



NPRS TRIALS REVIEW



AUSTRALIAN
**FOOD &
GROCERY**
COUNCIL

NPRS Trials Review

A Report to the Australian Food and Grocery Council (AFGC) (ABN 99 056 538 480)
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In the spirit of reconciliation MRA Consulting Group acknowledges the Traditional Custodians of Country throughout Australia and their connection to land, sea and community. We pay our respects to Aboriginal and Torres Strait Islander peoples and to Elders past, present and emerging.

Table of contents

Executive Summary.....	vi
1 Introduction.....	9
1.1 National Plastics Recycling Scheme	9
1.2 Collection and Processing Trial.....	9
1.3 Data reviewed for this report.....	12
1.4 Key questions answered in this report.....	13
2 Household Survey	14
2.1 Results.....	14
2.2 Learnings and Recommendations.....	15
3 Household Participation.....	16
3.1 Results.....	16
3.2 Learnings and Recommendations.....	17
4 Average Weight of Bags	19
4.1 Results.....	19
4.2 Learnings and Recommendations.....	22
5 Contents of Bags	23
5.1 Results.....	23
5.2 Learnings and Recommendations.....	24
6 Condition of Bags	25
6.1 Results.....	25
6.2 Learnings and Recommendations.....	29
7 Inbound Contamination.....	30
7.1 Results.....	30
7.2 Learnings and Recommendations.....	30
8 Sorting at MRFs.....	32
8.1 Results.....	33
8.2 Learnings and Recommendations.....	35
9 Outbound Contamination	36
9.1 Results.....	36
9.2 Learnings and Recommendations.....	36
10 Stakeholder Consultation	38
10.1 Results.....	38
10.2 Learnings and Recommendations.....	38
11 Key Findings and Observations of the trials	39
11.1 Inbound.....	39
11.2 Sorting	40
11.3 Outbound	41

12	Recommendations	42
12.1	Non trial period.....	42
12.2	Pilot phase - Next six months.....	42
12.3	Six to twelve months	42
13	Acknowledgements.....	43
	Appendix A.....	44
	Results from the Household Survey – National	44
	Appendix B.....	51
	Bag Condition Audit	51

List of Tables

Table 1	Trial bag types	10
Table 2	Collection trial details by Council	11
Table 3	Data and reports reviewed in this report	12
Table 4	Household participation rate by Council over 3 months	17
Table 5	Comparison of bag weight data by region.....	21
Table 6	The purpose and limitations of bag content audits	23
Table 7	Bag condition categories.....	25
Table 8	Bag condition results by bag gauge	26
Table 9	Bag condition results by bag type	27
Table 10	Bag condition results by glass-out and glass-in system	28
Table 11	MRF process audits undertaken by ECS and MRA.....	32
Table 12	Elements of the MRF process audit undertaken by MRA.....	32
Table 13	Location and condition of bags past pre-sort.....	34
Table 14	Number of pre-sorters required at MRFs	35
Table 15	MRF Infrastructure requirements	35
Table 16	Questions and key findings regarding the inbound material	39
Table 17	Questions and key findings regarding the sorting of material	40
Table 18	Questions and key findings regarding the outbound material.....	41
Table 19	Bag condition audit sample details.....	51
Table 20	Bag condition categories.....	52

List of Figures

Figure 1 Material flow for the National Plastics Recycling Scheme (trial elements highlighted in green)..	9
Figure 2 Resident preferences for soft plastics recycling (<i>N = 861 respondents</i>).....	14
Figure 3 Fortnightly participation rate by Council over 5 months.....	16
Figure 4 Overall average bag weight by audit.....	19
Figure 5 Comparison of average bag weights data by bag type and audit.....	20
Figure 6 Qenos compositional audit results	24
Figure 7 Bag condition results by bag gauge.....	26
Figure 8 Bag condition results by bag type	27
Figure 9 Bag condition results by glass-out and glass-in system	28
Figure 10 Average bag capture rate for each participation rate scenario tested.....	33
Figure 11 Average capture rates by MRF for each participation rate scenario tested	34
Figure 12 Contamination in the fibre stream	37
Figure 13 NPRS trial elements tested and the key findings and observations.....	39

Executive Summary

In 2020, the Australian Food and Grocery Council (AFGC) launched a sustainable initiative to foster a circular economy for soft plastic packaging in Australia. The National Plastic Recycling Scheme (NPRS) project aims to:

- Identify market failures in the soft plastic recycling supply chain.
- Develop a product stewardship scheme for better product design and increased investment in recycling infrastructure.
- Boost the soft plastics recycling rate.
- Enhance access to recycled content, meeting global food grade standards.

Backed by the Government's Product Stewardship Investment Fund and industry support, a draft stewardship framework emerged, guided by a cost-benefit analysis and global best practices. A consortium of brands, councils, MRFs, recyclers, and resin producers collaborated on a collection and sortation trial in 2022/2023, signalling a collective commitment to sustainable practices in addressing soft plastic waste challenges.

Trials and Results

Trials were undertaken across six councils in New South Wales, South Australia, and Victoria. The trial involved households using distinctive bags for separating soft plastics in their commingled recycling bins.

Survey results showed a positive community response, with 52% participating fortnightly and 70% expressing high satisfaction for the service. Bag-in-a-bin was clearly the preferred collection method (92.4%). Participation ranged from 24% to 38%, and bag weight increased over time, emphasising the need for future designs to maximise volume and account for user preferences.

Contamination within the bags was minimal (<2%), mainly consisting of rigid plastic and paper/cardboard. An audit of polymer composition revealed 80-85% suitability for advanced recycling, while unsuitable polymers (PVC, PVDC, PET films) were present in low quantities and required pre-treatment or redesign.

Bag conditions were assessed, favouring a thicker gauge (50uM) for structural integrity with less than 1% spilling. The impact on inbound recycling quality varied across councils, with no statistical variation in soft plastic contamination. MRF audits indicated high capture rates of 95% at pre-sort stations without additional staff.

Outbound contamination on paper/cardboard recycling commodities had negligible impact, and risk can be further reduced by increasing bag thickness and refining community education.

Stakeholder consultations highlighted support for a national scheme, preference for multiple collection methods, and concerns about transparency in end markets. Education consistency and design solutions upstream were emphasised.

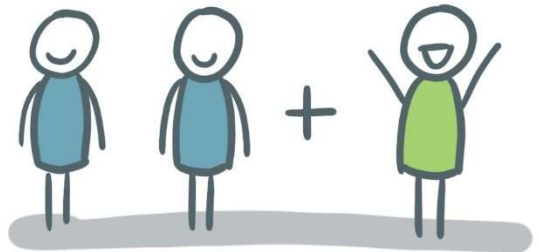
Recommendations from the trial include community surveys, optimising bag design, initiating phase 2 trials to assess multiple collection options, education campaigns, kerbside audits, developing contract clauses, and auditing MRF's to validate contamination rates over a longer time period.

Community engagement & participation

92.4% of households prefer **KERBSIDE COLLECTION**



50% more users than RedCycle



Participation rates peaked between **34%** and **38%** within 3 months



Top 3 Likes

- Circular plastics
- Government & industry collaboration
- Convenience

What's in the bag & the bin?

No evidence indicating residents are placing additional loose soft plastic in the bin



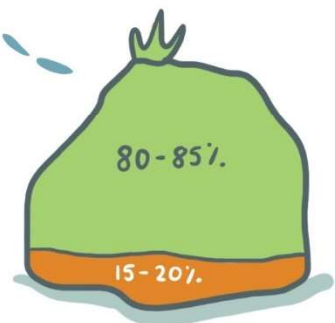
No statistical difference between trial and control samples:
→ Control: 1.8% loose soft plastic
→ Trial: 2.0% loose soft plastic



Bags contained **less than 2%** contamination

This is very low compared to recycling bins that commonly have 10-15% contamination.

80-85% of material is suitable for mechanical or advanced recycling



Impacts on Recycling

Are bags breaking and spilling into other items?

Less than **1%** of thick bags (50uM) tore and spilled into other material



<1% →

Can the MRF's extract the bags?

95% of bags were captured at presort with no additional staff

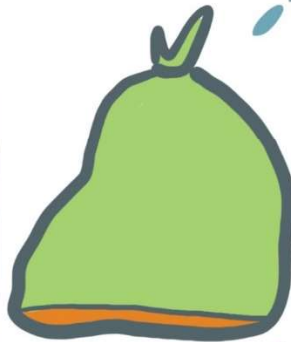


← 5%

Potentially capture missed bags with additional staff with product stewardship scheme support

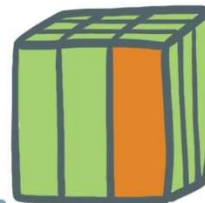
Do the 5% missed bags burst in MRF?

Between 83% and 95% of missed bags remained intact as they passed through the MRF, meaning the maximum failure rate is less than 0.8%. (17% of 5%)



1% maximum failure rate in the MRF

Does soft plastic make paper or cardboard unsaleable?



0.3% →

Bagged soft plastics had **negligible impact** on outbound cardboard quality at 0.3% by weight

Paper & cardboard contamination rates by weight

8.0%

MAX LOCAL THRESHOLD

5.0%

EXPORT STANDARDS

0.2%

CONTROL

0.3%

TRIAL

1 Introduction

1.1 National Plastics Recycling Scheme

The Australian Food and Grocery Council (AFGC) is developing the National Plastics Recycling Scheme (NPRS) to recover hard-to-recycle soft plastic packaging and recycle it into new products, including food grade packaging. The NPRS research project was commenced in 2020 by the AFGC with financial support from the Australian Government until March 2023, and further support from the AFGC and its members. This funding has enabled collaboration on collection, processing trials and measurement in 6 councils, 4 material recovery facilities (MRFs) and downstream processors. These local trials continue with the support of the AFGC, consumer goods brands, Local Government Councils (Councils), MRF operators and plastic processors. The proposed flow of the scheme is presented in Figure 1, the elements tested in the trial and covered in this report are shown in the green circle.



Figure 1 Material flow for the National Plastics Recycling Scheme (trial elements highlighted in green)

1.2 Collection and Processing Trial

To evaluate collection bag designs and household collection and sorting elements of the scheme, the AFGC commenced trials collecting soft plastics from households in November 2022 using a bag-in-the-bin collection method in select Councils across New South Wales (NSW), South Australia (SA) and Victoria (VIC). The trial required households to separate soft plastic packaging waste into a specially supplied distinctive trial bag and place it in their commingled recycling (yellow) bin. Once collected, the bin contents were delivered to a MRF using existing kerbside recycling trucks where the material was sorted, consolidated and sent for reprocessing.

Note: a similar yellow bin program, known as the Curby program, collecting soft plastics in specialised bags or any bag with a specialised tag on the Central Coast and Newcastle in NSW commenced in 2020 with bags being sorted at the iQ Renew MRF.





The AFGC contracted independent consultants to conduct audits and collect data from existing bagged soft plastic collections in NSW that use Curby bags/tags through the iQ Renew MRF. This report includes findings from both the NPRS trials and existing iQ Renew collections.

Households within a Council involved in the trial were either:

- **Designated:** a designated geographic area of households within the Council were mailed specially designed trial bags to participate in, or opt-out of, the trial. Councils selected households from specific collection truck runs; or
- **Opt-in:** households were mailed an information leaflet about the trial and could self-select/opt-in to their Councils' trial. They were then mailed specially designed trial bags.

The trial tested the use of 3 specifically designed trial bags as well as 'any' bag with a QR tag model as summarised in Table 1.

Table 1 Trial bag types

Image	Bag type	Bag colour	Bag Thickness	Comments
	Satchel bag	Orange	50uM	Uses an adhesive strip to seal and enclose the contents (similar to a postage satchel bag)
	Singlet bag	Orange	45uM	Tied at the top to enclose the contents
	Singlet bag	Yellow	37uM	Tied at the top to enclose the contents. Some households chose to use the QR tag sticker
	BYO bag with QR tag sticker	Any colour or style	Any	Used in iQ Renew trials with a QR tag sticker applied by the resident

In addition to the trial bags or QR tags, households were given educational material including an introductory letter and link to relevant websites. Elements of the collection trials are summarised by council in Table 2.

Table 2 Collection trial details by Council

Council	City of Albury [#]	City of Wodonga [#]	Macedon Ranges Shire Council [#]	City of Charles Sturt [#]	City of Port Adelaide Enfield [#]	City of Adelaide [#]	City of Newcastle [*]	Central Coast [*]
State	NSW	VIC	VIC	SA	SA	SA	NSW	NSW
Opt-in or designated	Designated	Designated	Designated	Designated	Designated	Opt-in	Opt-in	Opt-in
Number of households	1,000	1,000	2,250	2,000	1,000	<1,000	16,202	8,060
Bag gauge, type & colour	50uM Satchel Orange	50uM Satchel Orange	45uM Singlet Orange	45uM Singlet Orange	37uM Singlet Yellow	37uM Singlet Yellow	37uM Singlet Yellow & Any bag	37uM Singlet Yellow & Any bag
Sorting facility	Cleanaway MRF Albury, NSW	Cleanaway MRF Albury, NSW	APR MRF Truganina, VIC	CAWRA MRF Kilburn, SA	CAWRA MRF Kilburn, SA	CAWRA MRF Kilburn, SA	iQ Renew SMRF Somersby, NSW	iQ Renew SMRF Somersby, NSW

[#] Denotes councils participating in the trials initiated by AFGC commencing in November/December 2022. These are co-funded trials by councils and AFGC.

^{*} Denotes councils participating in the iQ Renew soft plastics Curby collections for past 4yrs. These are funded by iQ Renew.

1.3 Data reviewed for this report

The NPRS trials commenced in November 2022 to collate a range of data sets and reports assessing the successes, failures, areas for improvement and the overall operational viability of kerbside collections of soft plastics.

Throughout the trial period, data was collected by the participating councils, MRF's, independent auditors (EC Sustainable (ECS), MRA Consulting (MRA), and plastic processor (Qenos)), including:

- Community attitudinal feedback on the trial;
- Trial bag quantities and weights;
- Trial bag condition;
- Trial bag contents polymer and contamination audits;
- MRF inbound and outbound material contamination audits; and
- MRF operational impacts.

MRA was engaged by AFGC in 2023 to:

- Undertake a bag condition audit;
- Undertake a MRF sorting audit;
- Review the information and data gathered so far related to the collection and sortation trials (including a household survey), outlined in Table 3;
- Undertake interviews with key industry stakeholders; and
- Assess the performance of the trials.

The results of all these components are presented in this report.

Table 3 Data and reports reviewed in this report

Data or report	Author	Focus element	Section in this report
Household survey March 2023	Councils/AFGC	Attitudinal feedback on collection trial	- Section 2 Household Survey
NPRS Trial data spreadsheet Nov 2022-March 2023	Councils / MRFs	Bag in kerbside bin	- Section 3 Household Participation - Section 4 Average Weight of Bags
Soft Plastics Composition Audit March 2023	Qenos	Trial Bag contents composition	- Section 4 Average Weight of Bags - Section 5 Contents of Bags
Soft Plastics Recovery: Audits of Councils and MRFs March 2023	ECS	Trial Bags in kerbside bin Collection Sorting	- Section 4 Average Weight of Bags - Section 5 Contents of Bags - Section 6 Condition of Bags - Section 8 Sorting at MRFs
CAWRA Kerbside Infeed Waste Audit Report August 2022	APC	Trial Bag in kerbside bin Sorting	

Albury-Wodonga Region Collection Contract: Household Kerbside Bin Audit 2022	ECS	Soft plastics in kerbside bin Sorting	
Macedon Ranges Shire Council Commingled Recycling Audit March 2022	ECS	Soft plastics in kerbside bin Sorting	
CPC-P SMRF Curby Soft Plastics Baseline Feb 2022	MRA	Bag in kerbside bin Sorting	
MRF Trial Audit Results – AFGC Analysis July 2023	AFGC	Bag in kerbside bin Collection Sorting	
Bag Condition Audit	MRA	Sorting	- Section 6 Condition of Bags
MRF Sorting Audit	MRA	Sorting	- Section 4 Average Weight of Bags - Section 8 Sorting at MRFs

1.4 Key questions answered in this report

The AFGC posed a series of questions likely to be asked by the NPRS supply chain stakeholders about the trials and collections, that they sought to be answered in this report, namely:

1. How often did households put a trial bag in the yellow kerbside bin?
2. How many households participated in the trial collections?
3. How much soft plastic did households put in the trial bag?
4. Did households contaminate the trial bags with non-soft plastic?
5. Did the trial bags break?
6. What's the impact on the trial bags of glass collected separately (not in the yellow kerbside bin)?
7. Was the inbound material (recyclate) in the yellow kerbside bin more contaminated by soft plastic?
8. How effectively were the trial bags sorted in the MRF?
9. What happens to the sorting efficiency when participation rates increase?
10. Where do trial bags missed at the first sorting location (pre-sort) go and what is their condition?
11. Can the missed trial bags be extracted at these other locations?
12. What is the impact of the trial bags on other commodity streams collected in the MRF (paper, cardboard)?

These questions have been answered in Section 11.

2 Household Survey

An online survey was undertaken to understand the behaviours and opinions of households participating in the NPRS trial. The AFGC and participating councils developed the survey and distributed a letterbox leaflet/newsletter to 8,250 households in 6 councils participating in the trial in March 2023 (approximately 3 months into the trial). 1,136 responses were received within 2-4 weeks resulting in an engagement rate of 13.8%:

- Macedon Ranges Shire Council (30% of survey respondents)
- City of Charles Sturt (14% of survey respondents)
- City of Port Adelaide Enfield (6% of survey respondents)
- City of Adelaide (26% of survey respondents) (notified by social media)
- Albury City Council (14% of survey respondents)
- Wodonga Council (10% of survey respondents)

Note: residents in the long-established programs in City of Newcastle and Central Coast Council were not involved in this survey.

2.1 Results

Key findings from the survey include:

- The bag-in-a-bin system was the 1st preference for soft plastics recycling in the future for 92.4% of respondents, with only 3.9% preferring the return to a store model, 0.6% preferring another local drop off facility and 3.0% stating they will continue to place their plastics in the general waste bin, see Figure 2.

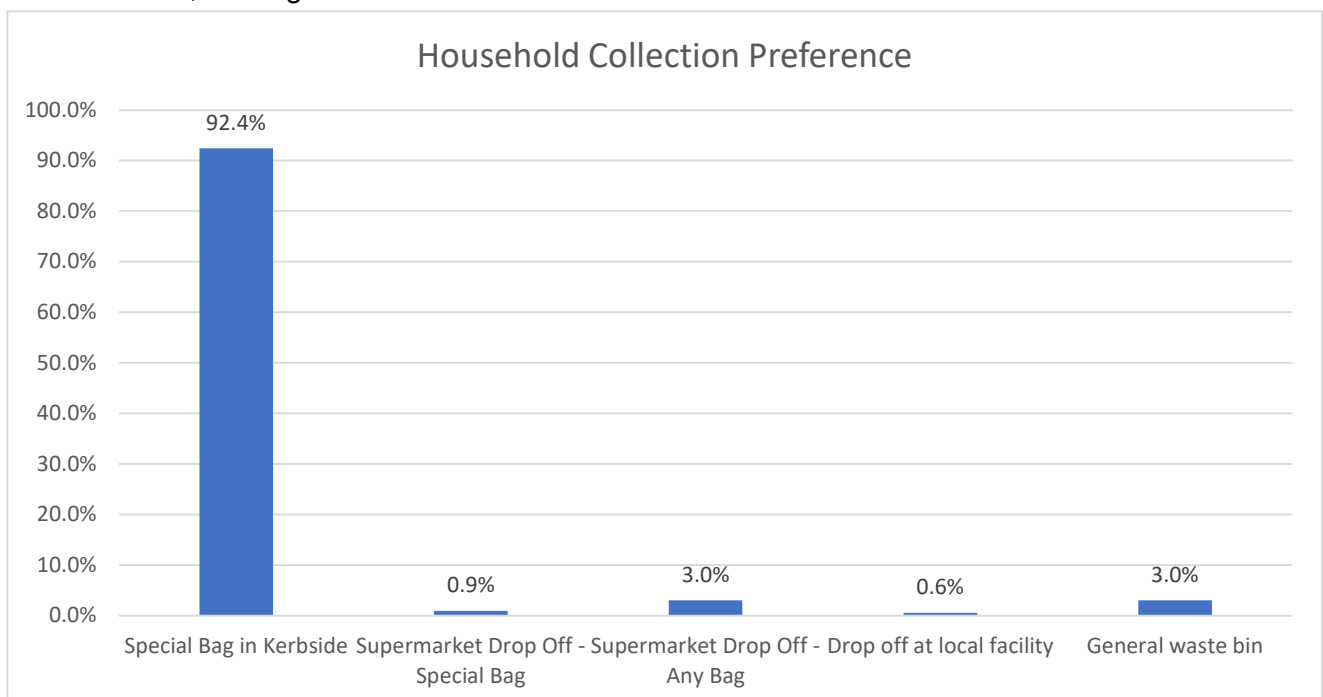


Figure 2 Resident preferences for soft plastics recycling (N = 861 respondents)

- 47% of respondents previously used supermarket drop-off frequently and 16% sometimes. 33% of respondents had not previously participated in supermarket soft plastic drop-off, signifying a 50% increase in community participation compared to previous initiatives.
- The majority of households (52%) reported filling one trial bag fortnightly, 21% monthly and 16% weekly. When surveyed about the number of trial bags used at the time of the survey, 36% of households estimated they had used the equivalent of 1 trial bag per fortnight (i.e. 4-6 bags in 2-

3 months). 32% had used more, 32% had used less. highlighting a mismatch of perceived bag use and actual bag use.

- Nearly 70% of respondents were 'extremely satisfied' with information on how to use the trial bags and the quality of the bags. Approximately 50% wanted more information on the scheme and where the bags go.
- Over 80% of respondents used the letter in the starter pack to determine what to put in the trial bags; 24% mentioned using the Australian Recycling Label (ARL).
- The top four responses for why people most valued the program are:
 1. Good to see that the plastics are going to be made back into product in Australia (65%);
 2. It's good to see industry and councils collaborating on solutions (57%);
 3. I love the convenience (55%); and
 4. I recycle more soft plastics than before (53%).
- Open questions provided residents opportunity to provide comments and suggest improvements:
 1. Difficulty fitting the trial bags into the recycling bin leading to overflowing bins;
 2. The limited availability of information about what can/cannot be recycled; and
 3. Uncertainty and hassle about the cleanliness requirements for recyclability.

Refer to Appendix A for the household survey results.

2.2 Learnings and Recommendations

- Undertake market research on how to increase household participation and collection of more plastics per household per trial bag;
- Continue surveying residents to gauge opinions at different time points;
- Survey more non-participating residents in trial areas to understand the barriers to participation;
- Survey residents in the City of Newcastle and Central Coast Council;
- Provide residents with more information on where the trial bags go (i.e. processing);
- Undertake a kerbside audit to assess space in bins and bin sizes being used; and
- Confirm frequency of bag use through visual kerbside audits prior to arrival at the MRF: bin audits or utilisation of recycling truck cameras to determine the number of trial bags per household.

3 Household Participation

Throughout the NPRS trial, the participating Councils/MRFs recorded information about the trial bags received at the MRF including:

- Total number of bags;
- Total weight of bags; and
- Condition of bags (acceptable, not acceptable, empty whole).

Data collection commenced in the last week of November 2022 with the trials continuing until residents used their allotment of trial bags. All residents have the option to collect additional packs from their councils.

To ensure data integrity was not compromised the following data has been excluded:

1. Where the agreed data recording methodology was not followed by the Council and/or MRF;
2. Where Councils and/or MRF's recorded 5 or less collection weeks data;
3. Opt-in councils where the total baseline of potential participating households could not be isolated/defined by specific truck runs; or
4. Data totalling two or more councils with differing bag types or bag distribution methods.

3.1 Results

The household participation rate by Council for each fortnight is presented in Figure 3. The participation rate is calculated by the total number of bags received at the MRF divided by the number of households in the designated trial area.

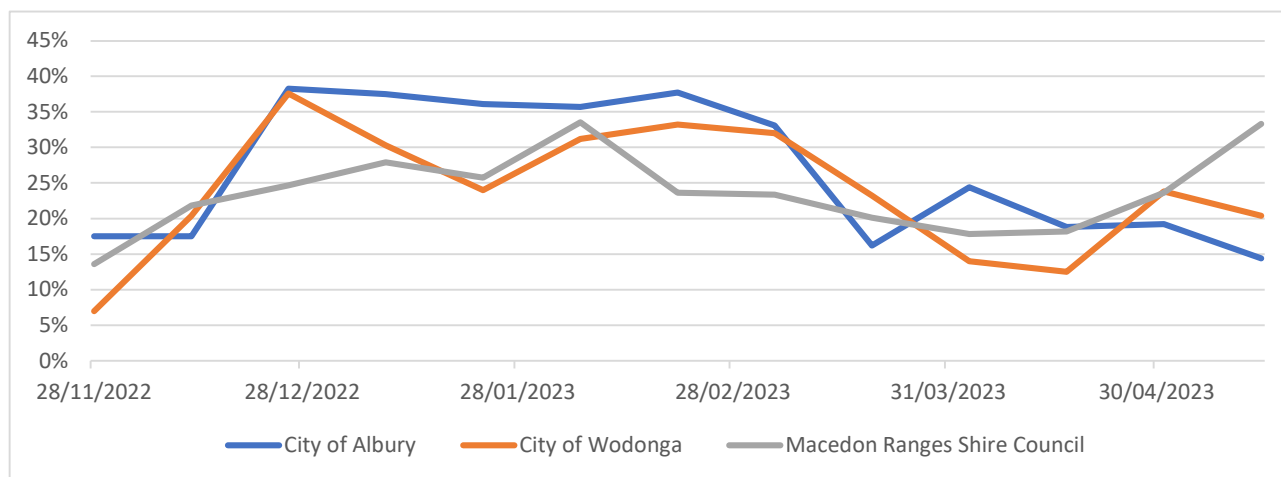


Figure 3 Fortnightly participation rate by Council over 5 months

The key findings include:

- The Councils had similar average fortnightly participation rates for the trial: 27% for City of Albury, 24% for City of Wodonga, and 24% for Macedon Ranges Shire Council.
- Household participation peaked at 38% for both City of Albury and City of Wodonga and 34% for Macedon Ranges Shire Council.
- The fortnightly participation rates for the 3 Councils followed similar trends over the course of the trial:
 - Low participation rates at the beginning of the trial;
 - Participation rates peaked in collection cycles 3 to 8, ranging between 24% and 38%; and
 - Reduced participation at the 4-month mark.

The detailed participation rates are reported in Table 4.

Table 4 Household participation rate by Council over 3 months

Fortnight Commencing	Collection cycle	Albury	Wodonga	Macedon Ranges
28/11/2022	1	18%	7%	14%
12/12/2022	2	18%	20%	22%
26/12/2022	3	38%	38%	25%
9/01/2023	4	38%	30%	28%
23/01/2023	5	36%	24%	26%
6/02/2023	6	36%	31%	34%
20/02/2023	7	38%	33%	28%*
6/03/2023	8	33%	32%	23%
20/03/2023	9	16%	23%	20%
3/04/2023	10	24%	14%	18%
17/04/2023	11	19%	13%	18%
1/05/2023	12	19%	16%*	26%*
15/05/2023	13	14%	20%	33%
Average	Overall	27%	24%	24%

* Weeks where data was not captured by the MRF operator. An average of the prior and subsequent weeks participation rate has been calculated as a proxy for these weeks.

3.2 Learnings and Recommendations

- Undertake market research on how to increase household participation and collection of more plastics per household per trial bag;
- Undertake further communications with households beyond initial letter with the Starter Pack to maintain and build commitment and behaviour
- To determine how many trial bags each household contributed and how often, visual kerbside audits or utilisation of recycling truck cameras are recommended to determine the number of trial bags per bin;
- Run trials for 6 to 12 months to observe the behaviour change and participation rates over a longer period of time to assess the impact of factors affecting participation rates such as holiday periods and potential fatigue or waning of initial enthusiasm;
- Ensure both designated and opt-in collection trials are confined to a specific geographic area, defined by set collection runs to enable the calculation of comparable household participation rates;
- Where several councils utilise the same MRF, ensure councils select trial areas with different collection days or have different trial bags to ensure council by council data is recorded; and

- Test a variety of trial bag replenishment models, potentially including council distribution, availability in retail stores mirroring FOGO model, etc.

4 Average Weight of Bags

To determine the amount of soft plastics residents were putting in each trial bag, average bag weights were measured by 3 distinct groups:

1. MRF/Councils: Ongoing throughout the trial
2. ECS: During February/March MRF audits
3. MRA: During July/August MRF audits

In these audits, staff counted the total number of trial bags sorted at the MRF per fortnight and the total weight of the bags to calculate an average weight per bag.

4.1 Results

The key findings regarding bag weights include:

- Across all audits performed, the average bag weight ranged from 0.36 to 0.49kg, see Figure 4;
- The MRF/Council data reported an average bag weight of 0.45kg (sample size of 15,911 bags). The ECS audit (Feb/Mar 2023) data reported an average bag weight of 0.36kg, (sample size of 173 bags) while the MRA audit (July/Aug 2023) reported an average bag weight of 0.49kg (sample size of 1,276 bags). These results potentially indicate households increased the weight per bag over time;
- The average weight per bag increased by 0.13kg, or 36%, from the audit in March to the audit in August, signifying that households increased the weight of soft plastics in a bag over time.

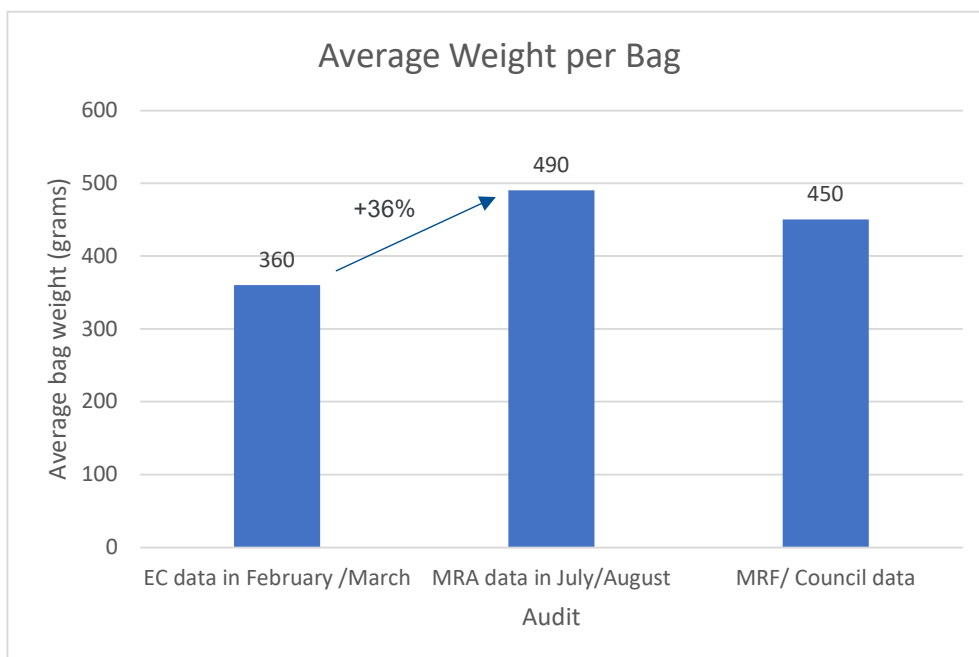


Figure 4 Overall average bag weight by audit

- The average bag weights by bag type and audit are presented in Figure 5;
- Based on MRA and ECS data, “any bags” with a QR tag were consistently the heaviest followed by satchel bags and then singlet bags. However, based on MRF/Council data (which had the largest sample size), singlet bags were heavier than satchel bags.

Note: the average weight of ‘any bag’ was not recorded for the MRF/Council data source.

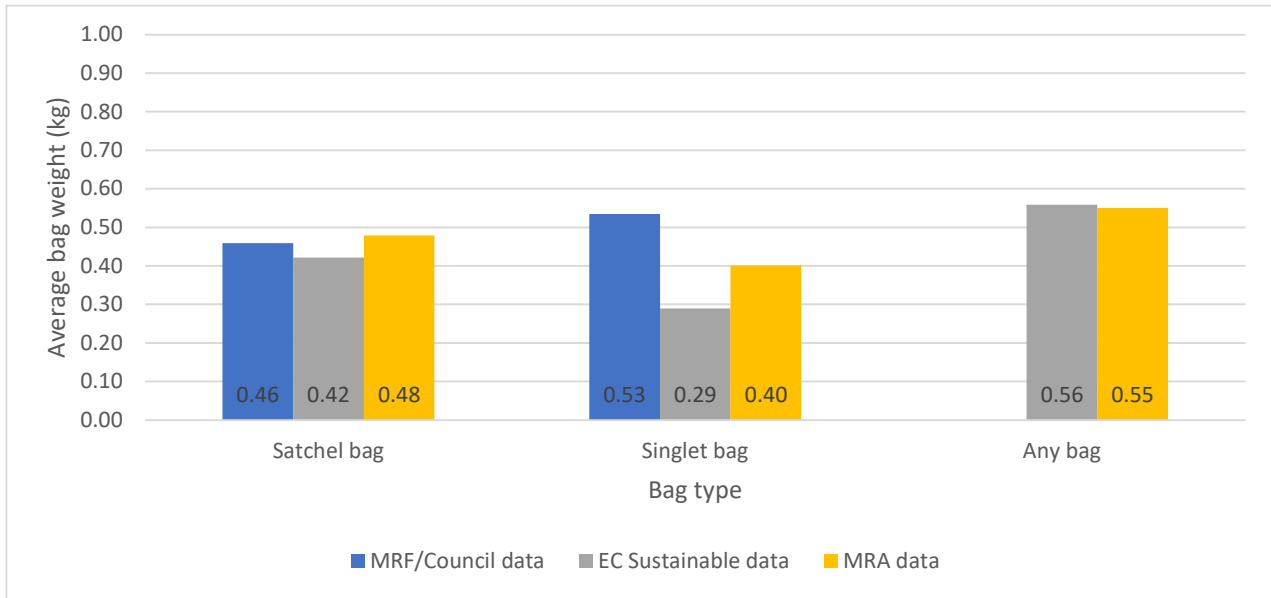


Figure 5 Comparison of average bag weights data by bag type and audit

The results by bag type, Council and audit are provided in Table 5.

Table 5 Comparison of bag weight data by region

Council		Albury	Wodonga	Macedon Ranges Shire Council	City of Charles Sturt	City of Port Adelaide Enfield	City of Adelaide	City of Newcastle	Central Coast	Overall
Bag gauge & type		50uM Satchel	50uM Satchel	45uM Singlet	45uM Singlet	37uM Singlet	37uM Singlet	Any bag	Any bag	All bags
MRF/ Council data	Average bag weight (kg)	0.45	0.47	0.40	0.47	0.63		Not included	Not included	0.45
	Sample size (# of bags)	3,464	2,858	6,245	1,752	1,592		N/A	N/A	15,911
EC data in February /March	Average bag weight (kg)	0.47	0.38	0.33	0.29	0.04*	0.25	0.59	0.53	0.36
	Sample size (# of bags)	18	14	107	16	2	1	7	8	173
MRA data in July/August	Average bag weight (kg)	0.48		0.40	Not included			0.55		0.49
	Sample size (# of bags)	524		243	N/A			509		1,276

*Note: this data point was excluded from calculations in Figure 5 due to likely anomaly.

4.2 Learnings and Recommendations

- Overall, residents put more soft plastics in a bag when using 'any bag' however anecdotal evidence was received regarding MRF staff potentially having difficulty identifying 'any bag' when sorting large quantities and potential confusion amongst residents;
- Results regarding whether satchel or singlet bags were heavier varied across the different audits however, the difference was marginal. To determine the standard bag for this scheme, other factors should be considered and assessed such as bag performance (see Section 6.1.3 on Condition of Bags), the cost of bags and resident preference;
- Future tests in selecting a standard bag for this scheme should identify the maximum volume of the bag, weight and the density of soft plastic to calculate the maximum theoretical weight of a filled bag. This could help improve the instructions for households, communications, and scheme budget;
- Future audits should include a large sample size for all Council areas and also consider weighing bags individually to capture variability in individual bag weights and to perform statistical analysis; and
- Educate residents to maximise the weight of their bags will likely increase the efficiency of the scheme by collecting more soft plastic material in less bags (which are likely to be a cost to the scheme), placing less demand on sorting processes at the MRF.

5 Contents of Bags

To determine what residents were placing in the bags, bag content audits were undertaken by Qenos and ECS. The purpose and method for each audit are outlined in Table 6.

This is useful information to inform communications to households, plastic processors, plastic sorting technology, brands, scheme eco-modulated levy and actions to phase out non-polyolefins from soft plastic packaging applications.

Table 6 The purpose and limitations of bag content audits

Data source	Purpose	Method
Qenos data	To assess the chemical/polymer composition of the soft plastics to inform packaging design and the advanced recycling industry of the recyclability of collected materials (i.e. compliance with the Circular Economy for Flexible Packaging (CeFlex) initiative in Europe).	6 bags from each of the NPRS trial councils (excluding Newcastle and Central Coast). As the audit focussed on polymer mix, it did not provide detailed commentary on the types of contamination.
ECS data	To assess gross contamination to inform future bag design and household communications.	Small sample sizes for selected Councils.

5.1 Results

The polymer compositional audits assessing the suitability of material for advanced recycling undertaken by Qenos is presented in Figure 6.

The key findings include:

- 80-85% of material is suitable feedstock for advanced recycling (HDPE, LDPE and PP) and approximately 10% are multilayer films (which are acceptable if the PET content is below 10%).
- Polymers not suitable for advanced recycling, including PVC and PVDC, were found in low quantities. Recent APCO design standards align with global CEFlex design guidelines to eliminate PVC and PVDC from soft plastic packaging.
- Other contamination mainly consisted of rigid plastic packaging, such as meat trays and yogurt tubs, paper/cardboard and desiccant packets.

NPRS trials composition analysis in weight %

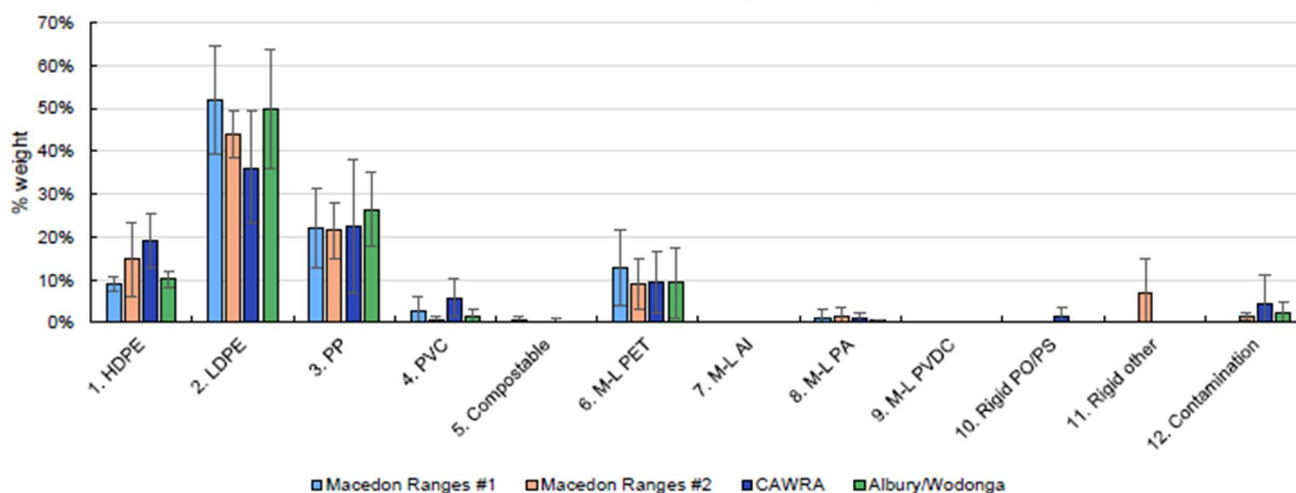


Figure 6 Qenos compositional audit results

The key findings include:

- 80-85% of material is suitable feedstock for advanced recycling (HDPE, LDPE and PP) and approximately 10% are multilayer films (which are acceptable if the PET content is below 10%).
- Polymers not suitable for advanced recycling, including PVC and PVDC, were found in low quantities. Recent APCO design standards align with global CEFlex design guidelines to eliminate PVC and PVDC from soft plastic packaging.
- Other contamination mainly consisted of rigid plastic packaging, such as meat trays and yogurt tubs, paper/cardboard and desiccant packets.

The results of the ECS audit looking into gross contamination included:

- Overall, there were low amounts of contamination found within the bags:
 - 1.88% contamination reported for designated trial councils (Albury, Wodonga, Charles Sturt and City of Port Adelaide Enfield); and
 - 0.76% contamination for opt-in trial councils (Adelaide, Newcastle and Central Coast).
- Detailed composition of contamination material was not provided however the most common contamination material was rigid plastic and non-plastic items such as food, paper, and nappies.

5.2 Learnings and Recommendations

- Opt-in households contain less contamination material in the bags which is likely due to their high motivation to participate in the scheme;
- Audits should be conducted at periodic intervals to determine how contamination changes at different time points to assess the impacts of community education;
- As reported by Qenos, polymers not suitable for advanced recycling, including PVC, PVDC and PET films, are being phased out with the implementation of the new APCO design standard and any residuals should be removed in a pre-treatment step; and
- Education material should continue to target key contamination items.

6 Condition of Bags

Bag condition audits were undertaken by ECS in March 2023 and by MRA in August 2023 to determine the condition of bags as they were received and sorted at MRFs.

During the audits, bags were sorted into one of six condition categories, see Table 7. Refer to Appendix A for the detailed methodology and example images of bag conditions.

Bags splitting or breaking due to the collection and sorting process, i.e. general wear-and-tear, were considered a 'bag fail' and were related to bag gauge/thickness. Bags leaking due to poor sealing by residents were considered a 'resident fail' and were related to bag type (satchel or singlet).

Table 7 Bag condition categories

Condition category	Condition status	Description
Sealed, no split	Acceptable (ideal)	Bag remained completely intact and sealed without splits or tears.
Sealed, minor split not leaking	Acceptable	Bag was sealed with a minor split where minimal plastic could escape.
Split, leaking	Not acceptable (bag fail)	Bag had large split where plastic could easily escape from. Considered a bag fail as bag did not withstand the collection and sorting process.
Burst bag	Not acceptable (bag fail)	There were no contents within the bag: bag was empty and partly shredded). Considered a bag fail as bag did not withstand the collection and sorting process.
Poorly sealed, unsplit bag, leaking	Not acceptable (resident fail)	Bag was sealed and without tears, but plastic is leaking out the top. Considered a resident fail as bag was poorly sealed by resident.
Unsealed, unsplit leaking (empty, whole)	Not acceptable (resident fail)	There were no contents within the bag. Considered a resident fail as bag was not properly sealed by resident (i.e. untied).

6.1 Results

Results from the ECS and MRA audits have been aggregated and are presented by bag gauge (50uM, 45uM, 37uM, 'any'), bag type (satchel, singlet, 'any') and glass-in/glass-out system in the subsequent sections.

Refer to Appendix B for more detailed results.

6.1.1 Results by bag gauge

Thicker gauge bags (50uM) had the lowest proportion of bag fails (0.9%) while the lower gauge bags (37uM) and 'any bags' had the highest proportion of bag fails (10.7% for both), see in Figure 7 and Table 8.

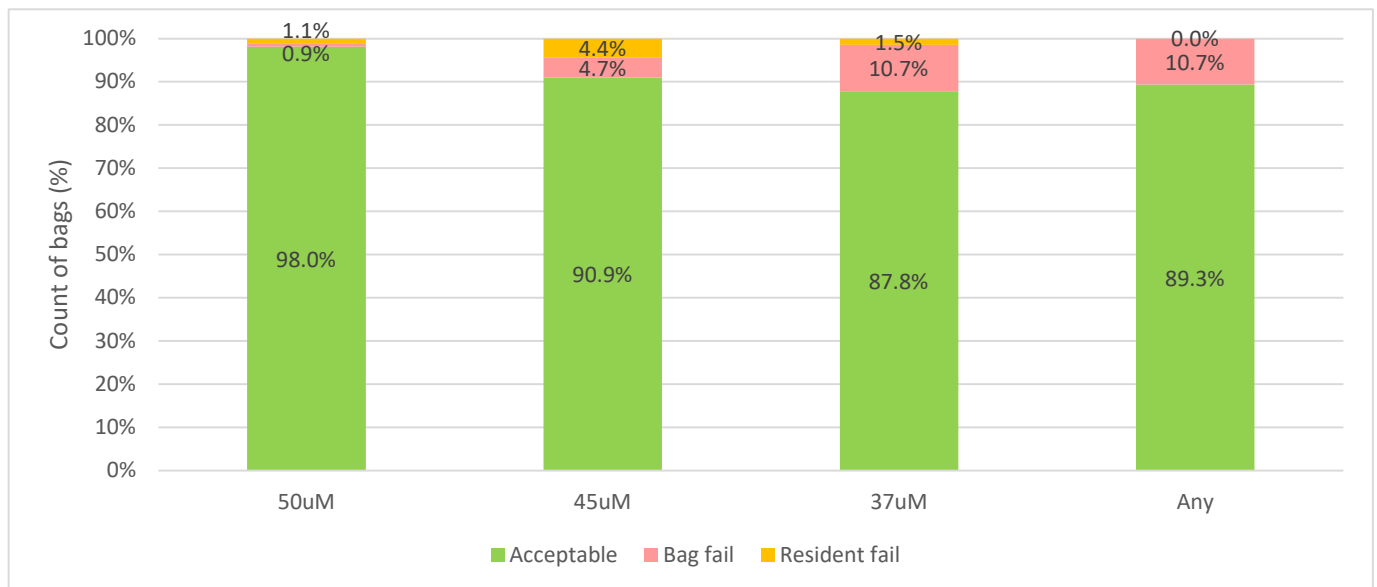


Figure 7 Bag condition results by bag gauge

Table 8 Bag condition results by bag gauge

Condition category	Condition status	Bag gauge			
		50uM Satchel	45uM Singlet Orange	37uM Singlet Yellow	Any (Predominantly Singlet)
Sealed, no split	Acceptable (ideal)	79.8%	86.9%	73.4%	78.6%
Sealed, minor split not leaking	Acceptable	18.2%	4.1%	14.4%	10.7%
Split, leaking	Not acceptable (bag fail)	0.9%	4.7%	10.7%	10.7%
Burst bag	Not acceptable (bag fail)	0.0%	0.0%	0.0%	0.0%
Poorly sealed, unsplit bag, leaking	Not acceptable (resident fail)	1.1%	2.2%	0.3%	0.0%
Unsealed, unsplit leaking (empty, whole)	Not acceptable (resident fail)	0.0%	2.1%	1.3%	0.0%
Total acceptable		98.0%	90.9%	87.8%	89.3%
Total not acceptable		2.0%	9.1%	12.2%	10.7%

6.1.2 Results by bag type

The satchel bags and ‘any bags’ had the lowest proportion of resident fails (1.1% and 0.0%, respectively) compared to the singlet bags (3.1%), see Figure 8 and Table 9. Although ‘any bags’ had a low resident fail rate, they had a higher bag fail rate.

Observations reinforce that the great majority of residents are highly compliant and competent in sealing satchel and tying singlet bags to secure the bag contents.

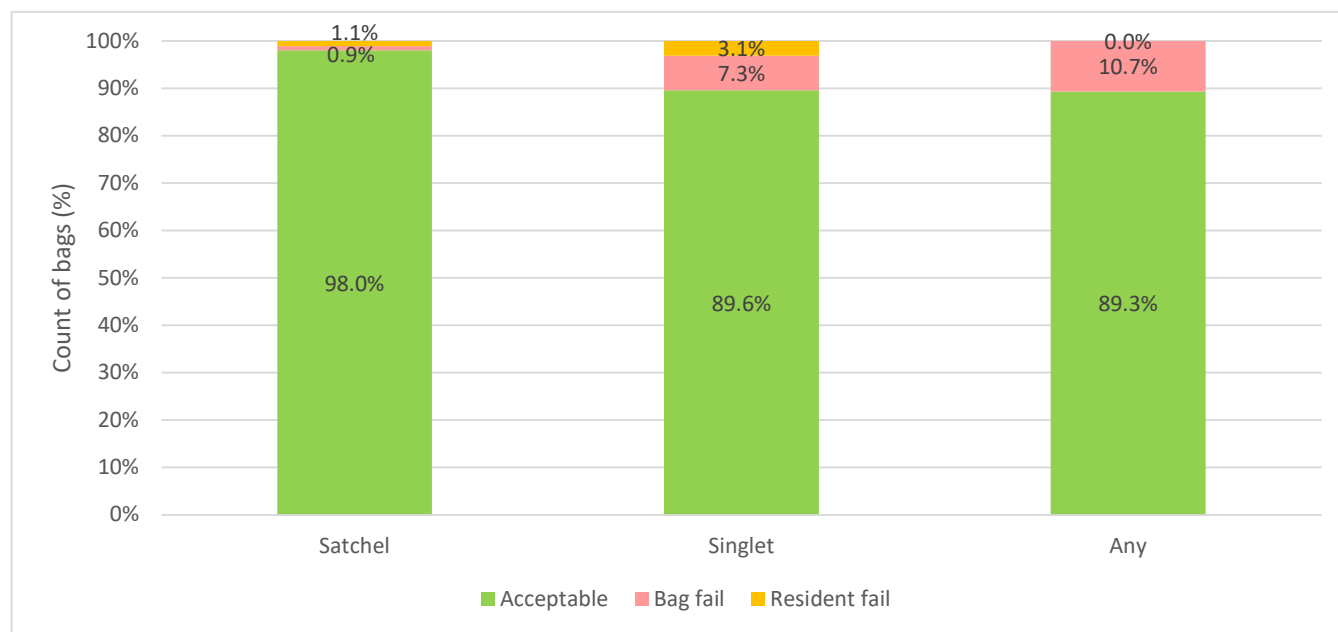


Figure 8 Bag condition results by bag type

Table 9 Bag condition results by bag type

Condition category	Condition status	Bag type		
		Satchel 50uM	Singlet 37-45uM	Any (uM unknown)
Sealed, no split	Acceptable (ideal)	79.8%	81.0%	78.6%
Sealed, minor split not leaking	Acceptable	18.2%	8.6%	10.7%
Split, leaking	Not acceptable (bag fail)	0.9%	7.3%	10.7%
Burst bag	Not acceptable (bag fail)	0.0%	0.0%	0.0%
Poorly sealed, unsplit bag, leaking	Not acceptable (resident fail)	1.1%	1.4%	0.0%
Unsealed, unsplit leaking (empty, whole)	Not acceptable (resident fail)	0.0%	1.8%	0.0%
Total acceptable		98.0%	89.6%	89.3%
Total not acceptable		2.0%	10.4%	10.7%

6.1.3 Results by glass system

To determine the impact of glass-in or glass-out systems (keeping bag gauge and bag type constant), the results for Macedon Ranges (glass out) and Charles Sturt (glass in) are presented in Figure 9 and Table 10.

The results demonstrate that there is no discernible difference in bag condition between the glass-in and glass-out system. Note: the glass-out system contains no glass in the bin or truck, theoretically reducing the risk of bag breakage due to glass piercing the bag. Due to the absence of glass, a higher truck compaction rate may be used during collection compared to glass-in systems which may cause more bags to break. Therefore, the impact of glass-in may have been offset by the higher compaction rate in glass-out trucks.

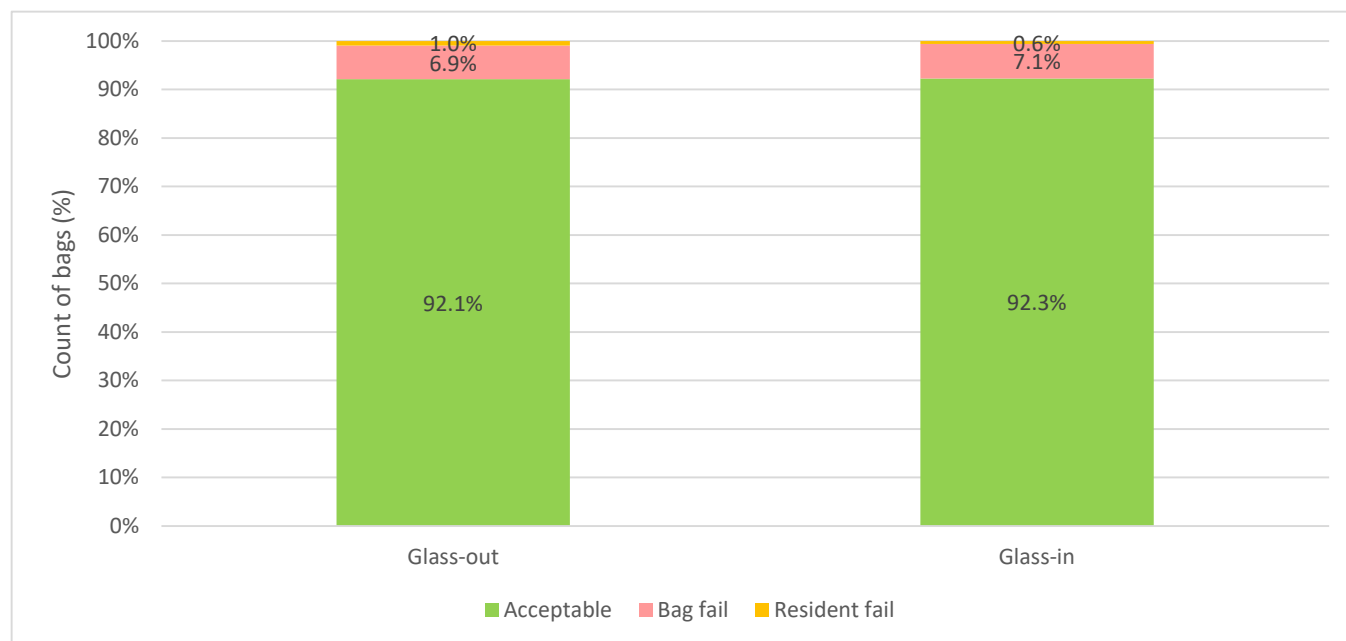


Figure 9 Bag condition results by glass-out and glass-in system

Table 10 Bag condition results by glass-out and glass-in system

Condition category	Condition status	Glass system	
		Glass-out	Glass-in
Sealed, no split	Acceptable (ideal)	91.6%	86.3%
Sealed, minor split	Acceptable	0.5%	6.0%
Split, leaking	Not acceptable (bag fail)	6.4%	2.7%
Burst bag	Not acceptable (bag fail)	0.5%	4.4%
Poorly sealed, unsplit bag, leaking	Not acceptable (resident fail)	0.9%	0.6%
Unsealed, unsplit leaking (empty, whole)	Not acceptable (resident fail)	0.1%	0.0%
Total acceptable		92.1%	92.3%
Total not acceptable		7.9%	7.7%

6.2 Learnings and Recommendations

- Anecdotal feedback was received from some Councils regarding preference for singlet bags over satchel bags. To determine the standard bag for the scheme, this feedback should be considered along with other factors;
- As bag gauge/thickness appears to have the biggest impact on the condition of the bags, it is recommended using a minimum of 50uM bags;
- Trial different polymer mixes to ascertain if greater proportions of LLDPE (stretch wrap) further reduces bag failure rates due to the inherent flexibility and strength of LLDPE vs LDPE; and
- Education should target appropriate usage and closure of the chosen bag design.

7 Inbound Contamination

An analysis of the impact of the bags on the input recycling quality of the yellow bin material was undertaken by ECS in February 2023. The objective of the analysis was to determine if:

- The consolidation of soft loose plastics into a dedicated bag would positively impact (reduce) the amount of soft plastic contamination generally present in the yellow bin (ie. Wish cycling); or
- Negatively impact (increase) the amount of soft plastics in the yellow bin (i.e. soft plastic that would not have been put in the yellow bin in the first place, now put in a bag in the bin and subjected to the collection and sortation process, increasing the likelihood of some bags failing and contaminating the yellow bin materials with soft plastics).

A detailed audit of representative truck loads from both a non-trial 'control' area and trial area for five participating councils was undertaken. The amount of soft loose plastic in the non-trial areas (the control) were compared against the trial areas to determine a contamination rate. The sample size was 1 tonne.

The results were also compared to historical results of previous kerbside yellow bin audits, including:

- APC Waste Consultants: CAWRA Kerbside infeed waste audit report, August 2022
- ECS: Albury-Wodonga Region Household kerbside bin audit, 2022
- ECS: Macedon Ranges Shire Council comingled recycling audit, March 2022

7.1 Results

The key results include:

- Negligible overall impact on inbound contamination:
 - An average 'control' contamination rate of 1.8% (range 0.5% – 5.9%)
 - An average 'trial' contamination rate of 2.0% (range 1.1% – 3.6%)
- The impact was variable, with some councils reporting a slight increase in overall contamination (1.9%) while others reported a decrease (-3.1%) compared to the ECS control.
- Overall, there was a very low contamination rate impact across all councils, including both small increases and small decreases.
- Historical soft plastic contamination rates in the yellow bin as reported in previous kerbside audits show a baseline range in the 'control' of:
 - Macedon Ranges: 1.6% (kerbside audit) and 1.7% (ECS control)
 - Albury: 1% (kerbside audit) and 0.5% (ECS control)
 - Wodonga: 1.4% (kerbside audit) and 0.6% (ECS control)
- It was noted that one non-trial/control area contained trial bags potentially due to Councils providing non trial residents with trial bags, or selected trial areas not being limited to specific truck runs.

7.2 Learnings and Recommendations

- In some cases the 'control' soft plastic contamination rates aligned with historical contamination rates reported in previous kerbside audits; in other cases there are some slight departures. Although, these departures are not significant enough to make any material impact on the overall contamination rate of the yellow bin by soft plastic collections; and
- Due to the evident low contamination impact of the trials, recommend expanding trials including the following refinements:
 - To improve the measurement of control and trial areas, limit trial and control areas to specific MSW truck runs only. Ensure the chosen MSW runs do not include any commercial premises such as strip shopping centres.

- Undertake kerbside audits for both trial and non-trial areas and supplement with historical 'pre-trial' audit reports to refine the contamination rate results.
- Undertake trials over a longer period, with periodic MRF and kerbside audits, to measure if contamination rates change over time as a result of community education and habit formation.

8 Sorting at MRFs

MRF process audits were undertaken by both ECS and MRA to determine the effectiveness and efficiency of MRFs to correctly sort trial bags, see Table 11. In March 2023, ECS undertook MRF process audits at all four MRFs involved in the trials and reported the number of bags captured by the pre-sorters and the number of bags missed by the pre-sorters.

In August and September 2023, MRA conducted more detailed MRF process audits at three of the MRFs involved in the trial.

Table 11 MRF process audits undertaken by ECS and MRA

MRF	ECS MRF Process Audit	MRA MRF Process Audit
MRF A	✓	✓
MRF B	✓	✓
MRF C	✓	✓
MRF D	✓	

During the MRA audit, two assessments were undertaken. The two assessments and the metrics measured and assessed in each is outlined in Table 12.

Table 12 Elements of the MRF process audit undertaken by MRA

Assessment undertaken	Metrics measured & assessed
1. To assess pre-sort capture rates: the trial bags were put through the normal sorting process of the MRF with no additional staff	<p>a) The number of bags captured by manual staff at the pre-sort tested in 4 scenarios of increased participation rate (30%, 45%, 60%, 75%).</p> <p>Note: the condition of bags captured at pre-sort was measured to determine the baseline rate of damage to compare to metric c) below.</p>
2. To model alternative sorting scenarios for MRFs and see where bags end up (potentially worst-case scenario): trial bags were deliberately allowed to flow past pre-sort and into the MRF	<p>b) The number of bags captured at other sorting locations, such as mixed paper, cardboard, and plastic, being the material streams soft plastics would travel to if allowed to enter the MRF sorting equipment.</p> <p>c) The condition of bags at each sorting location (acceptable or not acceptable).</p> <p>d) An assessment of whether it is viable to extract trials bags at these locations (i.e.: secondary quality assurance points)</p>

8.1 Results

8.1.1 Capture at pre-sort

Results from the ECS and MRA audits at the 4 MRFs is summarised below:

- Without increasing pre-sort staff, an overall average of 97% and 94% of trial bags were captured at pre-sort across all MRFs for the ECS and MRA MRF process audits, respectively.
- There was minimal variation between the MRFs in capturing bags at pre-sort, and all were close to 100% or above 90% including any bag with a tag. The variations may be due to a range of factors including MRF throughput and speed, number of pre-sorters, shape and colour of bags used.

The impact of increasing participation rate (PR) scenarios on pre-sort capture (metric a) was tested during the MRA audit and the key results included:

- As PR increased, the average capture rate at pre-sort across all MRFs decreased slightly, see Figure 10.

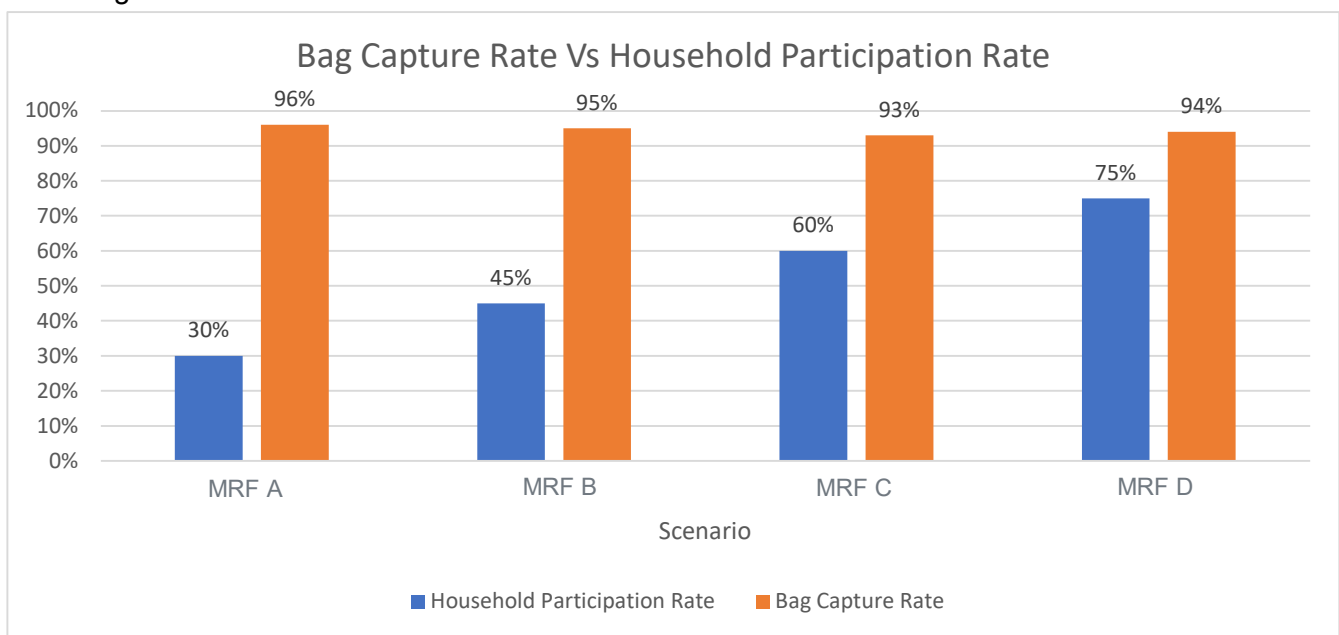


Figure 10 Average bag capture rate for each participation rate scenario tested

- At all MRFs running at processing speeds of <15t per hour, the capture rate was not impacted by increased PR, see Figure 11;
- Bag capture rates declined for MRFs processing >20t per hour, when the PR exceeded 45%, noting that the MRF did not stop the conveyor or increase staffing; and
- The maximum sort rate for a person at pre-sort was observed to be 36 bags per minute.

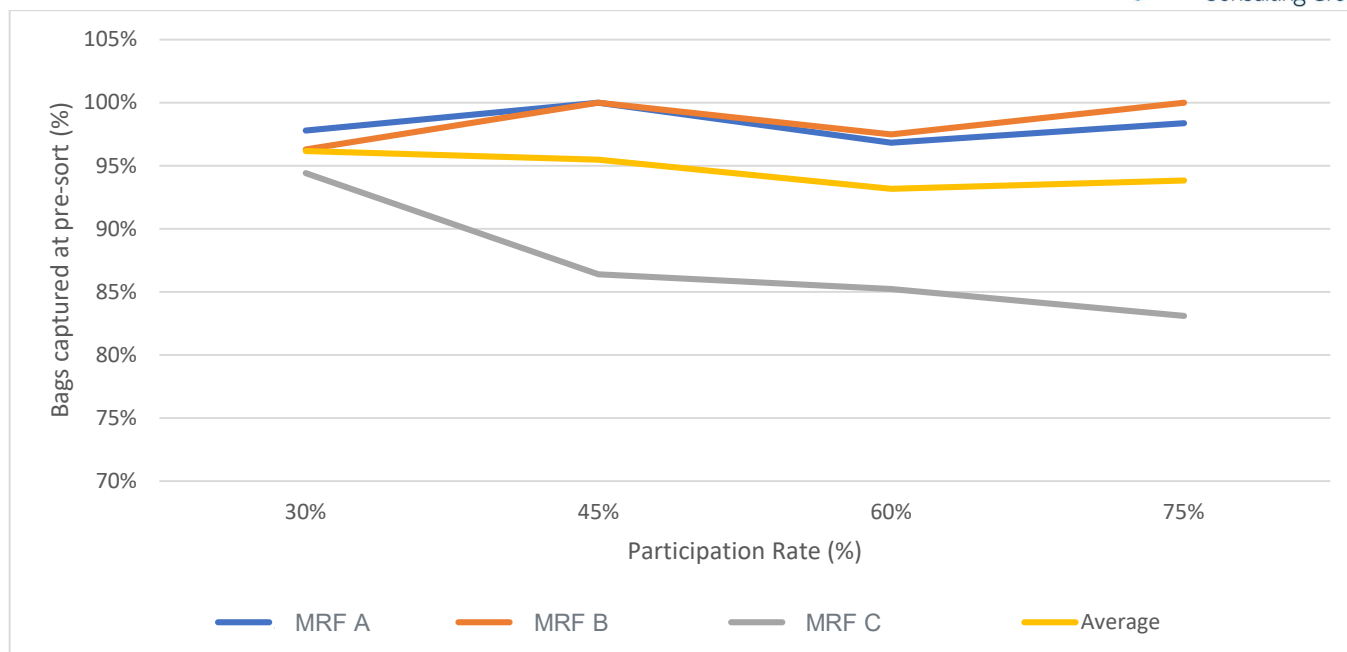


Figure 11 Average capture rates by MRF for each participation rate scenario tested

Note: Some MRFs employ additional staff at secondary quality assurance points to extract contaminants and maximise output quality.

8.1.2 Alternative Sorting Scenarios

Results for the metrics b-d, where bags were deliberately allowed to pass pre-sort and enter the MRF are summarised in Table 13 and summarised below:

Table 13 Location and condition of bags past pre-sort

Test*	Results without pre-sort
Material streams bags of soft plastics would travel to if bags were allowed to enter the MRF sorting equipment and not removed at other points	Location of bags: <ul style="list-style-type: none"> • Cardboard 75% • Plastic 17% • Mixed paper 2% • Other 5%
Bag breakage rates if they entered the MRF sorting equipment	Proportion of broken bags: <ul style="list-style-type: none"> • 5% at the MRF using a ballistic separator with a gentle paddle function. • 17% at the MRF where the ballistic separator uses more aggressive disk screens

*Note: these tests were not part of the original methodology and were added to test the sorting location and breakage rates of bags that make it past pre-sort. Therefore, only a small sample size was used at two MRFs.

Based on the maximum bag breakage rate (17%) and the average proportion of bags not captured at pre-sort (6%), the maximum risk of failures and loose plastics entering other commodities is 1% (17% of 6% not captured at pre-sort). With additional staff placed at pre-sort (where space permits), this can potentially be further reduced.

8.2 Learnings and Recommendations

- MRFs can vary greatly in their operations (e.g. throughput per hour, number of pre-sorters, number of quality assurance sorters on different material lines, operational policies and practices of stopping the conveyor) therefore there are limitations in comparing results across the different MRFs. Despite this, the audits showed that MRFs are effective at capturing the scheme bags at pre-sort (an overall average of 97% and 94% of bags were captured in the ECS and MRA audits, respectively), limiting the risk of contamination of other commodities or increasing MRF operational risks;
- The impact of pre-sort staff capturing bags instead of other contamination material was not tested;
- Future audits should aim to test the maximum sorting efficiency of 1 staff member at pre-sort to verify the observation of 36 bags/min;
- MRFs should scale the number of pre-sorters based on their speed (throughput/hour) and the number of bags received (participation rate of the councils), as outlined in Table 14;

Table 14 Number of pre-sorters required at MRFs

MRF Speed	Bags per hour @ 100% participation*	Bags per min @ 100% participation	Avg. pre-sorter capture rate	# of dedicated pre-sorters
4t/hr	400bags/hr	7 bags/min	36 bags/min	1
12t/hr	1200bags/hr	20 bags/min	36 bags/min	1
25t/hr	2500bags/hr	42 bags/min	36 bags/min	2
75t/hr	7500bags/hr	125 bags/min	36 bags/min	4-6 dependant upon the number of sortation lines

- Following pre-sort, the majority of bags (75%) went over the ballistic separator into the cardboard stream. While possible to collect bags at the cardboard line, through addition of a sorting line or optical/robotic equipment, it is not recommended to be the primary sorting point (i.e. instead of pre-sort) due to some bags going to plastic, mixed paper or unknown; and
- For other MRFs that are interested in participating in the trial/NPRS, a test sample of trial bags should be run through the MRF without pre-sorting to determine the potential sorting locations and the impact of the equipment on the condition of the bag. The likely infrastructure requirements are outlined in Table 15.

Table 15 MRF Infrastructure requirements

Minimum infrastructure requirements	Medium infrastructure requirements	Most infrastructure requirements
Pre-sorter/s	Same as minimum	Same as minimum
Chute	Extended picking line	Robot/optical equipment
Compactor/baler	Conveyor	

9 Outbound Contamination

An analysis of the impact of bags missed at pre-sort on the outbound quality of the paper/cardboard recycling commodities was undertaken by ECS in February 2023. An audit of representative samples of paper/cardboard taken from the outfeed chute/conveyor, handling waste from both a non-trial area and a trial area, was undertaken. The amount of trial bags, 'any bags', other filled bags and soft loose plastic, as a percentage of the whole, was recorded. Any variation between the non-trial area (the control) and the trial area was considered the change in the contamination rate. Four MRFs were included in the audit and the sample size was 250kg.

As outlined in Section 8 MRA's processing audit conducted in August and September 2023 measured the number of bags captured at the sorting locations after the pre-sort (including at paper/cardboard) at increased participation rates (30%, 45%, 60%, 75%). The purpose of this audit was to determine where the bags missed at pre-sort would travel to (paper/cardboard, glass, etc) and evaluate if increased participation rates (i.e. more bags running through the MRF) would increase the contamination rates of the commodity streams (see Section 8 for more details).

9.1 Results

The key ECS results on outbound contamination include:

- Overall, there is a negligible impact from the bags missed at pre-sort on the amount of soft plastic contamination of the paper/cardboard recycling commodities.
 - The impact was variable, with some councils reporting a slight increase in overall contamination (0.5%) while others reported a decrease (-0.2%).
 - An average 'control' contamination rate of 0.2% (range 0.07% – 0.47%).
 - An average trial contamination rate of 0.4% (range 0.03% – 0.80%).

The key MRA finding was that the majority of bags missed at pre-sort, went to the cardboard stream (75%), across all participation rates. However, the maximum risk of failures and additional loose plastics entering other commodities (cardboard, plastic, glass and paper) as a result of bagged collections is less than 1% (<17% of 5% not captured at pre-sort).

Note: 17% being the highest breakage rate if trials bags enter MRF equipment, and 5% being the average rate of bags not extracted at pre-sort.

9.2 Learnings and Recommendations

- The impact on paper/cardboard contamination can be further reduced by:
 - Increasing the bag thickness;
 - Increasing the bag stretch (eg LLDPE content);
 - Increasing/refining community education;
 - Employing additional staff at pre-sort if deemed beneficial; and/or
 - Employing additional staff on paper/cardboard line as a secondary quality assurance point if deemed beneficial.
- While the ECS analysis reports on the change in contamination rate between the control and trial, and provides a total contamination rate (by plastics) ranging from 0.07-0.8% of the paper/cardboard stream, it does not provide any commentary on the maximum allowable contamination rate of the paper/cardboard commodity before it does not pass specification for on-sale to a processor; and
- Anecdotal evidence for the local market shows a maximum contamination rate of ~8% per mass while commodities that are exported can only have a contamination rate of ~5% by mass. It is clear that the contribution the collection bags make to the overall contamination rate of the paper/cardboard commodity is negligible and well below the allowable contamination rate, see

Figure 12. Nevertheless, it is recommended that this anecdotal evidence be substantiated with local and international standards.

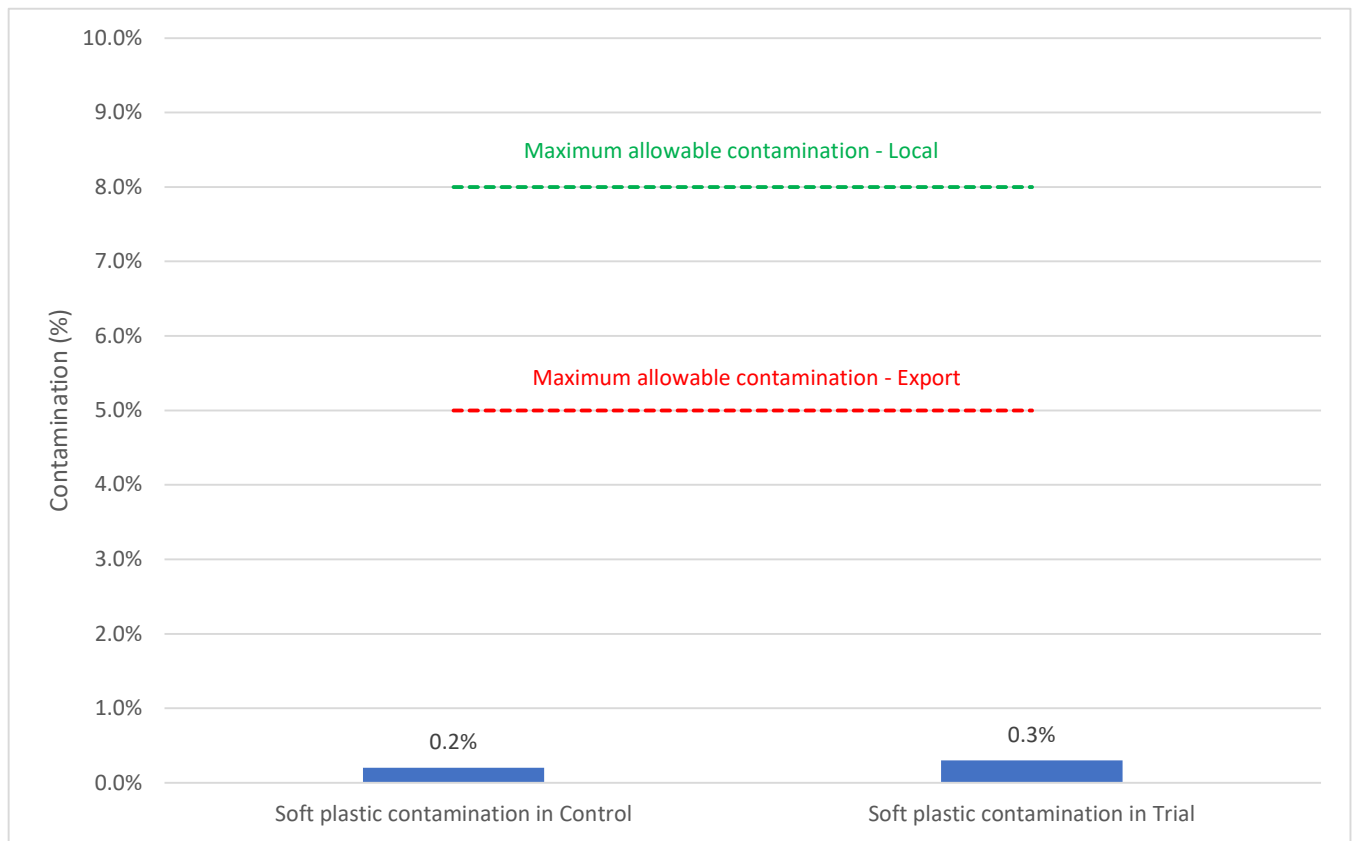


Figure 12 Contamination in the fibre stream

10 Stakeholder Consultation

A total of nine 30-minute interviews were undertaken by MRA in August-September 2023 with industry and government stakeholders across the waste and resource recovery sector in Australia.

The key topics discussed were:

- The effectiveness of collecting bagged soft plastics via kerbside bins;
- Infrastructure / MRF upgrades required to improve processing;
- How the cost of collection and sorting should be distributed across the supply chain;
- Whether an opt-in or opt-out model is preferred;
- Pros and cons of using a specialised bag;
- Barriers to an effective soft-plastics recycling system; and
- Support for a national product stewardship scheme.

10.1 Results

Key findings from the interviews include:

- All 9 stakeholders supported a national scheme but would like to see the results of the trials to better understand the market opportunities.
- 8 out of 9 stakeholders believe that soft plastics collection would be more efficient and accessible for households if a variety of collection methods were used.
- 4 out of 9 stakeholders agreed that specialised bags are preferred as these are easier to detect during pre-sort which can help to lower contamination in recycling and potentially improve the recycling rate of soft plastics.
- 4 out of 6* stakeholders believe that an opt-in method is preferred as it may reduce contamination in the recycling stream and reduce specialised bag wastage. (*3 have been excluded from the total as they did not comment).
- 3 MRFs/reprocessors and 1 industry body acknowledged that current sorting capacity and feedstock volumes collected limit the feasibility of plastic reprocessing in Australia.
- 8 out of 9 stakeholders were concerned about the lack of transparency in current and potential end markets.
- 7 out of 9 stakeholders were concerned about the limited labour capacity to pre-sort and minimal storage at MRFs.
- All 9 stakeholders agreed that education needs to be more consistent to avoid confusion among households and improve recycling outcomes.
- 4 out of 9 stakeholders mentioned that the EPR scheme should target design solutions upstream.
- 5 out of 9 stakeholders suggested that education could be partially funded by an EPR levy.

10.2 Learnings and Recommendations

- Sharing of trial results – specifically the risks and costs – with relevant stakeholders is recommended to:
 - 1) Increase transparency in the NPRS;
 - 2) Enable stakeholders to make informed decisions and/or opinions about the trial and plan for potential infrastructure changes; and
 - 3) Encourage greater collaboration across the supply chain to optimise access to feedstock.
- Consultation with additional Councils and MRF operators is recommended; and
- Consider the feedback provided by stakeholders in future decisions regarding the NPRS.

11 Key Findings and Observations of the trials

The key findings and observations of the trial are presented in the following sections as well as commentary on the impact through the supply chain to material output quality. The information is presented in sections that follow the process flow of materials (see Figure 13) and the MRF (inbound, sorting, and outbound).



Figure 13 NPRS trial elements tested and the key findings and observations

11.1 Inbound

The key findings related to inbound material are presented in Table 16.

Table 16 Questions and key findings regarding the inbound material

Question	Key Findings	Recommendations
1. How often did households put a trial bag in the yellow kerbside bin?	Once every fortnight, according to the majority in the household survey.	<ul style="list-style-type: none"> Undertake a visual kerbside audit of bin contents before truck collection or utilise recycling truck cameras to determine the frequency of bag use per household. Survey non-supporting residents to understand barriers.
2. How many households participated in the trial?	<p>On average, 24-27% of households put a bag in the bin each fortnight including the period when bag supplies were running low.</p> <p>In the core trial period (collection cycles 3-8) an average of 24-38% of households put a bag in the bin each fortnight.</p>	<ul style="list-style-type: none"> Undertake a visual kerbside audit of bin contents before truck collection or utilise recycling truck cameras to determine the number of participating households. Undertake market research to increase household participation and feedstock quantity.
3. How much soft plastic did households put in the trial bag?	Between 0.36 to 0.49kg per bag. The weight increased over time between audits.	<ul style="list-style-type: none"> Educate residents to maximise soft plastics in the bags to increase the

Question	Key Findings	Recommendations
	There was marginal difference between different bag types.	effectiveness and efficiency of the scheme.
4. Did households contaminate the trial bags with non-soft plastic?	In the composition audit, gross contamination (non-soft plastic material) made up less than 2% of bag contents, most commonly rigid plastic, paper, food and nappies. In the polymer composition audit, 80-85% of material was suitable for advanced recycling.	<ul style="list-style-type: none"> • Education to target key contamination items. • Continue undertaking bag composition audits to assess the impact of education. • Problematic polymers to be designed out of packaging.
5. Did the trial bags break?	Bag breakages ranged from 0.9-13.5%, depending on the gauge: the thicker the bag, the less breakages.	<ul style="list-style-type: none"> • The thicker gauge (50uM) is recommended. • Test performance of different proportions of LLDPE (stretch wrap).
6. What's the impact on the trial bags of glass collected separately (not in the yellow kerbside bin)?	No change in bag breakage rate when comparing glass-in and glass-out systems.	<ul style="list-style-type: none"> • Glass-in or out system had no discernible impact on the conditions of the bag – the impact of glass-in may have been offset by the higher compaction rate in glass-out trucks.
7. Was the inbound material (recyclate) in the yellow kerbside bin more contaminated by soft plastic?	The impact was variable, with some councils reporting a slight increase (+1.9%) while others reported a slight decrease (-3.1%). There was an average contamination rate of 1.8% (range 0.5-5.9%) in the 'control', this correlates with previous kerbside bin audits. There was an average contamination rate of 2% (range 1.1-3.6%) in the trial.	<ul style="list-style-type: none"> • Better defined trials areas to ensure they do not include any C&I collections. • Ensure no household in control areas have access to trial bags due to potential to impact control data. • Undertaking more kerbside audits limited to defined truck runs for both trial and non-trial areas and supplement this data with historical 'pre-trial' audit reports to refine the contamination rate results. • Undertake trials over a longer time period.

11.2 Sorting

The key findings and observations related to the sorting of material are presented in Table 17.

Table 17 Questions and key findings regarding the sorting of material

Question	Key Findings	Comment/Recommendations
8. How effectively were the trial bags sorted in the MRF?	An average of 94-97% of bags were captured at pre-sort without increasing staffing at the trial participation rates.	<ul style="list-style-type: none"> • Each MRF has different operating conditions and will need to self-assess their options and effectiveness of sorting bags.

Question	Key Findings	Comment/Recommendations
9. What happens to the sorting efficiency when participation rates increase?	<p>At MRFs processing <15t/hr, the capture rate was not impacted by increased participation. For MRFs processing >20t/hr, bag capture rates declined slightly with increased participation.</p> <p>One dedicated pre-sorter can capture a maximum of 36 bags per minute.</p>	<ul style="list-style-type: none"> • Future audits to verify the maximum sorting efficiency of 36 bags/min for 1 sorter. • Depending on the speed of the MRF and the participation rate, an additional dedicated pre-sorter may be required.
10. Where do trial bags missed at the first sorting location (pre-sort) go and what is their condition?	<p>With no pre-sort, 75% of bags go to cardboard.</p> <p>Between 5-17% damaged bags were recorded at this sorting location.</p> <p>With pre-sort, the contamination risk is <1% (ie: 17% of the 5% missed bags).</p>	<ul style="list-style-type: none"> • Depending on the MRF equipment, the increase in damaged bags at cardboard should be further tested at increased participation rates.
11. Can the missed trial bags be extracted at these other locations?	<p>Yes, manual, robot or optical sorting could be utilised on the cardboard line.</p>	<ul style="list-style-type: none"> • It is not recommended that the cardboard line be the primary sorting point due to the risk of increased breakages and missed bags going to other locations. Pre-sort should be the primary sorting point.

11.3 Outbound

The key findings and observations related to the sorting of material are presented in Table 18.

Table 18 Questions and key findings regarding the outbound material

Question	Key findings	Comment/Recommendations
12. What is the impact of the trial bags on other commodity streams collected in the MRF (paper, cardboard)?	<p>Negligible impact on the amount of soft plastic contamination of the paper/cardboard recycling commodities.</p> <ul style="list-style-type: none"> • Control: 0.2% (Range 0.1-0.5%) soft plastic in the paper/cardboard stream • Trial: 0.4% (Range 0-0.8%) soft plastic in the paper/cardboard stream. <p>Total contamination rate (by plastics) ranges from 0.07-0.8% of the paper/cardboard stream. Contribution of the bags to overall contamination rate of the paper/cardboard commodity is negligible and well below the allowable contamination rate (anecdotal 3-8%).</p>	<ul style="list-style-type: none"> • Validate the anecdotal evidence of the maximum contamination rate (local: 8% by mass; export: 3-5% by mass) with local and international standards.

12 Recommendations

MRA recommends the following actions and timelines to inform the development of the subsequent pilot phase, and update of the scheme costings and levy calculations.

12.1 Non trial period

- Obtain recent audits from councils and/or conduct a kerbside red and yellow bin audit in the proposed trial areas to measure the weight of soft plastics in each household bin while there is no kerbside or return to store collection option.

12.2 Pilot phase - Next six months

- Obtain, participate or conduct surveys, including with councils of households (participating and non-participating) to understand:
 - Barriers preventing participation by non-supporting residents;
 - Ways to get households to put more into bags and deposit when full; and
 - Effective prompts and behaviours with different demographics and at different time points during trials.
- Confirm the maximum theoretical weight of a filled bag (volume and density).
- Commence phase 2 trials taking into account the learnings and recommendations of this report.
- Conduct another round of education campaigns targeting key contamination items found in bags as well as information on where the bags go.
- Conduct a kerbside yellow bin visual audit at each of the eight councils to determine and validate:
 - The number of bags households put in the bin per fortnight;
 - The condition and weight of the bags households put in the bin;
 - Household participation rates; and
 - The contamination rate of loose soft plastic.

Note: use of cameras on recycling trucks to capture images of bin contents would allow more accurate data collection over the course of the trial.

- Develop model contract clauses for each party along the supply chain (council, MRF and pre-processor) to account for the following scenarios:
 - Current: Existing ongoing contracts;
 - Current: New tenders; and
 - Future: Kerbside collection standards containing soft plastics.

These should be developed in consultation with the relevant stakeholders to meet the legislative and regulatory requirements pertaining to contracts within all Australian states and territories.

- Validate the anecdotal evidence of the maximum contamination rates of common recycling commodities (paper, cardboard, glass, rigid plastic, etc) that does not lead to a drop in the value of the commodity.

12.3 Six to twelve months

- Utilise or undertake additional MRF audits at a representative selection of MRFs of various size and equipment. The audit methodology should be revised to include the recommendations of this report.
- Update the *2020 MRA Cost Benefit Analysis* to include the new data from the collection and sortation trials.
- Prepare Tender Documentation packs for future contracts.

13 Acknowledgements

The AFGC wishes to thank the local councils and recycling organisations involved for their support and passion that made the trials possible. Additionally, the AFGC wishes to acknowledge the Australian Government and the following brands for their financial support and/or associated initiatives to improve soft plastic recycling.

SUPPORTERS OF SOFT PLASTIC RECYCLING



Trial Partners



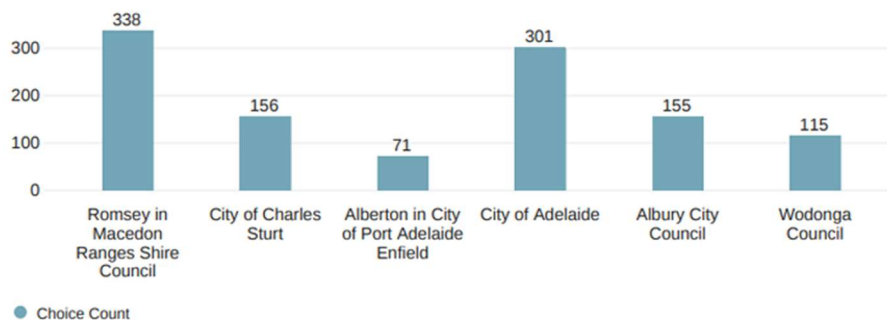
Appendix A

Results from the Household Survey – National



TRIALS PROGRESS: RESPONSE RATE

Q1 - Please indicate which trial area you are in.



Extraordinarily high response rate of **13.8% indicating high engagement**.
 1,136 respondents from 8,250 homes; most prompted by letter, newsletter.
 Only Adelaide City Council residents received electronic prompt and link.

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5

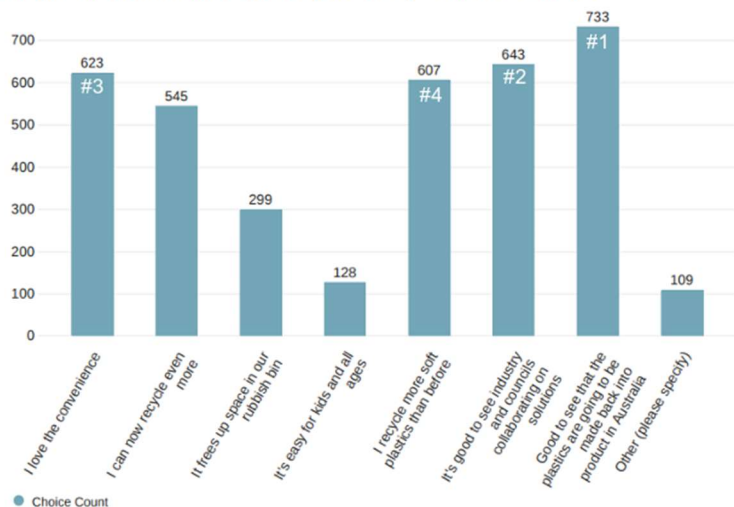


TRIALS: VALUE FOR USER

Q2 - Which of the statements below match your thoughts about recycling soft plastics from home? (Pick up to three) - Selected Choice

Respondents most value this program for:

1. Circular plastics
2. Collaboration between industry and government
3. Convenience
4. Recycling more plastics than before.

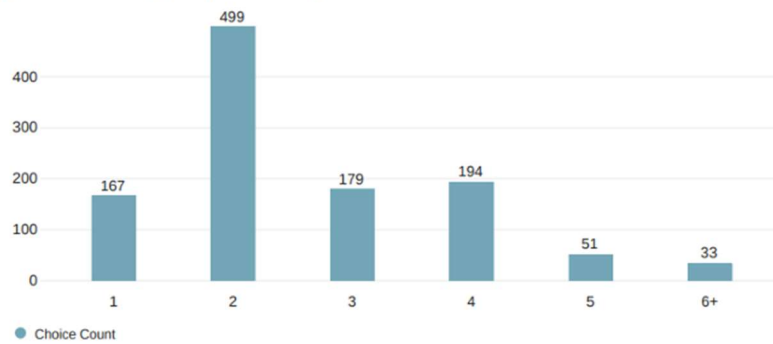


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6

TRIALS: HOUSEHOLD TYPE

Q3 - How many people live in your household?



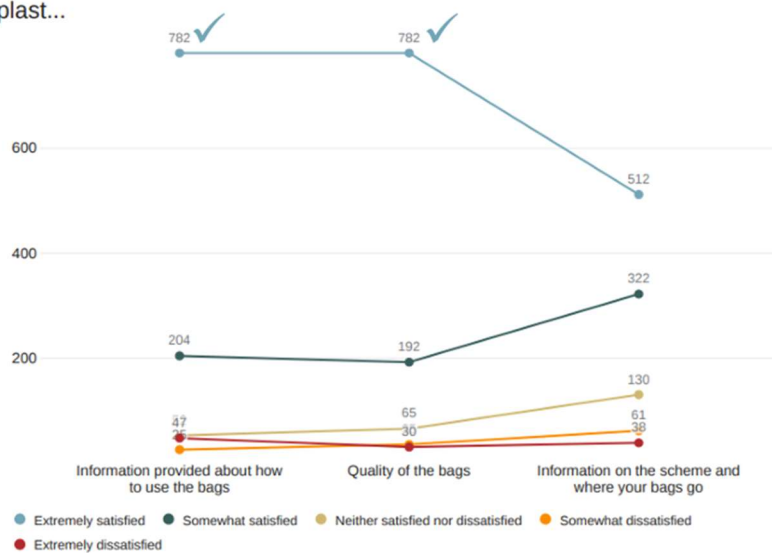
The majority of respondents were two-person households, with 24% having four or more people in a busy household.

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7

TRIALS: SATISFACTION

Q4 - How satisfied are you with the following aspects of the kerbside soft plast...



Nearly 70% of respondents were 'extremely satisfied' with information on how to use the bags and quality of the bags.

Half wanted more information on the scheme and where the bags will go, possibly in response to REDCycle media.

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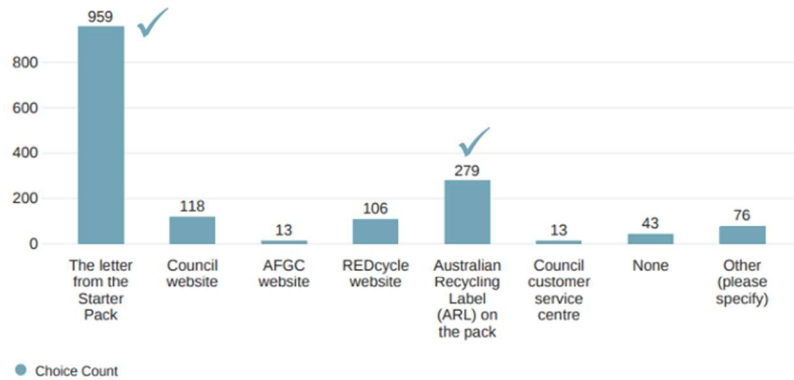
8

TRIALS: INFORMATION SOURCES

Q7 - What information have you used to determine what to put in the special bag? - Selected Choice

Over 80% respondents used the letter in the Starter Pack, and

24% referenced the ARL.

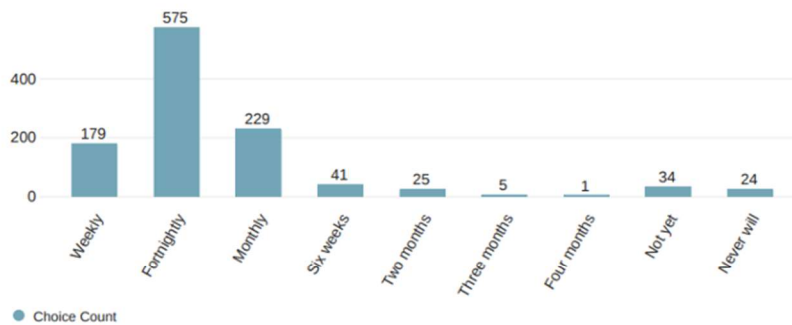


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9

TRIALS: FREQUENT USE

Q5 - How often are you putting a supplied special trial bag in your recycling bin?



Most households are using the bags fortnightly. We will consider changing our next round of communications requesting residents:

- Fill the bags (greater weight)
- Place in the bin less frequently

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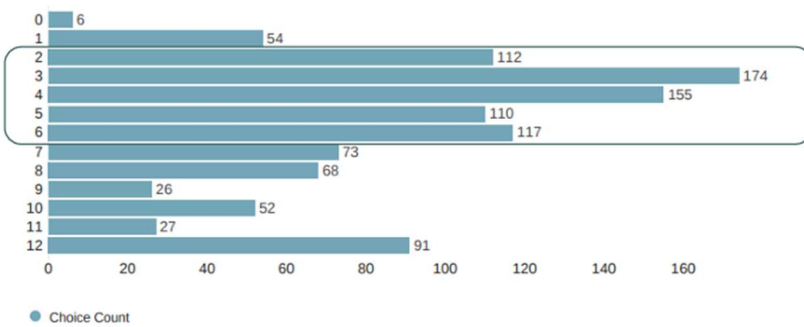
10

TRIALS: NUMBER OF BAGS USED

Most households had used only 2-6 bags at the time of doing the survey (2-3 months into the trial period).

This highlights the continual growth in household participation, and is reflected in collection volumes.

Q6_1 - Supplied bags used

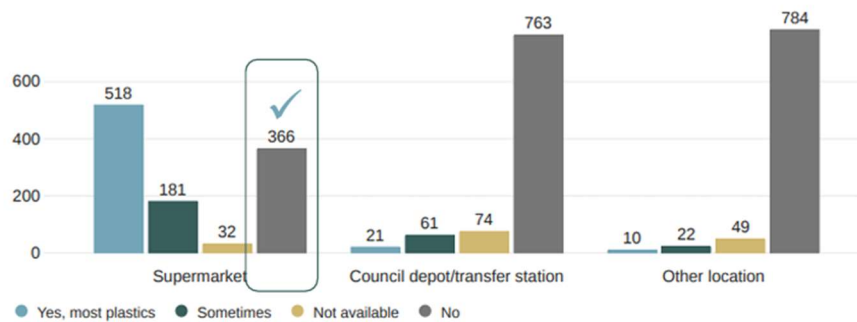


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TRIALS: PREVIOUS RECYCLING HABITS

Q8 - Did you previously drop off your soft plastics for recycling at the:



50% increase of households recycling soft plastics in kerbside vs REDCycle

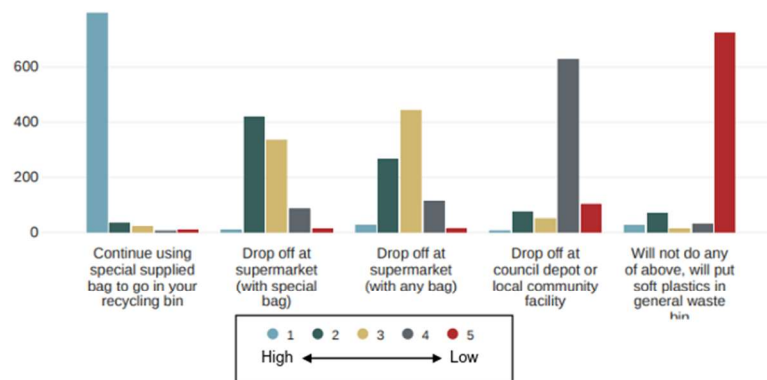
- ✓ 50% of households previously used REDCycle frequently
- ✓ 10% previously used REDCycle occasionally
- ✓ Over 1/3 never recycled any soft plastic before
- ✓ Most households had not used council depots or other locations.

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TRIALS: PREFERENCES FOR FUTURE

Q9 - Please rank your preferences for soft plastics recycling in the future by dragging them into your desired order.



1st preference for almost all respondents is to continue with bag program. Less than 5% will not bother and will put soft plastic in general waste.

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The following comments are examples verbatim quotes from community survey respondents:

TRIALS PROGRESS

Q10 - Would you like to share any ideas, comments or improvements you think could help this program grow? (cont.) (Unedited, verbatim from respondents)

Support: *

- Wonderrui program. I really hope it continues into the future.
- This is easier and more convenient than RedCycle I really love it and I hope it stays, I used to forget to take my bags to RedCycle a lot.
- Just keep doing it. It's so good and people will catch on through word of mouth.
- Keep it up and expand. Please provide more information on how it is recycled and what it is then used for.
- We are so pleased to have this option in the Adelaide city council. We have a small child and the volume of soft plastic we unfortunately go through is high. To be able to responsibly recycle these materials is a very big relief for us. Thank you!
- All my rubbish is soft plastic. Don't need to put general bin out every week, now it goes out monthly. Fabulous innovation and frightening how much plastic in our lives esp online deliveries.

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*These are examples of Verbatim comments from respondents

TRIALS PROGRESS

Q10 - Would you like to share any ideas, comments or improvements you think could help this program grow? (cont.)

REDCycle:

- If you go back to shopping centre drop offs then they need to empty the receptacles more often as they are usually overflowing when you drop off your soft plastics.

Negative comments:

- Got to say I've found this an inconvenience thinking about which plastic goes where and washing some wrappings so they are clean enough to recycle. To add to the difficulty when other members of the family don't care where their rubbish goes, I find myself sorting through garbage to rescue the soft plastics. I wish the process was easier.
- It's very restrictive not being able to recycle anything that might have food residue.
- Fix the roads they are a disgrace you can tell the minute you cross to another shire the roads are not falling apart.

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15

TRIALS PROGRESS

Q10 - Would you like to share any ideas, comments or improvements you think could help this program grow? (cont.)

Bag design and availability:

- Where can I get a red bag?
- I prefer bags are cylindrical shape, tubular shape bag. So that bags can fit into bin that most houses have.
- I have not checked the website but hope the orange bags has been made from recycled materials and this should be identified on the bag.

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16

TRIALS: WRITTEN COMMENTS

Q10 - Would you like to share any ideas, comments or improvements you think could help this program grow?

Education and awareness:

- Advertising it more.
- I think that the council can film an advertisement on TV or on radio. More knowledge needs to be made aware of this program.
- Advertise / promote so more people are aware of the program & are also aware of how to recycle soft plastics the right way.

Information requests and suggestions:

- Include information to residents on how to reduce their plastic dependence.
- More info re the types of soft plastics that can go in the bin.

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17

Appendix B

Bag Condition Audit

MRA undertook the bag condition audit at the APR facility in Dandenong, Victoria.

Methodology

After sorting at the relevant MRF, bags were transported from the Councils/MRFs involved in the trials to the APR facility in either a baled or unbaled format, refer Table 19.

Table 19 Bag condition audit sample details

Council	Albury	Wodonga	Macedon Ranges Shire Council	City of Charles Sturt	City of Port Adelaide Enfield	City of Adelaide	City of Newcastle	Central Coast
Bag gauge, type, colour	50uM Satchel Orange	50uM Satchel Orange	45uM Singlet Orange	45uM Singlet Orange	37uM Singlet Yellow	37uM Singlet Yellow	37uM Singlet Yellow & Any bag	37uM Singlet Yellow & Any bag






For unbaled samples:


1. Bags were counted and then weighed in groups of 10.

For baled samples:

1. The bale wire was cut to open the bale.
2. The outer bags of the bale were removed to access the inner bags, i.e. those not impacted by the baling and transport process. This method was chosen so that the results for baled and unbaled samples could be compared.
3. 300 inner bags were counted and sorted into the condition categories in Table 20.
4. Bags were counted and then weighed in groups of 10.

Table 20 Bag condition categories

Condition category	Condition status	Description	Example image
Sealed, no split	Acceptable (ideal)	Bag remained completely intact and sealed without splits or tears.	
Sealed, minor split	Acceptable	Bag was sealed with a minor split where minimal plastic could escape.	
Split, leaking	Not acceptable (bag fail)	Bag had large split where plastic could easily escape from. Considered a bag fail as bag did not withstand the collection and sorting process.	
Burst bag	Not acceptable (bag fail)	There were no contents within the bag: bag was empty and partly shredded). Considered a bag fail as bag did not withstand the collection and sorting process.	
Poorly sealed, unsplit bag, leaking	Not acceptable (resident fail)	Bag was without tears, but plastic is leaking out the top due to being poorly sealed by resident. Considered a resident fail.	

Condition category	Condition status	Description	Example image
Unsealed, unsplit leaking (empty, whole)	Not acceptable (resident fail)	There were no contents within the bag. Considered a resident fail as bag was not properly sealed by resident (i.e. untied).	 <p>(Source: ECS Audit Report)</p>

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