Australian Material Recovery Facility Infrastructure Survey 2023

Prepared for

The Australian Packaging Covenant Organisation
and
The Australian Council of Recycling

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APCO Foreword

This survey represents a facility-by-facility assessment of MRFs across Australia. Its purpose is to understand the nature and type of infrastructure and to determine resource recovery functions and outputs. The data collected has been anonymised and aggregated to protect the identity of individual MRFs, ensuring that the findings can be publicly shared without compromising commercial sensitivities. The nature and type of infrastructure at these facilities play a significant role in their resource recovery functions, capabilities, and capacities.

The objective of this survey was to build a detailed, timely, and accurate evidence base that captures the diversity and performance of MRFs in Australia. This is no small task, as the country's MRF infrastructure varies widely, from highly automated plants with leading-edge technologies serving large metropolitan populations to smaller, manual-sorting facilities. Understanding this diversity is crucial for informing a range of industry, policy, and regulatory outcomes, particularly concerning the Australasian Recycling Label (ARL), an on-pack labelling scheme. The ARL is critical in helping consumers recycle correctly and encouraging brand owners and manufacturers to design recyclable packaging.

Valuable information was collected at a high level, revealing a range of MRF typologies, which can inform an approach to segmenting facilities for a more targeted analysis. However, access to more granular data was limited by commercial sensitivities. Recognising the importance of addressing the potential gaps between ARL recyclability thresholds and MRF capabilities, APCO plans to undertake subsequent consultation across the industry in addition to engagement through the ARL program's governance structure. These consultations will aim to gather the necessary insights while respecting commercial boundaries, ultimately ensuring that the ARL program continues to evolve in alignment with the realities of Australia's recycling infrastructure.

The findings of this survey provide an opportunity to consider the broader implications of the data presented. This report is a call to action for all of Australia's recycling ecosystem stakeholders. It underscores the importance of collaboration across the packaging value chain to enable APCO to align recyclability thresholds with the capabilities of our MRFs, not only to improve the accuracy of the ARL but also to foster innovation and sustainability in the years to come.

In closing, I would like to extend my gratitude to the MRF operators and industry stakeholders who contributed to this survey. Your insights and collaboration have helped advance our understanding of Australia's recycling infrastructure, and I look forward to the continued progress we will achieve together.

Kind regards,

Chris Foley
Chief Executive Officer
Australian Packaging Covenant Organisation Ltd

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1. Executive summary

The Australian Packaging Covenant Organisation (APCO) and the Australian Council of Recycling (ACOR) commissioned a survey of MRFs in order to:

- Provide a detailed, timely and accurate evidence base to understand the diversity of Material Recovery Facilities (MRFs) and their technical sortation capability
- Enable alignment of APCOs recoverability parameters with detailed current data from national MRF throughput
- Inform and contribute to a range of industry, policy and regulatory considerations

MRFs in Australia serve a range of functions. While primarily for the receipt and sorting of recyclable materials from households and businesses, MRFs are a key point in the whole recovery and recycling chain, with their function, capacity and performance determining overall recycling outcomes.

The MRFs in focus are those servicing Municipal Solid Waste (MSW) receipt and sorting, that is, household recyclables. This report does not address MRFs targeting commercial and industrial materials or e-waste only or paper only or the like.

The survey found that MRFs can be grouped by the following common elements:

Type	**Common elements**	**Infrastructure**	**Typical or targeted product output and specification (contamination)**
Large modern	100 ktpa, fine grades of fibre and plastic	Technology dependent, extensive optical sorting	2-3 fibre grades (<5%) Up to 5 plastic grades (<5%)
Large steady state	100 ktpa, fewer product grades	Older technology with manual quality control	2 -3 fibre grades (>5%) 3 + plastic grades (>5%)
Mid-size modern	About 50,000 tpa, fine grades of fibre and plastic	Technology dependent with manual quality control	2 or 3 fibre grades (<5%) Up to 5 plastic grades (<5%)
Mid-size steady state	About 50,000 tpa, fewer product grades	Older technology with manual quality control	2 or 3 fibre grades (>5+%) 3 + plastic grades (>5%)
Small modern	About 10,000 tpa, fewer product grades	Technology plus manual	1 or 2 fibre grades (<5%) 3 + plastic grades (<5%%)
Small manual	About 10,000 tpa, fine grades of fibre and plastic	Extensive manual sort	Three fibre grades (<5%) Five plastic grades (<5%)

The survey data covers MRFs that reported receiving and processing 2.004 million tonnes of material per year as at 2022 and the national total MSW material through MRFs is reported to be 2.122 million tonnes per year as at 2019-2020. Therefore, based on responses, data was gathered

covering 94% of MRF throughput in Australia.

The survey data was adjusted to allow for the reported and whole of economy total national MRF throughput.

The survey provided the following insights into current operations of Australia MRFs:

- 60 to 65 MRFs are processing a total of2 million tonnes of MSW kerbside recyclables in Australia per year as at 2022
- While 58 currently operating MRFs were identified and surveyed, six other MRFs are in the process of coming online or are mothballed but could come online in the future
- All MRFs differ in operations and infrastructure mix and a wide variety of factors determines MRF infrastructure

The following tables show that large and modern MRFs are processing the bulk of kerbside recyclables in Australia.

Findings by size of MRF - adjusted data				
MRF size	**Number of MRFs**	**MSW kerbside national whole of economy throughput (tpa)**	**Percentage by sites**	**Percentage by volume**
Large	9	1,152,860	16%	54%
Mid	13	615,880	22%	29%
Small	16	114,049	28%	5%
Not allocated	20	239,412	34%	11%
Total	58	2,122,201	100%	100%

Findings by type of MRF - adjusted data				
MRF type	**Number of MRFs**	**MSW kerbside national whole of economy throughput (tpa)**	**Percentage by sites**	**Percentage by volume**
Modern	23	1,436,749	40%	68%
Steady state /	15	446,040	26%	21%

manual				
Not allocated	20	239,412	34%	11%
Total	58	2,122,201	100%	100%

Modern MRFs that employ more and or newer technology were found to be producing more grades of end products (specifically plastics and paper or fibre) with a lower contamination rate than the steady state MRFs.

Steady state MRFs that use well proven technology generally are producing paper and plastics that require further downstream processing and sorting.

Small scale MRFs tend to be more labour orientated than mid-size or large MRFs but in many cases are producing multiple grades of high-quality end products.

Overall, the survey finds that MRFs are in a process of on-going development and change in response to factors including input material mix, policy and regulations, market availability, site availability and space, contracts for receipt and processing and technology and labour availability.

The survey identifies there has been significant investment in MRF infrastructure in the last five to seven years and despite tight global prices and forecasts, capital investment and on-going infrastructure change continues.

The infrastructure that is being chosen and used varies greatly across all types of MRFs.

To some extent all MRFs use manual sorting either at infeed to remove contaminants or to target certain materials, or at the end point to clean up materials and bales.

Small MRFs more commonly use greater manual labour, and many small MRFs report producing high quality outputs and products.

Large and mid-size MRFs use more technology as greater throughput enables return on capital investment, and speed of throughput makes manual processes harder.

Decisions about infrastructure and operating modes are complex and inherently risky. The factors that determine what infrastructure may are wide and varied and include but are not limited to:

- Return on investment expectation
- Business models and desired products and outputs
- Contracted volume
- Products and market outlook
- Suitability of site and place
- Availability of sufficient space
- Timing of contracts
- Regulation and compliance costs
- Technology availability
- Labour availability

MRF infrastructure ultimately reflects and determines functions, capability, capacity and performance. Infrastructure choices are determined by a wide range of factors and not only the desirability of a particular output, quality or specification.

The key output from the survey is data contained in two spreadsheets:

- ***Australian MRF Infrastructure Throughput Analysis_OCT_2023*** (providing detailed survey results of the types of MRFs, how much material is going through those MRFs and the recovery performance by MRF type for paper and plastics

- ***Australian MRF Infrastructure Equipment Analysis_OCT_2023*** (providing detailed survey results on the equipment being used in different types of MRFs and the materials being targeted)

The data in the spreadsheets and supporting information provides APCO and ACOR with on-going means to check and assess current MRF activity such as:

- Total capacity
- Capacity by MRF type
- Targeted materials
- Materials outputs
- Quality of material outputs
- Infrastructure type
- Infrastructure and processing (including manual sorting)
- Infrastructure employed by MRF type

This report supports those spreadsheets and data sets and provides context and overall findings.

2. Scope and purpose

APCO and ACOR are building a detailed, timely and accurate evidence base on MRFs in Australia in order to understand the diversity and performance of MRFs and to inform a range of industry, policy and regulatory outcomes, including alignment of APCO's recoverability parameters and the Australasian Recycling Label.

This project scope recognises that MRF infrastructure ranges from sophisticated plants employing a range of modern technology servicing large populations and processing large volumes of materials, to smaller facilities relying on manual sorting and servicing smaller volumes and populations.

It also recognises that the nature and type of infrastructure at MRFs reflects and determines the recovery functions and outputs.

The survey is a facility-by-facility exercise to gather, document and interpret current MRF infrastructure.

The focus for the work is MRFs servicing Municipal Solid Waste (MSW) and kerbside recycling from Australian households. It does not include MRFs servicing commercial and industrial recycling and specific limited material streams such as paper only or e-waste.

The survey period is 2022 calendar year.

The data collected is aggregated and anonymised in order to respect and address any concerns about commercial in confidence information.

3. Method

The methodology for the survey and report and was co-designed by the consultants and APCO and ACOR, in consultation with ACOR's membership.

The engagement undertook detailed initial project planning to determine the steps to be taken and ensure the brief was being addressed.

The method for the project included the following key steps:

1. MRF identification - Identify and check on MRFs servicing MSW and operating during the period of calendar year 2022, including informal discussions with MRF operators about the project and desktop research to ensure completeness.
2. Survey preparation - Develop, test and finalise a detailed survey document and process.
3. Data management - Develop process and documents to capture and record detail of material flows through each MRF and equipment and infrastructure employed
4. Survey and MRF contact - Surveys supplied to all identified MRFs and contact made directly with appropriate people, assist with detailed survey responses and conduct interviews.
5. Research – Access and review public, third party and other reports and data about MSW recycling and MRFs
6. Data checking - Self-reporting from participants and therefore claims and statements not tested or audited however two-point verification used for some sites that did not provide detailed responses and to ensure accuracy of data. Data management and protection

protocol developed to ensure protection of any sensitive data and to protect the anonymity of participants

7. Analysis – Data protocol for analysis and results to ensure they are anonymous and aggregated
8. Reporting – Reporting and presentation of survey findings and observations

The data provided and the basis of the survey is self-reporting.

Data provided from all participants was checked against published data, industry intelligence reports and other readily available sources but was not audited or tested beyond that.

Confidentiality

The scope and brief included the requirement that the identity of MRFs, their operators and any customer information be treated as commercial in confidence and not divulged.

Harford Consulting established a data security protocol that was followed for all aspects of the survey and project.

Further to the protocol, survey participants were also offered the opportunity to enter into a mutual non-disclosure agreement (NDA) with the consultant and, if required, with APCO and AOCR.

The methodology also accounted for confidentiality matters for the purposes of general participation. That is, some MRF operators expressed reluctance to participate due to concern about the confidential nature of matters such as their infrastructure, the material flow through their facilities, and tonnes processed. Such concerns were addressed through the protocol and NDA and also through discussions about the scope and purpose of the project, including the intended use of gathered data.

Grouping

Based on the research and initial survey findings and to enable anonymous and aggregated findings, the MRFs surveyed have been group by type.

The following table provides the grouping and the determinants used.

Type	**Common elements**	**Infrastructure**	**Typical or targeted product output and specification (contamination)**
Large modern	100 ktpa fine grades of fibre and plastic	Technology dependent, extensive optical sorting	2-3 fibre grades (<5%) Up to 5 plastic grades (<5%)
Large steady state	100 ktpa fewer product grades	Older technology with manual quality control	2 -3 fibre grades (>5%) 3 + plastic grades (>5%)

Mid-size modern	About 50,000 tpa fine grades of fibre and plastic	Technology dependent with manual quality control	2 or 3 fibre grades (<5%) Up to 5 plastic grades (<5%)
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Small modern	About 10,000 tpa fewer product grades	Technology plus manual	1 or 2 fibre grades (<5%) 3 + plastic grades (<5%%)
Small manual	About 10,000 tpa fine grades of fibre and plastic	Extensive manual sort	Three fibre grades (<5%) Five plastic grades (<5%)

Along with speaking to the MRF operators, stakeholders including traders and exporters, researchers and government officials were also consulted in the development and operation of the survey.

4. Findings

Capacity and throughput

Initial identification found 88 MRFs and individual sites and further inquiries and research determined 58 MSW MRFs currently operating for the survey period 2022.

The responses and engagement achieved 94% coverage of MRFs by throughput and 76% coverage by number of sites.

The survey provided data direct from respondents and other sources, and where a MRF did not respond or there were gaps in responses, research was done to determine the current throughput of any non-participating MRFs.

The survey and data throughput was then adjusted for a whole-of-economy to include the non-participating and provide a national throughput total for further analysis and results

The following table shows survey data throughput and the whole-of-economy throughput.

MRF infrastructure survey and data - volume throughput and or capacity				
State / Territory	**Survey and data (tpa)**	**Survey and data (%)**	**Adjusted whole of economy national throughput (tpa)**	**Adjusted whole of economy national throughput (%)**
ACT	66,500	3%	66,500	3%
NSW	515,735	26%	581,547	27%
NT	36,000	2%	36,000	2%
QLD	379,005	19%	389,005	18%
SA	124,180	6%	124,180	6%
TAS	75,654	4%	75,654	4%
VIC	585,830	29%	592,830	28%
WA	221,485	11%	256,485	12%
Total	2,004,389	100%	2,122,201	100%

As noted the groupings enable assessment and examination of the different types of MRFs in an aggregated and anonymous manner.

The following table provides the breakdown of volumes of materials being handled by the different types of MRFs.

MRF Type	Survey and response data			Adjusted data		
	Number of MRFs (survey data)	MSW throughput (tpa)	Percentage of all MRFs	Number of MRFs (total national)	MSW kerbside national whole of economy throughput (tpa)	Proportion of all MRFs national whole of economy (%)
Large Modern	7	976,360	49%	7	976,360	12%
Large steady state	2	176,500	9%	2	176,500	3%
Mid-size modern	9	390,300	19%	9	390,300	16%
Mid-size steady state	4	225,580	11%	4	225,580	7%
Small modern	7	70,089	3%	7	70,089	12%
Small manual	9	43,960	2%	9	43,960	16%
Not Allocated	6	121,600	6%	20	239,412	34%
Total MRFs	44	2,004,389	100%	**58**	**2,122,201**	**100%**

The survey data in the above table again illustrates that the survey covered 94% of the total volume of materials going through MRFs.

The survey data and assessment by MRF grouping and type was adjusted to allow for a whole-of-economy throughput by MRF type.

The following table provides a breakdown of throughput of materials by MRF size and type based on the survey responses and data.

Findings by size of MRF - adjusted data				
MRF size	**Number of MRFs**	**MSW kerbside national whole of economy throughput (tpa)**	**Percentage by sites**	**Percentage by volume**
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The key findings from the capacity and throughput assessment include:

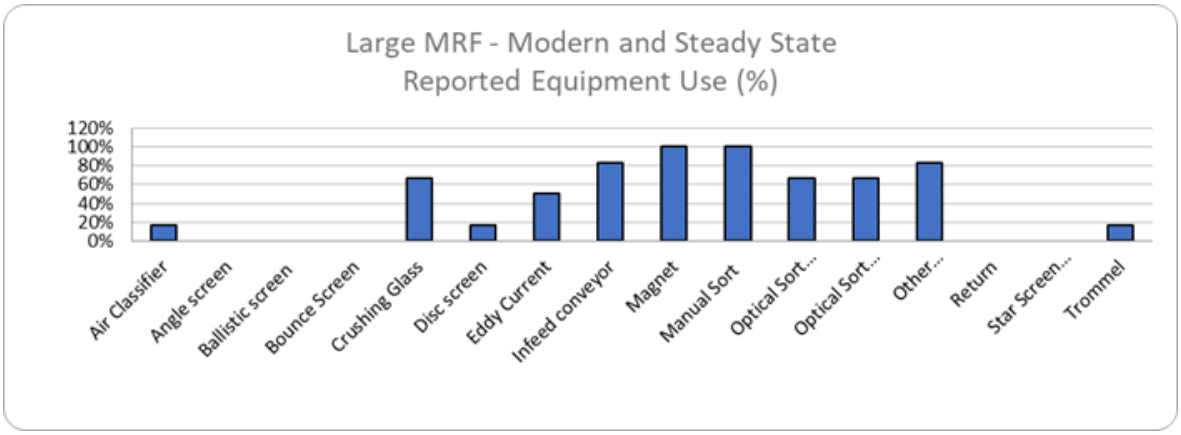
- Large MRFs are 16% by total number of MRFs and 54% by total national volume throughput
- Mid-size MRFs are 22% by total number of MRFs and 29% by total national volume throughput

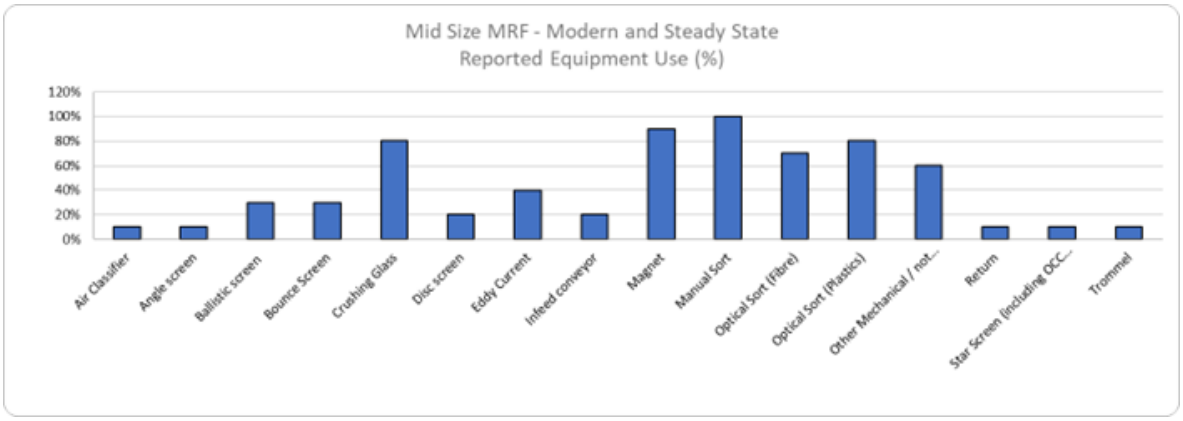
- Small MRFs are 28% by total number of MRFs and 5% by national volume throughput
- Modern MRFs are 40% by total number of MRFs and 68% of total national volume throughput
- Steady state and manual MRFs are 26% by total number of MRFs and 21% of total national volume throughput
- 34% of MRFs by number and 11% by throughput not able to be allocated

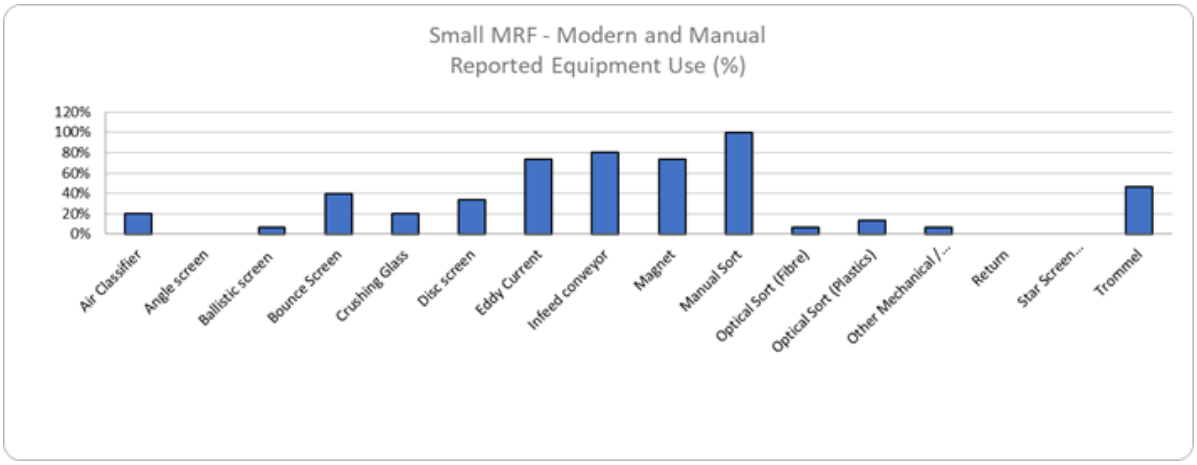
Infrastructure and technology

The infrastructure that is being chosen and used varies greatly across all types of MRFs.

The following provides an overview of the application and use of different infrastructure across large, mid-size, and small MRFs.







As the above illustrates there is some common technology widely used across all sizes of MRFs and that to some extent all MRFs use manual sorting – either at infeed to remove contaminants or target certain materials (such as a pre-sort), or at the end point to clean up materials and bales or at points in between.

The survey does not enable distinction between manual approaches at pre-sort and elsewhere in the MRF operations.

Small MRFs more commonly use greater manual labour and have less automated sorting, and many small MRFs produce high quality outputs and products.

Large and mid-size MRFs use more technology and automated sorting. Greater throughput not only makes return on capital investment more feasible, but the speed of throughput needed to process large volumes makes manual processes harder.

The survey found there is an increased and increasing use of optical sorting for both paper and plastic, especially in large MRFs, and that there is some initial use of other robotics in large and mid-size MRFs to target specific materials or to clean up product.

5. Conclusion and observations

The survey confirms that MRF infrastructure reflects and determines functions, capability, capacity and performance.

Interviews and research for the survey finds that MRFs are in near constant development. That is, MRFs are not a set-and-forget operation but rather complex facilities that require on-going attention, modification, and refinement to adjust to factors including material in-feed quality and quantity, equipment performance and end-market specifications and demands.

Decisions about the type of infrastructure and operating modes at MRFs are complex and inherently risky. The factors that determine what infrastructure may be used are wide and varied. They include but are not limited to:

- Return on investment expectation
- Business models and desired products and outputs
- Contracted volume
- Products and market outlook
- Suitability of site and place
- Availability of sufficient space
- Timing of contracts
- Regulation and compliance costs
- Technology availability
- Labour availability

This survey and related research enable the following concluding observations with respect to MRF infrastructure currently:

Modern MRFs performance differs compared to steady state MRFs – The former is generally producing more grades of products (particularly plastics and paper) at a higher quality and lower contamination rate. Many mid-size MRFs are employing a relatively basic initial sort that extracts saleable metals and glass streams but has all or some mixed plastics and paper that requires further downstream processing.

Significant investment has been made over the last five years and is on-going – Especially in larger MRFs where greater use of optical sorting equipment is targeting more and cleaner grades of plastics and paper or fibre. There is also investment in new, upgraded, or rebuilt facilities that are coming online.

Global prices and outlook are tight – Especially for some grades of plastics and paper there is a market expectation of low prices that may impact infrastructure investment decisions.

The survey has provided APCO and ACOR with detailed, timely and accurate evidence to understand Australian MRFs, their diversity and their performance.

The key output from the survey provides APCO and ACOR with on-going means to check and assess current MRF activity including:

- Total capacity
- Capacity by MRF type
- Targeted materials

- Materials outputs
- Quality of material outputs
- Infrastructure type
- Infrastructure and processing (including manual sorting)
- Infrastructure employed by MRF type

The survey will facilitate on-going assessment of MRF performance and inform a range of policy deliberations.

MRFs will of course continue to evolve based on a wide range of factors and not only the desirability or requirement to meet a particular output.

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