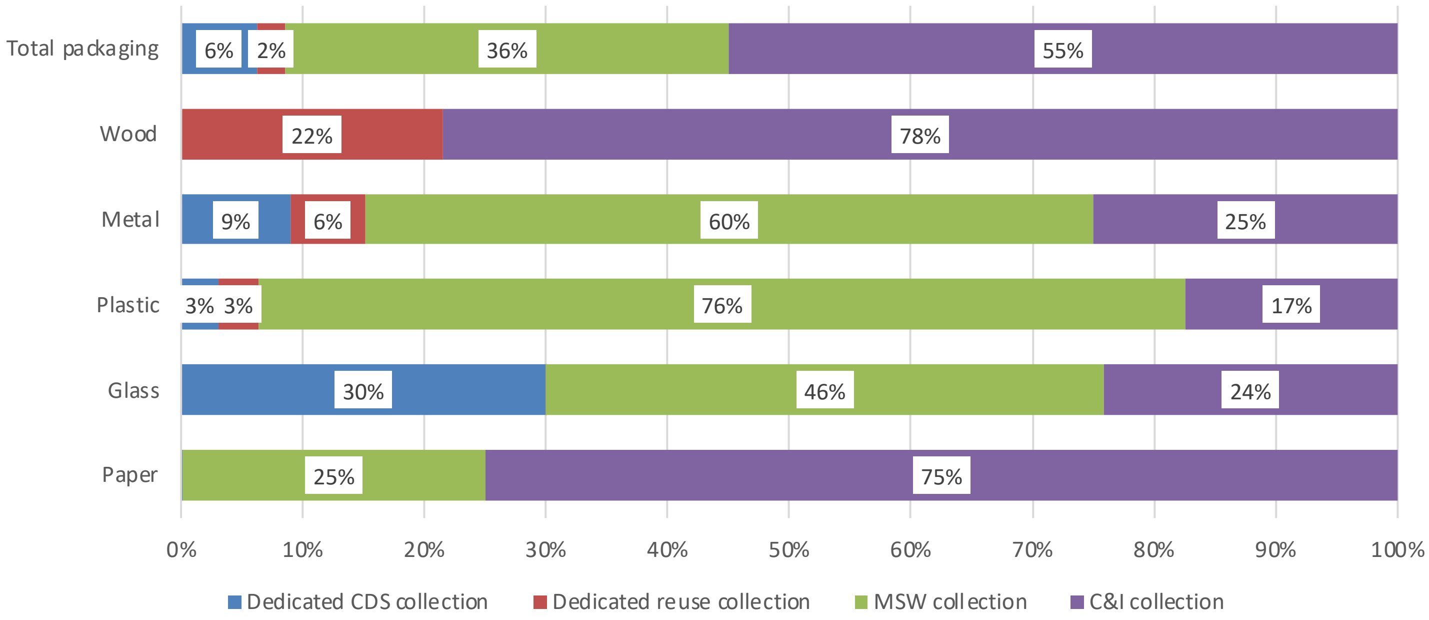

Figure 16. Summary of packaging collection via collection pathway for Scenario 1

The assumed collection pathway for rigid and flexible plastic packaging for 2024-25 BAU is shown in Table 23. This is relevant for the evaluation of possible changes to the plastic packaging recovery system discussed below (Scenarios 3 to 5). MSW collection is the dominant collection pathway for both rigid and flexible plastic, consistent with the current (2019-20) system.

Table 23. Collection by collection pathway for rigid and flexible polymer packaging (Scenario 1)

Plastic packaging material	Dedicated reuse collection		Dedicated CDS collection/separate collections		MSW collection		C&I collection	
	Rigid [% PoM]	Flex [% PoM]	Rigid [% PoM]	Flex [% PoM]	Rigid [% PoM]	Flex [% PoM]	Rigid [% PoM]	Flex [% PoM]
PET	0%	0%	23%	0%	70%	92%	8%	8%
HDPE	6%	0%	1%	0.2%	87%	87%	6%	12%
PVC	0%	0%	0%	0%	71%	71%	29%	29%
LDPE	1%	6%	0%	0.4%	73%	73%	26%	21%
PP	1%	9%	0%	3.3%	71%	66%	28%	22%
PS/E-PS	0%	NA	0%	NA	55%	NA	45%	NA
Other	0%	0%	0%	0%	74%	80%	26%	20%
Total	**2%**	**4%**	**6%**	**1%**	**76%**	**76%**	**16%**	**19%**

Figure 17 summarises packaging performance indicators for 2024-25 BAU for all packaging categories. The recovery rate for all packaging is projected to increase from 55% in 2019-20 to 56% by 2024-25, with approximately 3.9 million tonnes recovered.

Overall collection efficiency is projected to be approximately 64% of total PoM in 2024-25, an increase of approximately 2% above the 2019-20 performance. This is due to increased collection via CDS systems and a reduction in hard-to-recycle packaging formats that are currently being phased out (e.g., PVC). Downstream recovery, local utilisation and packaging circularity rates are also expected to increase. The local utilisation rate showed the biggest improvement, increasing from 34% of PoM in 2019-20 to 53% in 2024-25. This is the direct impact of the export restrictions and increases in local processing capacity of packaging in 2024-25 consistent with proposed expansions. It was assumed that reprocessing capacity for packaging grade recovery relative to industrial grade recovery in 2024-25 is maintained at the same proportions as 2019-20. Quantities that may have been exported overseas as recyclate for industrial grade applications before the export restrictions are assumed to be utilised locally for non-packaging purposes.

Significant improvements in collection and recovery performance are expected for plastic and glass packaging by 2024-25 under the BAU assumptions. Plastic collection efficiency is expected to increase from 20% in 2019-20 to 43% in 2024-25 in-line with expansion of CDS collection systems nationally, as well as the expected improvements in kerbside collection that are required to meet the projected increases in downstream reprocessing capacity. Glass packaging collection efficiency is projected to increases from 77% of PoM in 2019-20 to 89% in 2024-25. Similar to plastics, this increase is expected due to expanded CDS collection and projected increases in glass reprocessing capacity. Metal and paper packaging, however, is expected to experience a drop in collection and recovery performance, with collection rates declining from 57% and 72%, respectively in 2019-20, to 55% and 63% in 2024-25. This is attributed to significant projected increases in quantities of packaging PoM for these packaging types, without the associated proportional increases in projected recovery capacity[28].

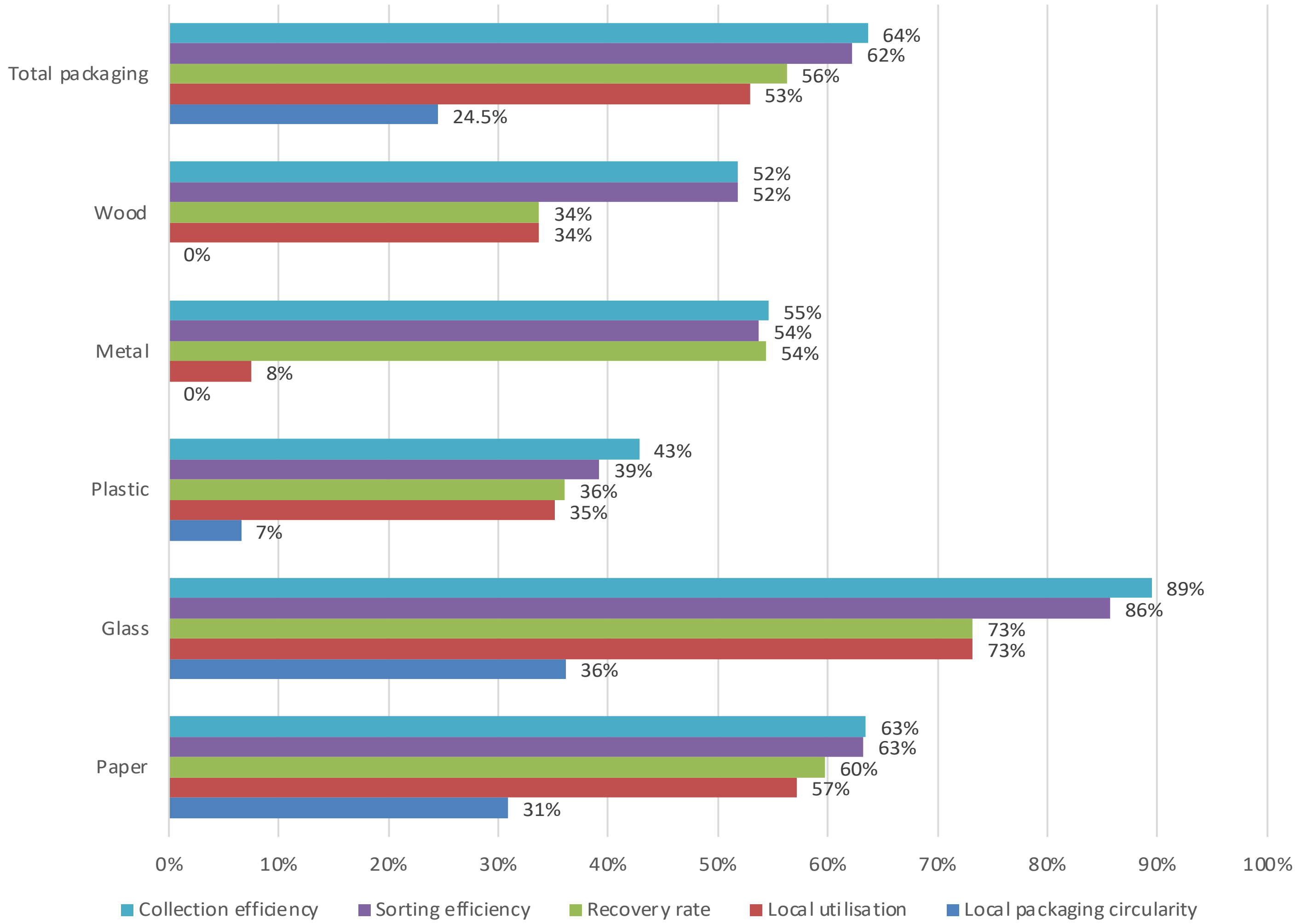

Figure 17. Summary of packaging performance indicators for Scenario 1

Total plastic recovery is projected to increase from 16% in 2019-20 to 36% in 2024-25. Rigid and flexible polymer packaging performance indicators are summarised in Table 24. Collection efficiency is projected to be 65% for rigid plastics and 19% for flexible plastics by 2024-25, an increase of 36%-points and 10%-points respectively over 2019-20 levels. These increases are owing to expansions in CDS collection for rigid packaging, as well as expected improvements in kerbside collection in line with the projected

28 APCO (2021), Australian packaging consumption & recovery data 2019-20, p. 97

increases in recovery capacity. Rigid and flexible packaging recovery rates are projected to be 58% and 13% respectively in 2024-25, an increase of 32%-points and 9%-points respectively over 2019-20 levels. Some polymer packaging types are projected to reach the 70% packaging recovery target, namely rigid PET. In the case of PVC (rigid and flexible) and rigid PS/EPS, the observed recovery rates are above 70%, which may be optimistically high given expected phase-outs of these materials placed on the market[29]. A comparison of plastic recovery against the 2025 targets will be discussed in more detail in Section 4.3.

Table 24. Summary of rigid and flexible plastic packaging performance indicators for Scenario 1

Plastic packaging material	Collection efficiency		Sorting efficiency		Recovery rate		Local utilisation		Packaging circularity rate	
	Rigid [% PoM]	Flex [% PoM]	Rigid [% PoM]	Flex [% PoM]	Rigid [% PoM]	Flex [% PoM]	Rigid [% PoM]	Flex [% PoM]	Rigid [% PoM]	Flex [% PoM]
PET	95%	0%	93%	0%	87%	0%	83%	0%	26%	0%
HDPE	67%	8%	66%	8%	62%	7%	62%	7%	7%	1%
PVC	89%	97%	80%	87%	77%	83%	55%	83%	0%	0%
LDPE	40%	26%	36%	18%	33%	17%	32%	17%	6%	3%
PP	41%	15%	37%	12%	33%	5%	33%	5%	6%	1%
PS/E-PS	96%	NA	87%	NA	74%	NA	74%	NA	6%	NA
Other	33%	4%	29%	3%	28%	3%	28%	0%	0%	0%
Total	**65%**	**19%**	**63%**	**14%**	**58%**	**13%**	**57%**	**12%**	**11%**	**2%**

Figure 18 gives a breakdown of packaging recovery for 2024-25 by recovery pathway. The share of baled exports (from CDS and MRF systems) drops from 26% of total packaging recovery in 2019-20 to 3% in 2024-25, owing to restrictions on waste exports. Diversion of stranded exports to local reprocessing leads to increased local utilisation for industrial applications from 18% in 2019-20 to 51% in 2024-25. Under this scenario, overseas baled exports are still a significant pathway for metals, accounting for 83% of metal packaging recovery in 2024-25. Overall, however, the share of exported recyclate is expected to decrease from 10% in 2019-20 to 3% in 2024-25, comprising metals and some packaging grade paper.

[29] For this scenario, projected 2024-25 recovery for PVC and PS/EPS were not changed from the primary data (APCO, 2021), however projected PoM was reduced to account for additional packaging phase-outs. As recovery rates are measured against PoM (i.e., recovery rate = recovered/ PoM), estimated recovery rates for these materials may be optimistic

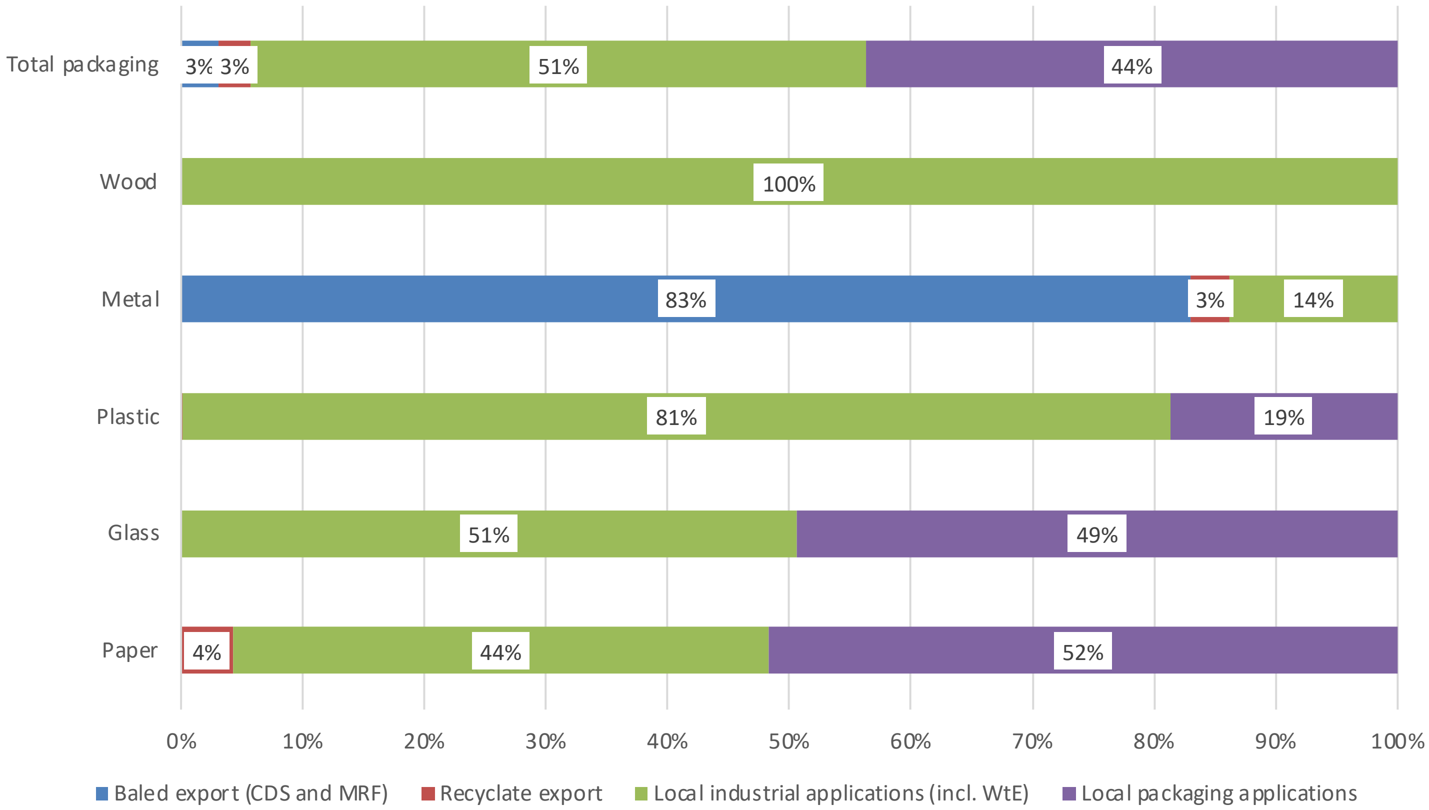

Figure 18. Breakdown of packaging recovery by pathway for Scenario 1

Table 25 shows the modelled local reprocessor throughput (i.e., packaging received 'in-the-gate' at reprocessing facilities) for 2024-25 under BAU assumptions. Compared to 2019-20, total reprocessor throughput is expected to increase by approximately 50% from 2.7 million tonnes in 2019-20 to 4 million tonnes in 2024-25. The largest increase is expected for plastic packaging, which is projected to increase by over 313% from 102,300 tonnes in 2019-20 to 422,200 tonnes in 2024-25. Local packaging-grade recovery (i.e., recyclate destined for packaging applications) for 2024-25 is expected to increase by 11% across all packaging categories compared to 2019-20, with local plastic packaging-grade recovery projected to increase by 134%. This is a result of scenario assumptions where stranded baled exports caused by export bans are recovered locally for packaging applications at a rate consistent with 2019-20 (see Table 6). A comparison of estimated reprocessor throughputs and packaging-grade recovery with projected reprocessor capacities, including for rigid and flexible polymers, is presented in Section 4.3.

Table 25. Estimated packaging in-the-gate at reprocessors and local packaging grade recovery for Scenario 1

Packaging category	Local reprocessor packaging in-the-gate, 2024-25 [tonnes]	Local reprocessor – packaging recovered as packaging grade, 2024-25 [tonnes]
Paper	2,410,188	1,274,430
Glass	1,023,992	448,508
Plastic	422,221	73,384
Metal	25,049	133
Wood	204,835	0
Total packaging	4,086,285	1,796,455

4.2.2 Scenario 2: CDS expanded to all glass

Table 26 gives an overview of projected CDS eligible glass packaging PoM in 2024-25 under BAU assumptions and assuming the expansion of CDS (Scenario 2). Under BAU assumptions for 2024-25, CDS is expected to expand to include all Australian state and territories. Under scenario 2, CDS is expected to expand to all Australian states and territories as well as include all glass materials. Total CDS-eligible glass packaging PoM in 2024-25 is expected to increase by 95%, from approximately 638,400 tonnes under BAU to approximately 1.2 million tonnes in Scenario 2. Flint (clear) glass is projected to see the largest increase in eligible PoM of approximately 171%. This is because the flint glass material includes the largest amount of currently ineligible packaging, i.e. wine and spirit bottles, as well as cordial syrup containers.[30] Amber and green glass are also projected to see an increase in eligible PoM of 52% and 40%, respectively. Currently ineligible packaging for these categories include beverage bottles 3L and above (amber), and wine bottles (green).

Table 26. Summary of CDS-eligible glass PoM in 2024-25 (BAU and Scenario 2)

Glass packaging materials	CDS eligible – 2024-25 BAU [tonnes]	CDS eligible – 2024-25 Scenario 2 [tonnes]	Difference [tonnes](%-change)
Amber glass	230,900	351,056	120,156 (52%)
Flint glass	245,283	664,028	418,745 (171%)
Green glass	162,208	226,631	64,423 (40%)
All glass packaging	**638,390**	**1,241,715**	**603,325 (95%)**

Table 27 summarises glass packaging collection via collection pathway for 2024-25 Scenario 2. The proportion of glass packaging collected via dedicated CDS collection channels is expected to increase from 30% for all glass packaging under BAU assumptions, to 68%. The largest expected increase is observed for flint glass, which increases from 22% collected via CDS in BAU to 71%.

For this scenario, it was assumed that levels of MRF redemption remains consistent with BAU (approximately 19% of CDS-eligible PoM), with all additional CDS redemption occurring via dedicated collection channels. Total CDS-eligible glass collected via dedicated collection was estimated to be approximately 848,300 tonnes, an increase approximately 128% over BAU levels.

Table 27. Collection by collection pathway for glass packaging material types for Scenario 2

Glass packaging material	Dedicated reuse collection [% PoM]	Dedicated CDS collection/separate collections [% PoM]	MSW collection [% PoM]	C&I collection [% PoM]
Amber glass	0%	65%	19%	16%
Flint glass	0.03%	71%	21%	8%
Green glass	0%	64%	21%	15%
All glass packaging	**0.01%**	**68%**	**20%**	**11%**

Table 28 summarises performance indicators for 2024-25 for Scenario 2 for glass packaging. Collection efficiency is expected to reach levels of 96% for overall glass packaging, an increase of around 7%-points over BAU levels. The recovery rate for glass packaging overall is expected to reach 79% in this scenario, an improvement of 6%-points above BAU. While CDS is a more efficient pathway compared to kerbside collection, losses are still expected via CDS at a rate of approximately 2%. As such, with the increased volumes of CDS eligible glass collected via CDS, losses attributed to CDS are expected to increase from approximately 10,000 tonnes for BAU to approximately 19,500 tonnes. With no exports of recovered glass

[30] EPA SA (2021). *Improving South Australia's Recycling Makes Cents – A discussion paper to review SA's container deposit scheme*, South Australia EPA

expected to occur, the local utilisation rate of recovered glass is equal to the recovery rate. The packaging circularity rate is expected to increase from 36% under BAU to 39%.

Considering the estimated recovery rates in Scenario 2, the expected reprocessor throughput for glass recovery is expected to increase from approximately 1 million tonnes under the BAU scenario to 1.1 million tonnes, an increase of approximately 86,700 tonnes. Given that estimated local glass reprocessor capacity is expected to increase by approximately 120,000 tonnes by 2024-25.[31] there is likely to be sufficient reprocessing capacity to manage increased glass packaging flows under Scenario 2 assumptions.

Table 28. Summary of performance indicators for glass packaging material types for Scenario 2. Total glass packaging performance indicators for BAU are also shown

Glass packaging material	Collection efficiency [% PoM]	Sorting efficiency [% PoM]	Recovery rate [% PoM]	Local utilisation [% PoM]	Packaging circularity rate [% PoM]
Amber glass	95%	92%	79%	79%	39%
Flint glass	96%	93%	80%	80%	40%
Green glass	96%	92%	78%	78%	38%
All glass packaging	96%	93%	79%	79%	39%
All glass packaging (BAU)	***89%***	***86%***	***73%***	***73%***	***36%***

4.2.3 Scenario 3: Increased collection and recovery of rigid plastic

Table 29 summarises rigid polymer packaging collection by pathway in 2024-25 under Scenario 3 assumptions. Note that the only polymer categories impacted by changes assumed for this scenario are shown in the table (i.e., for this scenario, rigid HDPE and PP, and overall rigid plastic packaging), with all other polymer categories consistent with BAU assumptions (see Table 23). For this scenario, there were no assumed changes for collection via reuse or C&I. CDS collection for rigid HDPE is projected to increase given assumed CDS system expansion to include all HDPE milk bottles, with the additional material for CDS collections diverted from the MSW collection stream. Collections of rigid HDPE packaging through CDS are expected to increase by 7%-points over the BAU scenario, with overall rigid plastic packaging collection via CDS increasing from 6% in BAU, to 9%. Rigid PP recovery was assumed to increase to the same level as for rigid HDPE, and the required increase in collection was distributed across MSW and C&I at a ratio consistent with BAU.

Table 29: Collection by collection pathway rigid polymer packaging for Scenario 3

(Rigid) Plastic packaging material	Dedicated reuse collection [% PoM]	Dedicated CDS collection/separate collections [% PoM]	MSW collection [% PoM]	C&I collection [% PoM]
HDPE (rigid)	6%	8%	80%	6%
PP (rigid)	1%	0%	71%	28%
Total (rigid)	**2%**	**9%**	**74%**	**15%**

Table 30 summarises estimated system performance indicators for the impacted polymer materials for Scenario 3 (see Table 24 for BAU performance of non-impacted polymers). Collection efficiency is projected to increase significantly above BAU levels for rigid HDPE and PP at 11%-points and 51%-points respectively. This increase in collection efficiency is expected to lead to an increase in downstream recovery rates over BAU, with rigid HDPE recovery increasing from 62% to 73%, and rigid PP recovery

31 APCO (2021), Australian packaging consumption & recovery data 2019-20

from 33% to 73%. Total rigid packaging recovery increases by approximately 13%-points over BAU recovery, and 32%-points over 2019-20 recovery. Comparison of recovery rates against packaging targets is discussed further in Section 4.3.

Table 30. Summary of performance indicators for rigid polymer packaging for Scenario 3

Plastic packaging material	Collection efficiency [% PoM]	Sorting efficiency [% PoM]	Recovery rate [% PoM]	Local utilisation [% PoM]	Packaging circularity rate [% PoM]
HDPE (rigid)	78%	77%	73%	72%	9%
PP (rigid)	91%	82%	73%	74%	14%
Total (rigid)	**81%**	**77%**	**71%**	**70%**	**13%**

4.2.4 Scenario 4: Increased separate collection of soft plastics

Table 31 shows collection via pathway for flexible plastics impacted by ramping-up soft plastics collection. For this scenario, separate collection of flexible HDPE, LDPE and PP (B2C), and direct-to-reprocessor flows of flexible LDPE (B2B) were assumed to ramp up by 400% over BAU levels. Under this scenario total collection of B2C flexible polymer packaging via the separate collection pathway (i.e., REDcycle-type collection) is approximately 13,400 tonnes. Flexible PP accounts for approximately 66% of this quantity, or 8,900 tonnes, with collection via separate collection increasing from around 3% in BAU to around 13% of PoM. Collection of B2B flexible LDPE via the C&I stream (direct to reprocessors) is expected to increase from approximately 2,900 tonnes under BAU assumptions to approximately 11,600 tonnes. While this scenario assumed a 400% ramp up of flexible packaging collection via separate B2C collection and direct B2B to reprocessor collections, kerbside collection is still the primary collection pathway, accounting for 93% of total collections for soft plastics.

Table 31. Collection by collection pathway for flexible polymer packaging for Scenario 4

Plastic packaging material	Dedicated reuse collection [% PoM]	Dedicated CDS collection/separate collections [% PoM]	MSW collection [% PoM]	C&I collection [% PoM]
HDPE (flexible)	0%	1%	87%	12%
LDPE (flexible)	6%	1%	68%	24%
PP (flexible)	9%	13%	56%	22%
Total (flexible)	**4%**	**3%**	**72%**	**21%**

Table 32 summarises system performance indicators for the impacted polymers for Scenario 4. Collection efficiency for overall flexible polymer packaging increased from 19% in BAU to 24%, a direct result of increases in separate collection and B2B soft plastic collections. This improvement in collection efficiency leads to a downstream recovery rate of 17% for flexible packaging, an increase in recovery of 4%-points over BAU.

Table 32. Summary of performance indicators flexible polymer packaging for Scenario 4

Plastic packaging material	Collection efficiency [% PoM]	Sorting efficiency [% PoM]	Recovery rate [% PoM]	Local utilisation [% PoM]	Packaging circularity rate [% PoM]
HDPE (flexible)	9%	9%	8%	8%	0%
LDPE (flexible)	31%	24%	22%	22%	0%
PP (flexible)	28%	25%	17%	17%	4%
Total (flexible)	**24%**	**19%**	**17%**	**16%**	**3%**

4.2.5 Scenario 5: Meeting the 70% plastic packaging recovery target

Scenario 5 combines assumptions from Scenarios 3 and 4 and assumes a further increase in rigid and soft plastic collection and recovery necessary to meet the 70% plastic recovery target for plastic packaging. Performance indicators for this combined scenario are summarised in Table 33. To meet the 70% target, collection efficiency needs to increase significantly for rigid and flexible packaging compared to 2019-20—from 30% and 8% to 82% and 88%, respectively. Compared to BAU collection efficiency (see Table 24), Scenario 5 sees an increase for flexible packaging of 70%-points compared to 16%-points for rigid. Note, in this scenario, it is assumed that proportions recovered for packaging vs industrial applications and local reprocessing vs export are consistent with BAU. Given the low rate of recovery for packaging-to-packaging applications, the majority of flexible packaging is assumed to be utilised locally for industrial applications, with the exception of some packaging-grade recyclate export of flexible HDPE and PP.

Table 33. Summary of performance indicators for rigid and flexible polymer packaging for Scenario 5

Plastic packaging material	Collection efficiency		Sorting efficiency		Recovery rate		Local utilisation		Packaging circularity rate	
	Rigid [% PoM]	Flex [% PoM]	Rigid [% PoM]	Flex [% PoM]	Rigid [% PoM]	Flex [% PoM]	Rigid [% PoM]	Flex [% PoM]	Rigid [% PoM]	Flex [% PoM]
PET	95%	84%	93%	76%	87%	70%	83%	70%	26%	0%
HDPE	81%	83%	79%	75%	75%	70%	75%	70%	9%	8%
PVC	89%	97%	80%	87%	77%	83%	55%	83%	0%	0%
LDPE	40%	90%	36%	77%	33%	70%	32%	70%	6%	14%
PP	92%	92%	83%	83%	75%	70%	75%	70%	14%	13%
PS/E-PS	96%	NA	87%	NA	74%	NA	74%	NA	6%	NA
Other	33%	84%	29%	76%	28%	67%	28%	67%	0%	0%
Total	**82%**	**88%**	**78%**	**77%**	**71%**	**70%**	**71%**	**70%**	**13%**	**10%**

4.3 Discussion

4.3.1 Meeting the plastic packaging recovery targets

Figure 19 summarises overall plastic recovery rates (rigid, flexible and total plastic packaging) for comparison against the 2025 Target of 70% of plastic packaging recovered. As indicated in Section 4.2, it is not projected that total plastic packaging will meet the recovery target by 2024-25 under BAU assumptions. Collection efficiency is poor for plastic packaging and as such, the low collection rate limits the achievable downstream recovery rate. The BAU collection efficiency is 65% for rigid plastic packaging, and 19% for flexible plastic packaging (43% overall).

Under Scenario 3 assumptions, with expanded CDS collection of rigid HDPE milk bottles, and increased rigid PP collection to align with HDPE recovery, the 70% target is reached for rigid plastic packaging, with a modelled recovery rate of 71%. This recovery rate is achieved assuming an average collection efficiency of 81% for all rigid polymers. Moreover, this scenario achieves high levels of recovery across all rigid polymers, with the exception of rigid LDPE, and 'other' polymers (i.e., plastics identification code 7), which both have poor rates of upstream collection (40% and 33%, respectively). In this scenario, the soft plastic recovery system does not change and so despite the increase in the recovery rate for rigid packaging in line with the target, the overall plastic recovery rate only reaches 43%. This highlights the importance of focussing on soft plastic packaging to support achievement of the overall plastics target, as soft plastics make up approximately 49% of total plastic packaging PoM.

Scenario 4 specifically targets separate collections of soft plastics. This is achieved by ramping up separate collection of municipal soft plastics (B2C–away from home), and B2B soft plastic collections by 400%. However, these interventions only lead to an increase in soft plastics recovery of approximately 4%-points over BAU soft plastics recovery, and an increase in overall plastics recovery from 36% in BAU to 38%. This highlights the extent to which separate collection of soft plastics and B2B collection would need to increase to support overall recovery and achieve the overall 70% recovery rate target.

The final scenario modelled (Scenario 5), combining collection and recovery system assumptions from Scenarios 3 and 4, ensures the 70% plastic packaging recovery target is achieved, supported by further increases in soft plastics collection and recovery. In the case of rigid packaging, the target is achieved under assumptions for Scenario 3 with the exception of LDPE (recovery rate of 33%) and 'other' polymers (28%). While recovery rates for these two exceptions are considerably lower than the target of 70%, their share of total rigid packaging PoM is low at approximately 5% in total. In the case of flexible packaging, assumptions assured that the 70% target would be reached for all flexible polymer packaging PoM, supported by additional kerbside collection. Soft plastic collections via separate collection for B2C and B2B were fixed in line with Scenario 4. Flexible PVC was already projected to achieve recovery rates of 83% under BAU, however for the other flexible polymers, recovery rates were 17% (flexible LDPE) and below under BAU assumptions. The recovery rate target might alternatively be met by focusing on specific flexible polymer types, for example flexible LDPE, HDPE and PP account for 73% of all flexible plastic packaging. By this pathway, an estimated recovery rate of approximately 83% for these targeted polymers would be required.

To achieve the 70% recovery rate target for rigid plastics, a collection efficiency of 82% is required—an increase of 17%-points over BAU. For soft plastics, an estimated collection efficiency of 88% is required, which represents a significant increase compared to BAU collection efficiency of 19%. Thus, to achieve the 2025 packaging recovery target for plastics, a higher collection efficiency for flexible plastic is needed compared to rigid assuming current sorting (MRF) and recovery efficiencies that are lower for flexibles (for simplification we have not assumed changes in sorting or recovery efficiencies). In other words, more flexible plastic needs to be collected compared to rigid plastic to achieve the same recovery rate. The flexible plastic collection efficiency under Scenario 4 assumptions is only 24%, indicating the need to further ramp up collections by all pathways including via kerbside collections as was considered under Scenario 5. Further reductions in hard-to-recycle soft plastic packaging PoM, through design and innovation would also improve performance.

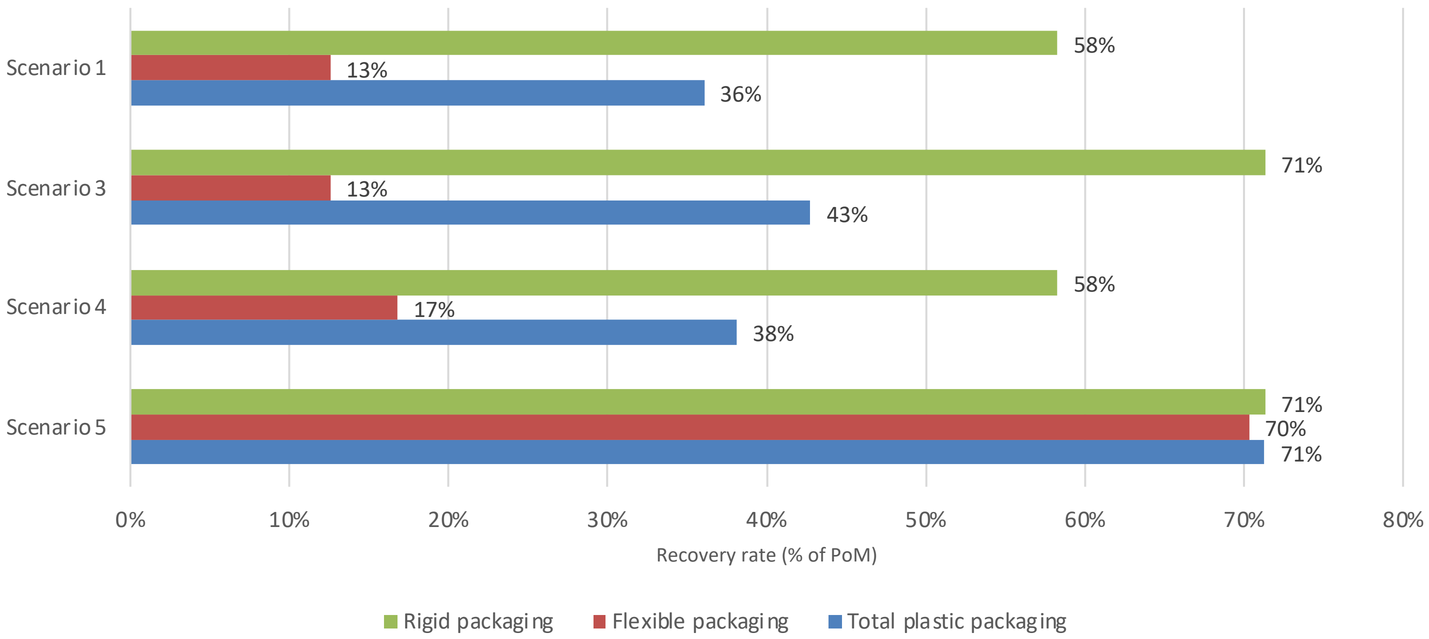

Figure 19. Summary of recovery rates for total rigid, flexible and overall plastic packaging for modelled 2024-25 scenarios. Note Scenario 2, which focuses on glass packaging, is not included in the figure

4.3.2 Contribution of local plastic packaging grade recovery towards 2025 National Recycled Content targets

Figure 20 shows packaging-grade recovery as a proportion of plastic packaging PoM to illustrate the extent the 2025 Targets for recycled content could be met from local packaging-grade recovery (see Table 34 for an overview of the targets). It is projected that rigid PET packaging-grade recovery will be approximately 26% of packaging PoM by 2025 across all modelled scenarios, indicating the significant opportunity to contribute to the recycled content target of 30% for PET with local packaging-grade recovery. In 2019-20, approximately 15% of PET packaging PoM was derived from post-consumer recycled content, with approximately 2% (or 2,200 tonnes) recycled content derived from overseas sources. To meet the recycled content target for PET would require an additional 4% of PoM to be derived from overseas sources, or approximately 4,500 tonnes, assuming that projected local reprocessing capacity maintains a capability for packaging grade recovery at the same proportions as 2019-20.

In the case of the other packaging polymers, the local recovery of packaging grade material (i.e., the packaging circularity rate) falls a long way short of the recycled content targets considering the modelled system changes. For the case of rigid HDPE, the changes evaluated do not make a significant impact on packaging-grade recovery. Specifically, the assumed expansion of CDS to include all milk bottles only resulted in a 2%-point improvement in packaging grade recovery. This is owing to the assumption that industrial applications continue to be the primary pathway for local HDPE recovery, consistent with the current system settings (2019-20). Improvements in design for recycling and recovery of food-grade HDPE by reprocessors, for example through removal of contaminants including glues and labels, would be necessary to improve packaging-grade recovery.[32] In the case of rigid PP packaging, the target of 20% is almost reached under the assumed system changes evaluated (Scenario 3), reaching a packaging circularity rate of 14%.

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[32] Jazbec, M., Madden, B., Florin, N. (2021). *Pathways towards circularity for HDPE packaging*, CRC-P summary report prepared by Institute for Sustainable Futures

For flexible plastics, only Scenario 5 recovers sufficient material to achieve the recycled content target with locally sourced material. The other interventions evaluated achieve packaging circularity rates of between 2 and 3%. In 2019-20 approximately 4% of flexible packaging was derived from local recycled content, however approximately half of this quantity was derived from pre-consumer sources.[33] This indicates that to meet the target from locally derived post-consumer recycled content, packaging grade recovery needs to reach at least 8% of flexible packaging PoM, assuming the same proportions of pre-consumer recycled content would be available in 2025.

Table 34. Overview of Australian 2025 National Recycled Content Packaging Targets evaluated in this scenario analysis

Packaging material	Target [% of packaging PoM as recycled content]
Overall plastic packaging	20%
PET	*30%*
HDPE	*20%*
PP	*20%*
Flexible plastics	*10%*

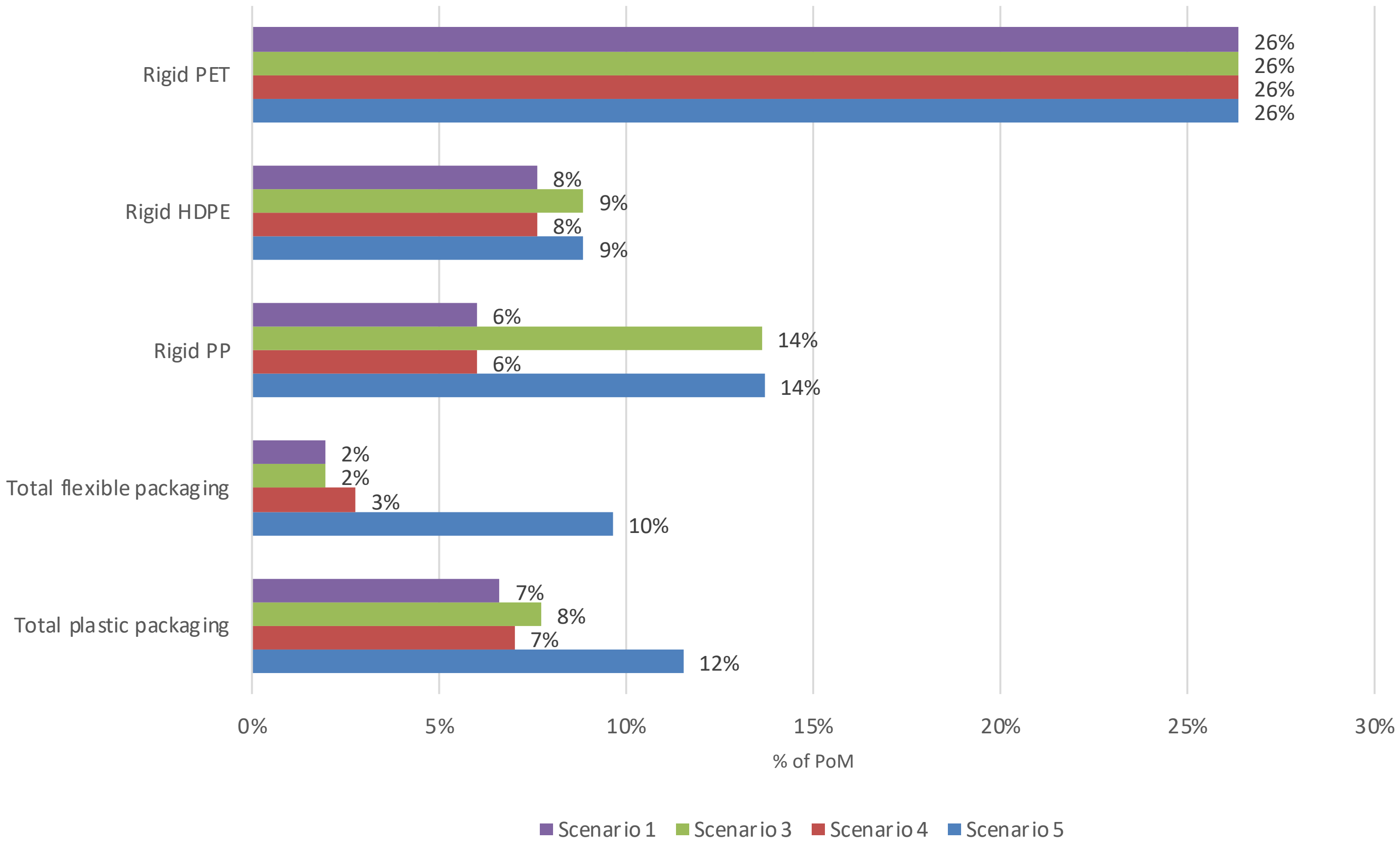

Figure 20. Summary of packaging-grade recovery for comparison against 2025 recycled content targets. Note Scenario 2, which focuses on glass packaging, is not included in the figure

33 APCO (2021), Australian packaging consumption & recovery data 2019-20

4.3.3 Projected plastic reprocessor capacity utilisation and shortfalls

Table 35 compares expected baseline local reprocessor capacity with the modelled reprocessor throughputs (in-the-gate) for BAU and the plastic system interventions (Scenarios 3 to 5). The estimated utilisation of capacity for packaging grade recovery is also shown. The expected baseline capacity for the BAU system assumes that capacity is 100% utilised in 2024-25. The projected recovery levels in 2024-25 are based on existing capacity in 2019-20 plus committed new capacity.[34] Table 36 shows estimated capacity shortfalls, computed as the difference between baseline capacity and estimated reprocessor throughput for each scenario. Negative numbers in Table 36 represent potential capacity shortfalls.

For Scenario 3, targeting rigid HDPE via CDS and rigid PP collections via kerbside, an expected shortfall of approximately 80,900 tonnes of reprocessor capacity is expected, with PP accounting for the largest proportion at 58,500 tonnes. For Scenario 4, targeting increased separate soft plastics collections, an estimated shortfall of 25,000 tonnes is anticipated, primarily for LDPE processing (approximately 15,800 tonnes), and PP processing (approximately 8,900 tonnes). To achieve recovery rates assumed for Scenario 5, where plastic packaging recovery rate targets are met, a shortfall in reprocessor capacity of approximately 425,900 tonnes is expected. The additional reprocessing capacity that would be required is primarily for flexible LDPE (169,600 tonnes) and PP (107,000 tonnes); with 'other polymers' (68,900 tonnes), and HDPE (51,200 tonnes) recovery also expecting significant shortfalls. There is sufficient reprocessing capacity for rigid PET recovery under this scenario, however to meet the overall 70% target, a shortfall of approximately 29,000 tonnes in flexible PET processing capacity is anticipated.

An estimated 17% of plastic reprocessing capacity is expected to be utilised for packaging grade recovery in BAU (packaging-to-packaging). This increases with assumed system interventions, reaching 30% for all polymers under Scenario 5. The most significant changes are expected for PP recovery, aligned with system changes assumed for Scenario 3 and 5, and LDPE recovery in Scenario 4 and 5. For the scenario analysis, specific recycling technologies were not modelled, however, to achieve projected packaging grade recovery and specifically food grade recovery, it is likely that advances in recycling technology (e.g., improved source control, contamination removal, chemical recycling, etc) will be important.

Table 35. Estimated baseline local reprocessor capacity for plastics recovery compared with expected in-the-gate quantities for 2024-25 BAU (Scenario 1) and Scenarios 3 to 5. Proportion of capacity utilised for packaging application is also shown for all scenarios

Packaging Material	Scenario 1 reprocessor in-the-gate [tonnes] (% packaging applications)	Scenario 3 reprocessor in-the-gate [tonnes] (% packaging applications)	Scenario 4 reprocessor in-the-gate [tonnes] (% packaging applications)	Scenario 5 reprocessor in-the-gate [tonnes] (% packaging applications)
PET	127,793 (29%)	127,793 (29%)	127,793 (29%)	156,917 (29%)
HDPE	140,232 (11%)	162,617 (13%)	140,582 (11%)	191,442 (16%)
PVC	12,410 (0%)	12,410 (0%)	12,410 (0%)	12,410 (0%)
LDPE	57,115 (18%)	57,115 (18%)	72,891 (23%)	226,699 (72%)
PP	49,971 (17%)	108,487 (36%)	58,845 (20%)	157,038 (52%)
PS/E-PS	17,698 (7%)	17,698 (7%)	17,698 (7%)	17,698 (7%)
Other polymers	17,001 (0%)	17,008 (0%)	17,008 (0%)	85,947 (0%)
Total	**422,221 (17%)**	**503,128 (20%)**	**447,226 (18%)**	**848,151 (30%)**

[34] APCO (2021), Australian packaging consumption & recovery data 2019-20, p. 96

Table 36. Estimated reprocessor capacity shortfall to baseline (in Table 35) for 2024-25 Scenarios 3 to 5. Negative numbers are considered capacity shortfalls.

Packaging Material	Scenario 3 reprocessor capacity shortfall [tonnes]	Scenario 4 reprocessor capacity shortfall [tonnes]	Scenario 5 reprocessor capacity shortfall [tonnes]
PET	0	0	-29,124
HDPE	-22,385	-349	-51,209
PVC	0	0	0
LDPE	0	-15,776	-169,584
PP	-58,516	-8,874	-107,067
PS/E-PS	0	0	0
Other polymers	0	0	-68,945
Total	**-80,908**	**-25,006**	**-425,931**

4.3.4 Contribution of single-use packaging avoidance to 2024-25 recovery

The contribution of increased reuse to recovery rates by avoiding single-use packaging was evaluated for the BAU scenario. This evaluation, performed for the first time, assumes that an increase in reusable packaging PoM would impact packaging PoM via an increase in single-use avoidance, thereby impacting recovery rates.

For this evaluation, we first considered two reuse 'cases': the BAU case, where approximately 2% of packaging PoM is reusable ('the BAU case'); and where reusable packaging PoM is increased to 10% of packaging PoM ('the 10% case'). For both cases, it was assumed that the materials composition of new reusable packaging PoM is at the same proportions as in 2019-20. Avoided single-use packaging in the BAU case was first calculated based on the approach used in the APCO report,[35] where the size of the reuse pool (in '000 units) was multiplied by an assumed factor of single-use avoided per reuse rotation, and the number of rotations per year. For this analysis it was assumed that avoided single-use packaging in 2024-25 offsets packaging placed on the market in 2024-25. As such, by adding BAU packaging PoM and subtracting the estimated quantity of avoided single-use packaging, a theoretical reduction in packaging PoM can be computed. This reduced quantity PoM is then used to evaluate the impact of reuse in the 10% case.

Critical in the estimation of single-use packaging avoidance is the size of the reuse pool in the year of analysis. To estimate the reuse pool size in 2024-25 (the BAU case), it is assumed the net increase in pool size in 2019-20 (approximately 51,000 tonnes) as an average annual net increase in pool size. By multiplying this net increase over the 5 years from 2019-20 to 2024-25, we can estimate the anticipated increase in pool size for 2024-25 assuming the composition of the reuse pool is the same as in 2019-20. Table 37 shows the assumed composition of the reuse pool.

35 APCO (2021), Australian packaging consumption & recovery data 2019-20

Table 37. Assumed composition of the reuse pool

Reusable packaging types	Share of reuse pool
Kegs (beer and cider)	1.3%
Drums (200-205L)	4.7%
Rigid intermediate bulk containers	3.2%
Reusable pallets – plastic	7.0%
Reusable pallets – timber	81.8%
Plastic crates – non-collapsible	0.9%
Plastic crates – collapsible (RPCs)	0.7%
Reusable shopping bags – LDPE	0.1%
Reusable shopping bags – PP	0.3%
Cups/mugs	0.1%

To estimate the reuse pool size in 2024-25 for the 10% case, we first computed the total percentage increase in new reusable packaging PoM compared to 2019-20. New reusable packaging PoM for 2019-20 has been estimated in this MFA to be approximately 156,000 tonnes (approximately 2% of 2019-20 PoM). An increase from 2% to 10% for new reusable packaging PoM relative to total PoM equates to an annual net increase in the reuse pool size of 345%.[36] Table 38 shows the reuse pool size for 2019-20, compared with estimated pool sizes for 2024-25 BAU and 10% reuse cases.

Table 38. Estimated reuse pool sizes for 2024-25, compared to 2019-20

Reusable packaging type	Reuse pool size, 2019-20 [tonnes]	Reuse pool size, 2024-25 (BAU case) [tonnes]	Reuse pool size, 2024-25 (10% case) [tonnes]
Kegs (beer and cider)	16,067	19,345	30,639
Drums (200-205L)	58,262	70,148	111,099
Rigid intermediate bulk containers	39,407	47,446	75,144
Reusable pallets – plastic	87,435	105,273	166,728
Reusable pallets – timber	1,020,078	1,228,182	1,945,161
Plastic crates – non-collapsible	11,250	13,545	21,451
Plastic crates – collapsible (RPCs)	8,928	10,749	17,025
Reusable shopping bags – LDPE	919	1,106	1,752
Reusable shopping bags – PP	4,340	5,225	8,275
Cups/mugs	1,012	1,219	1,930
Total pool size	**1,247,698**	**1,502,238**	**2,379,204**

[36] At 10% of packaging PoM in 2024-25, new reusable packaging PoM is approximately 693,500 tonnes—a percentage increase of 345% over 2019-20 levels. It is assumed that the reuse pool for 2024-25 in the 10% case must increase at the same rate. I.e., the net change in pool size goes from 51,000 tonnes in 2019-20 to 226,300 tonnes in the 10% case. This results in a reuse pool size in 2024-25 of approximately 2,379,200 tonnes.

Table 39 summarises the estimated single-use packaging avoided under the 2024-25 BAU scenario and 10% reuse cases, compared with 2019-20 avoidance. Total single-use avoided in 2024-25 for the BAU and 10% case are estimated to be approximately 2.8 million tonnes (an increase of 20% over 2019-20) and 4.5 million tonnes (an increase of 91%), respectively. Wood packaging avoidance (via avoidance of fibreboard packaging) contributes the most, at approximately 81% of total avoidance (consistent across 2019-20, and 2024-25 cases). In the 10% case, some materials are entirely offset through reuse, notably fibreboard packaging (via reusable wooden and plastic pallet packaging), and flexible HDPE (via reusable LDPE and PP shopping bags).

Table 39. Estimated single-use packaging avoidance for 2024-25, compared to 2019-20 avoidance

Packaging category	Single-use packaging avoided, 2019-20 [tonnes]	Single-use packaging avoided, 2024-25 (BAU case) [tonnes]	Single-use packaging avoided, 2024-25 (10% case) [tonnes]
Paper	183,562	221,010	350,030
Glass	214,018	257,679	408,105
Plastic	101,000	121,605	192,595
Metal	55,880	67,280	106,557
Wood	2,377,407	2,862,415	4,533,416
Total packaging	**2,931,868**	**3,529,990**	**5,590,704**

Table 40 shows the impact of single-use avoidance through increased reusable packaging PoM (the 10% case) on packaging PoM by material category, and the computed recovery rates.[37] It was estimated that for the 10% case, total packaging PoM for 2024-25 is approximately 6.5 million tonnes. This represents an estimated 7% decrease in packaging PoM by 2024-25. The overall packaging recovery rate increases from 56% in BAU Scenario 1 to 60% in the 10% reuse case, as a result in offsets to packaging PoM. The largest increase in the recovery rate is observed for glass packaging, where glass PoM falls due to a switch to more reusable beer and cider kegs. Metal and wood packaging also see significant increases in their recovery rates of 9%-points, as a result of reusable pallets offsetting fibreboard packaging in the case of wood, and reusable kegs, drums, and intermediate bulk carriers offsetting single-use steel and aluminium packaging.

Table 40: Impact of increased reuse (10% case) on estimated BAU Scenario 1 recovery rates

Packaging category	Estimated packaging PoM 2024-25 (BAU 2% reuse case) [tonnes]	Estimated packaging PoM, 2024-25 (10% reuse case) [tonnes]	Estimated recovery rate 2024-25 (10% reuse case) [tonnes]	Recovery rate increase compared to BAU (Scenario 1) [%-points]
Paper	3,811,455	3,682,435	62%	2%
Glass	1,241,715	1,091,288	83%	10%
Plastic	1,108,916	1,059,040	38%	2%
Metal	267,348	228,072	64%	9%
Wood	505,729	396,011	43%	9%
Total packaging	**6,935,163**	**6,456,846**	**60%**	**4%**

[37] For this analysis, estimated recovery rates for material categories based on Scenario 1 recovery quantities are divided by estimated packaging PoM with offsets from single-use avoidance from the 10% case.

5 Conclusions

5.1 2019-20 material flows

Packaging recovery

- Total packaging recovery in 2019-20 was 3.4 million tonnes, at a recovery rate of 55% of packaging placed on the market.
- The highest performing packaging material in terms of recovery was paper packaging at a recovery rate of 68%, or approximately 2.2 million tonnes of packaging recovered. Other high performing packaging categories include glass (60% recovery rate) and metals (56% recovery rate).
- Packaging recovery was poorest for plastic packaging, at a 16% recovery rate. Rigid PET had the highest recovery rate of the plastic packaging types at 42%, however rigid PET made up only about 12% of plastic packaging placed on the market.
- Local packaging grade recovery (packaging-to-packaging) was the primary pathway for packaging recovery in 2019-20, accounting for 46% of recovery. This was highest for paper and glass packaging, which accounted for 35% and 30% of total recovery, respectively.

Export pathways and future impact of waste export bans

- In total, approximately 1.2 million tonnes of discarded packaging material was exported overseas in 2019-20 as baled packaging and as recyclate.
- Paper packaging, mainly old corrugated cardboard, was exported in the greatest quantities accounting for 81% of all discarded packaging exports.
- Metal packaging, specifically aluminium beverage containers, had the highest rates of export relative to PoM with approximately 49% of all metal packaging destined for export.
- The majority of exports occur as baled packaging exports from CDS and MRF sorters. Approximately 899,000 tonnes of discarded packaging was exported via this pathway.
- Of the 899,000 tonnes exported as bales, approximately 790,000 tonnes are assumed to be subject to export restrictions from 2020-21.

Recoverable packaging losses

Collection losses

- Approximately 2.7 million tonnes of discarded packaging, or 43% of all packaging PoM, was disposed to landfill from collection.
- Glass and paper packaging categories achieved the highest rates of collection for recycling at 77% and 72%, respectively.
- Highest collection losses are observed for plastic packaging, with only 20% of packaging PoM collected for recycling.
- Approximately 74% of all CDS eligible containers PoM were redeemed in 2019-20. Redemption rates were highest for glass and metal (aluminium) containers.
- South Australia and Northern Territory had the highest rates of redemption at 84% and 87%, respectively.

Sorting losses

- Sorting losses were relatively low for all material categories, estimated at 76,000 tonnes. Sorting losses varied between 1-4% of packaging PoM for each material category.

Reprocessing losses

- Reprocessing losses were also relatively low compared to collection losses, estimated at 220,000 tonnes. Recovery losses varied between <1%-3% for most of the material categories, with the exception of glass with recovery losses of approximately 8%.

5.2 Scenario analysis

Proposed system changes only achieve an incremental increase in overall packaging recovery of 56% (2024-25)

- Overall discarded packaging recovery is expected to reach 56% of packaging placed on the market in 2024-25, under BAU assumptions. This represents an increase of about 4% points compared to 2019-20.
- Glass and paper recovery are anticipated to be highest achieving recovery rates of 73% and 60% respectively.

Targeted interventions to increase plastic recovery is critical, especially for flexible packaging

- Plastic packaging recovery is anticipated to be approximately 36% of PoM in 2024-25 for BAU—significantly less than the 2025 plastic packaging recovery target of 70%.
- Some polymer packaging types are projected to reach the 70% packaging recovery target, that is rigid PET, PVC and PS/EPS, and flexible PVC.
- Recovery performance is higher for rigid plastic packaging types at 58% PoM compared to flexible plastic types that is very low at only 13%.
- Flexible packaging types make up approximately half of the plastic packaging PoM and BAU scenario projections clearly highlight the importance of targeting system interventions that increase collection and recovery of flexible plastic.

Expanding CDS collections improves overall recovery rates by avoiding kerbside collection and MRF sorting losses

- With expansion of CDS systems nationally CDS redemptions are expected to increase from approximately 338,400 tonnes in 2019-20 to approximately 573,600 tonnes in 2024-25 (BAU).
- The expansion of eligible CDS containers to include all glass packaging (Scenario 2) results in an increase in redemptions from 573,600 tonnes in BAU to approximately 1 million tonnes, resulting in a downstream recovery rate for all glass of 79%.
- Expansion of CDS eligibility to include HDPE milk bottle packaging was investigated in Scenario 3. This intervention sees plastic packaging redemptions increasing from about 42,100 tonnes in BAU to about 65,000 tonnes.
- In general, the increase in CDS collections, and diversion of material from kerbside collection, results in improved overall recovery rates by avoiding MRF sorting losses.

Improving rigid and soft plastics collection at the kerbside is essential to achieve recovery targets

- Collection losses for plastic packaging is the most significant limiting factor for downstream packaging recovery and overall recovery rates cannot be met without significant improvements in kerbside collection.
- To achieve the 70% recovery rate target for rigid plastic, a collection efficiency of 82% is required, an increase of 17%-points over BAU; this can be achieved by expanding CDS to include all HDPE milk bottles, and by increasing rigid PP collection at the kerbside in line with HDPE collection rates (Scenario 3).
- For flexible plastic, an estimated collection efficiency of 88% is required, which represents a significant increase compared to the BAU collection rate that is only 19%.
- A dramatic increase in all collection pathways for flexible plastics is needed to reach the recovery target; scenario modelling (4) revealed that even with a targeted four-fold increase in separate flexible plastic collection from households and C&I the overall plastics recovery rate only increased by 2% points to 38%.
- Considering the large share of flexible plastic PoM (about 50%), and the relatively low collection rates under BAU (19%), a major increase in kerbside collections will likely be important to achieve the 70% recovery target.
- Compared to rigid plastic, higher collection rates are needed for flexible plastic considering the

lower sorting (MRF) and recovery efficiencies with existing technology.

Addressing shortfalls in local reprocessing capacity is needed to meet the 70% plastic recovery target, especially for the recovery of soft plastics

- Increases in collection efficiency to meet the 70% plastic recovery rate target requires expansion in local reprocessor capacity key polymers estimated to be about 425,900 tonnes.
- The shortfall in capacity is observed across all polymers, with the greatest shortfall in capacity observed for LDPE at about 169,600 tonnes and PP at about 107,000 tonnes.
- Sufficient capacity is observed for rigid PET to meet the 70% plastic recovery target, however a shortfall is expected for flexible PET reprocessing, estimated at approximately 29,000 tonnes.
-

Single-use packaging avoidance through increasing reuse may have a significant impact on future recovery rates

- Reusable packaging in 2024-25 is expected to result in approximately 3.5 million tonnes of avoided single-use packaging for BAU, primarily single-use wooden packaging (approximately 81% of total avoidance). This is compared to approximately 2.9 million tonnes of single-use packaging avoided in 2019-20.
- Increasing the share of reusable packaging placed on the market in 2024-25 from 2% to 10% total PoM could lead to total single-use avoidance of approximately 5.6 million tonnes.
- This avoided use impacts recovery rates for all packaging by approximately 4%-points. The largest increases in recovery rates through single-use avoidance are expected for glass (10%-points) and wood/metal (9%) packaging. A more targeted approach to reuse, for example by prioritising reusable products that lead to higher single-use plastic packaging avoidance, could further improve recovery rates.

6 Appendix

Table 41. System process and flow descriptions

Processes	Description
Packaging placed on market	This process represents the use system, and aggregates flows of packaging placed on the market (PoM) from all sources including for business-to-business (B2B) and business-to-consumer (B2C) applications
Reuse system	This process represents the reuse system, where flows of reusable packaging from the use system enter this process as 'returns', and then are redirected back into the use system as 'reuse'.
CDS system	This process represents the nation-wide CDS collection system
Business waste collection (C&I)	The business waste collection system (i.e., C&I collection)
Consumer waste collection (MSW)	The consumer/household waste collection system (i.e., MSW collection)
Landfill disposal	Aggregated disposal, representing disposal to landfill and informal disposal (i.eg., littering)
MRF sorting	This process represents nation-wide MRF sorting systems
Unutilised material	A stockpile of sorted and recovered material that is not utilised within the study timeframe
Secondary material processing	This process represents nation-wide secondary materials processing

Flows	Description
F0.1 Primary input, local	Quantity of packaging produced from primary materials locally
F0.2 Secondary input, local	Quantity of packaging produced from secondary materials locally
F0.3 Primary input, overseas	Quantity of packaging produced from primary materials overseas
F0.4 Secondary input, overseas	Quantity of packaging produced from secondary materials overseas
F1.1 Reuse system input	Reusable packaging placed on the market
F1.2 Direct CDS collection	Eligible CDS containers collected through dedicated channels (e.g., reverse vending machines)
F1.3 C&I collection	Packaging placed on market (PoM) and collected through business waste collection
F1.4 MSW collection	Packaging PoM and collected through household waste collection (kerbside)
F2.1 From pool	Reusable material from existing pool that enters the waste management system in 2019-20
F2.2 To pool	Reusable material that is kept within the reuse system in 2019-20
F2.3 Reuse to reprocessing	Outflows of reusable packaging material sent direct to reprocessing from the reuse system
F2.4 Reuse system leakage	Leakage of reusable material from the reuse system. For this analysis, this material is considered unutilised
F2.5 Reuse to landfill	Packaging returned to reuse system but is ultimately disposed to landfill
F3.1 Baled export	Exports of baled packaging from the CDS system destined to be recovered overseas
F3.2 Overseas losses	Packaging residual stream that is exported. This material becomes reprocessing losses overseas once processed and therefore does not contribute to packaging recovery rates
F3.3 CDS to landfill	Packaging collected through CDS and sent to landfill
F3.4 CDS to reprocessing	Packaging collected through CDS and sent to materials reprocessing
F4.1 Direct to reprocessor	Packaging from businesses sent direct to reprocessing
F4.2 C&I to MRF	Packaging collected through C&I collection and sent to MRFs for sorting
F4.3 C&I to landfill	Packaging from businesses disposed in residual stream bins, destined for landfill disposal. This may include recyclable and non-recyclable packaging
F5.1 MSW to MRF	Packaging collected through MSW collection and sent to MRFs for sorting
F5.2 MSW to landfill	Packaging from households disposed in residual stream bin destined for landfill disposal. This may include recyclable and non-recyclable packaging
F6.1 MRF CDS redemption	Eligible CDS containers entering CDS system via kerbside collection and MRF sorting
F6.2 Baled export	Exports of baled packaging from MRFs destined to be recovered overseas
F6.3 Overseas losses	Packaging residual stream that is exported. This material becomes reprocessing losses overseas once processed and therefore does not contribute to packaging recovery rates
F6.4 MRF to stockpiling	Sorted packaging material not recovered nor disposed

F6.5 MRF to reprocessing	Sorted material directed to local reprocessing
F6.6 MRF to energy recovery	Sorted material sent to local energy recovery
F6.7 MRF to landfill	MRF sorting residuals destined for landfill disposal
F7.1 Recyclate exports	Exports of recovered packaging material destined for overseas markets
F7.2 Overseas packaging applications	Recovered packaging exported destined for overseas packaging applications
F7.3 Overseas industrial applications	Recovered packaging exported destined for overseas industrial applications
F7.4 Local utilisation	Recovered packaging to be utilised locally
F7.5 Local packaging applications	Recovered packaging utilised locally for secondary packaging applications
F7.6 Local industrial applications	Recovered packaging utilised locally for industrial applications
F7.7 Reprocessor to landfill	Reprocessing residual destined for landfill disposal

Table 42. Summary of packaging placed on the market in 2019-20

Material category	Packaging placed on the market in 2019-20 [tonnes]	Primary material placed on the market (O/seas and local sources) [tonnes]	Secondary material placed on the market (O/seas and local sources) [tonnes]	Proportion recycled content (pre- and post-consumer) [-]
Polymer coated paperboard	316,000	106,250	209,750	66.4%
Paperboard/cartonboard	92,724	90,812	1,912	2.1%
Old corrugated board	2,512,600	570,278	1,942,322	77.3%
Other fibre packaging	355,943	241,369	114,574	32.2%
Total paper packaging	**3,277,267**	**1,008,709**	**2,268,558**	**69.2%**
PET rigid	128,581	111,885	16,696	13.0%
HDPE rigid	194,625	186,309	8,316	4.3%
LDPE rigid	10,381	9,957	424	4.1%
PVC rigid	4,448	4,397	51	1.1%
PP rigid	114,612	110,517	4,095	3.6%
PS/E-PS rigid	39,783	39,404	378	1.0%
Other rigid polymers	49,059	49,050	9	0.0%
Flexible polymers	582,361	559,634	22,727	3.9%
Total plastic packaging	**1,123,850**	**1,071,154**	**52,696**	**4.7%**
Aluminium	88,967	31,301	57,666	64.8%
Steel	158,878	117,943	40,934	25.8%
Total glass packaging	**1,155,801**	**654,950**	**500,851**	**43.3%**
Total metal packaging	**247,845**	**149,244**	**98,600**	**39.8%**
Total wood packaging	**461,651**	**461,651**	**0**	**0.0%**
Total packaging	**6,266,414**	**3,345,708**	**2,920,706**	**46.6%**

Table 43. Eligible container deposit scheme packaging and reusable packaging placed on the market in 2019-20

Material category	Eligible CDS packaging PoM [tonnes]	Reusable packaging PoM [tonnes]
Polymer coated paperboard	0	0
Paperboard/cartonboard	5,942	0
Old corrugated board	0	0
Other fibre packaging	0	0
Total paper packaging	**5,942**	**0**
PET rigid	46,852	0
HDPE rigid	4,782	11,794
LDPE rigid	0	71
PVC rigid	0	0
PP rigid	0	1,541
PS/E-PS rigid	0	0
Other rigid polymers	0	116
Flexible polymers	0	23,207
Total plastic packaging	**51,634**	**36,729**
Aluminium	38,056	0
Steel	236	19,699
Total glass packaging	**367,511**	**155**
Total metal packaging	**38,291**	**19,669**
Total wood packaging	**0**	**99,458**
Total packaging	**463,378**	**156,011**

Table 44. Summary of performance indicators for 2019-20 by packaging material

Material category	Collection efficiency	Sorting efficiency	Recovery rate	Local utilisation rate	Packaging circularity rate
Polymer coated paperboard	37%	36%	34%	13%	13%
Paperboard/cartonboard	7%	6%	6%	0%	0%
Old corrugated board	84%	84%	79%	44%	43%
Other fibre packaging	38%	38%	36%	21%	7%
Total paper packaging	**72%**	**72%**	**68%**	**37%**	**35%**
PET rigid	47%	46%	42%	17%	13%
HDPE rigid	28%	28%	27%	10%	3%
LDPE rigid	40%	36%	33%	17%	6%
PVC rigid	46%	41%	40%	0%	0%
PP rigid	16%	15%	13%	5%	2%
PS/E-PS rigid	29%	26%	22%	8%	2%
Other rigid polymers	26%	23%	22%	21%	0%
Flexible polymers	8%	5%	4%	2%	1%
Total plastic packaging	**20%**	**18%**	**16%**	**7%**	**3%**
Aluminium	82%	81%	77%	1%	0%
Steel	47%	46%	44%	11%	0%
Total metal packaging	**59%**	**58%**	**56%**	**7%**	**0%**
Total glass packaging	**77%**	**74%**	**60%**	**58%**	**30%**
Total wood packaging	**56%**	**56%**	**37%**	**37%**	**0%**
Total packaging	**62%**	**61%**	**55%**	**34%**	**24%**

Table 45. Summary of packaging collection via collection pathway for 2019-20

Material category	Dedicated CDS collection [tonnes]	MSW collection [tonnes]	C&I collection [tonnes]
Polymer coated paperboard	0	231,875	84,125
Paperboard/cartonboard	1,586	35,948	53,890
Old corrugated board	0	457,080	2,055,520
Other fibre packaging	0	94,128	263,115
Total paper packaging	**1,586**	**819,031**	**2,456,650**
PET rigid	22,362	97,482	10,776
HDPE rigid	1,636	185,660	13,680
LDPE rigid	0	7,720	2,743
PVC rigid	0	3,330	1,380
PP rigid	0	95,086	37,434
PS/E-PS rigid	0	21,879	17,903
Other rigid polymers	0	52,958	14,233
Flexible polymers	0	400,535	100,323
Total plastic packaging	**23,999**	**864,650**	**198,472**
Aluminium	22,885	28,539	37,543
Steel	60	115,126	24,022
Total metal packaging	**22,944**	**143,666**	**61,565**
Total glass packaging	**210,869**	**612,935**	**331,843**
Total wood packaging	**0**	**0**	**362,193**
Total packaging	**259,398**	**2,440,282**	**3,410,723**

Table 46. Summary of CDS eligible packaging redemption by material

Material category	CDS-eligible PoM [tonnes]	CDS-eligible redeemed via dedicated collection [tonnes]	CDS-eligible redeemed via MRFs [tonnes]	Redemption rate [-]
Polymer coated paperboard	0	0	0	0%
Paperboard/cartonboard	5,942	1,586	0	27%
Old corrugated board	0	0	0	0%
Other fibre packaging	0	0	0	0%
Total paper packaging	**5,942**	**1,586**	**0**	**27%**
PET rigid	46,852	22,362	5,174	59%
HDPE rigid	4,782	1,636	254	40%
LDPE rigid	0	0	0	0%
PVC rigid	0	0	0	0%
PP rigid	0	0	0	0%
PS/E-PS rigid	0	0	0	0%
Other rigid polymers	0	0	0	0%
Flexible polymers	0	0	0	0%
Total plastic packaging	**51,634**	**23,999**	**5,428**	**57%**
Aluminium	38,056	22,885	3,120	68%
Steel	236	60	0	25%
Total metal packaging	**38,291**	**22,944**	**3,120**	**68%**
Total glass packaging	**367,511**	**210,869**	**70,501**	**77%**
Total wood packaging	**0**	**0**	**0**	**0%**
Total packaging	**463,378**	**259,398**	**79,049**	**73%**

Table 47. Summary of estimated sorting system (CDS, reuse and MRF) losses for 2019-20

Material category	CDS system losses [tonnes]	Reuse system losses [tonnes]	MRF sorting losses [tonnes]	Total sorting system losses [tonnes]
Polymer coated paperboard	0	0	841	841
Paperboard/cartonboard	32	0	448	480
Old corrugated board	0	0	7,412	7,412
Other fibre packaging	0	0	1,034	1,034
Total paper packaging	**32**	**0**	**9,735**	**9,767**
PET rigid	447	0	769	1,216
HDPE rigid	33	135	935	1,103
LDPE rigid	0	44	418	462
PVC rigid	0	0	215	215
PP rigid	0	54	2,049	2,103
PS/E-PS rigid	0	0	1,152	1,152
Other rigid polymers	0	30	1,727	1,758
Flexible polymers	0	15,945	1,848	17,793
Total plastic packaging	**480**	**16,209**	**9,113**	**25,802**
Aluminium	458	0	498	955
Steel	1	159	1,089	1,249
Total metal packaging	**459**	**159**	**1,586**	**2,204**
Total glass packaging	**4,217**	**96**	**33,706**	**38,020**
Total wood packaging	**0**	**0**	**0**	**0**
Total packaging	**5,188**	**16,464**	**54,140**	**75,792**

Table 48. Summary of local reprocessor throughput by source

Material category	Direct from C&I collection [tonnes]	From CDS system [tonnes]	From reuse system [tonnes]	From MRF [tonnes]	Total reprocessor throughput [tonnes]
Polymer coated paperboard	31,600	0	0	20,368	51,968
Paperboard/cartonboard	0	0	0	107	107
Old corrugated board	628,150	0	0	837,087	1,465,237
Other fibre packaging	33,114	0	0	62,496	95,611
Total paper packaging	**692,864**	**0**	**0**	**920,058**	**1,612,922**
PET rigid	0	23,762	0	2,725	26,486
HDPE rigid	0	1,316	13,409	15,812	30,536
LDPE rigid	0	0	0	2,405	2,405
PVC rigid	0	0	0	0	0
PP rigid	0	0	761	9,201	9,961
PS/E-PS rigid	0	0	0	6,018	6,018
Other rigid polymers	0	0	349	15,518	15,868
Flexible polymers	2,650	0	2,150	6,188	10,987
Total plastic packaging	**2,650**	**25,077**	**16,668**	**57,865**	**102,261**
Aluminium	0	1,055	0	1,138	2,193
Steel	0	0	18,006	2,894	20,900
Total metal packaging	**0**	**1,055**	**18,006**	**4,032**	**23,093**
Total glass packaging	**6,412**	**277,153**	**0**	**504,306**	**787,871**
Total wood packaging	**158,094**	**0**	**47,242**	**0**	**205,336**
Total packaging	**860,020**	**303,285**	**81,917**	**1,486,261**	**2,731,482**

Table 49. Summary of packaging recovery by recovery pathway for 2019-20

Material category	Baled exports (CDS and MRF) [tonnes]	Recyclate export [tonnes]	Local industrial applications (incl. WtE) [tonnes]	Local packaging applications [tonnes]	Total packaging recovered [tonnes]
Polymer coated paperboard	58,500	7,754	0	40,563	106,817
Paperboard/cartonboard	4,937	25	0	71	5,033
Old corrugated board	603,000	287,930	9,894	1,087,392	1,988,215
Other fibre packaging	37,800	15,881	50,144	24,635	128,461
Total paper packaging	**704,237**	**311,590**	**60,037**	**1,152,660**	**2,228,525**
PET rigid	28,666	2,381	7,527	16,825	55,400
HDPE rigid	28,350	8,118	13,730	6,738	56,936
LDPE rigid	1,193	438	1,123	672	3,426
PVC rigid	1,337	0	537	0	1,874
PP rigid	8,421	1,774	4,111	3,191	17,497
PS/E-PS rigid	3,563	1,922	2,520	700	8,705
Other rigid polymers	0	912	13,966	0	14,877
Flexible polymers	6,534	2,127	8,191	3,027	19,880
Total plastic packaging	**78,065**	**17,671**	**51,706**	**31,152**	**178,595**
Aluminium	66,676	1,018	1,086	0	68,780
Steel	49,925	3,361	17,299	0	70,585
Total metal packaging	**116,601**	**4,379**	**18,385**	**0**	**139,365**
Total glass packaging	**0**	**23,051**	**331,026**	**345,087**	**699,164**
Total wood packaging	**0**	**0**	**170,574**	**0**	**170,574**
Total packaging	**898,903**	**356,692**	**631,729**	**1,528,900**	**3,416,223**

Table 50: Packaging losses over the packaging management chain by material

Material category	Collection losses [tonnes]	Sorting losses [tonnes]	Reprocessing losses [tonnes]
Polymer coated paperboard	200,270	841	3,651
Paperboard/cartonboard	85,358	480	11
Old corrugated board	402,117	7,412	80,022
Other fibre packaging	220,735	1,034	4,950
Total paper packaging	**908,480**	**9,767**	**88,634**
PET rigid	69,814	1,216	1,933
HDPE rigid	152,598	1,103	1,950
LDPE rigid	6,287	462	215
PVC rigid	2,558	215	0
PP rigid	112,027	2,103	886
PS/E-PS rigid	28,261	1,152	875
Other rigid polymers	49,917	1,758	1,019
Flexible polymers	479,732	17,793	947
Total plastic packaging	**901,193**	**25,802**	**7,825**
Aluminium	16,324	955	89
Steel	84,719	1,249	240
Total metal packaging	**101,043**	**2,204**	**329**
Total glass packaging	**264,238**	**38,020**	**88,706**
Total wood packaging	**204,099**	**0**	**34,762**
Total packaging	**2,379,053**	**75,792**	**220,257**