



zero waste network

SYDNEY

Reuse Impact Measurement Pilot Project: Final Report

Prepared by Matthew Allen, ZWN-S Network Facilitator

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Executive Summary

The Zero Waste Network Sydney (ZWN-S) is a regional division of the Zero Waste Network Australia. ZWN-S members are community-run reuse, repair and recycling organisations (CREs), and primarily identify themselves as social enterprises. Through a partnership with SSROC, ZWN-S initiated an Impact Measurement Pilot Project to design and trial methodologies for collecting and communicating the impact of CRE activity in the Sydney region.

Four CREs participated in this Pilot Project; Reverse Garbage, The Bower, Dunmore Reuse Shop, and Moss Vale Reviva Shop. Each site provided data collected over a 6-week period to ZWN staff, who conducted further analysis on the data at an individual site and aggregate level. The data collected during the 6-week trial period suggests that CREs represent a significant force for environmental impact and job creation in NSW, and that their work should be recognised as an essential component of waste management efforts in the state.

Following the design and implementation of a data collection method at the pilot group sites, a series of follow-up consultations and meetings were held to develop specifications and requirements for future data collection efforts. All participating sites agreed that improved data collection was essential to the success of their work, and that the measurement of waste diversion and reuse should be prioritised by state and local governments in NSW.

The growth and development of the CRE sector in NSW represents a significant opportunity to move citizens up the waste hierarchy with their values, choices and actions. In order for the sector to grow, and for resources to be allocated effectively, both baseline and ongoing data is essential. The majority of funding and support for waste management is currently targeted at improvements in recycling practices, with reuse remaining an area of activity that is under-resourced and largely unrecognised. This report closes with some recommendations for policy settings and practical programs that will address this issue, bringing reuse measurement practices into line with those already established for recycling and landfilling, while supporting the growth and development of enterprises that reduce waste to landfill, create sustainable employment opportunities, and educate the public about waste, reuse, repair and recycling.

1. Project Goals

The principal objective of the Impact Measurement Tool (IMT) Pilot Project has been to drive an increase in diversion of waste from landfill by developing a process for accurately recording and accounting for the waste diversion activities of ZWN-S members. The completion of a pilot project with a small group of enterprises was identified by researchers from the Centre for Social Impact Swinburne¹ as a critical step towards the creation of a sector-wide impact measurement approach linking the social, environmental and economic impacts of community reuse and recycling activity. In addition to the collection of high-quality data from participating sites, the project aimed to make progress towards sector-wide standards for data collection, as well as producing a draft design brief for a software tool or platform suitable for the needs of the sector.

1.1. Data Collection

The collection of impact data for individual participating sites was an important goal of this project, providing an immediate benefit to both the participating organisations and the Zero Waste Network. For participating organisations, the availability of improved data regarding their operations will allow the expansion of successful initiatives, and the allocation of resources to new programs. For the Zero Waste Network, the collected data represents an opportunity to advocate on behalf of the sector, and to demonstrate the potential for future activity, particularly in the areas of reuse, repair and waste education.

1.2. Development of Measurement Standards

Throughout the process of delivering the pilot project, significant efforts were made to ensure accuracy and verifiability of data, while taking into account the diversity of site requirements and collection methods. Due to the potentially enormous variety of goods being processed for reuse, the collection of individual item data was deemed impractical for most enterprises, necessitating the use of a weights-based system in which material composition of items was estimated. Furthermore, due to the differing benefits of recovering various types of material from landfill, it was necessary to reduce all enterprise data to weights of various material categories, which in themselves are necessarily only an approximation of material type.

1.3. Development of Design Brief for IMT

CREs have specific requirements for the collection, harmonisation and communication of impact data, and as such, an important outcome of this pilot project was the development of an initial design brief to inform development of a sector-wide data collection tool. This tool, which is expected to comprise a software and/ or hardware interface and a cloud-based data harmonisation platform, will bring reuse and repair-focussed enterprises into line with the data collection standards currently applied to the recycling, reprocessing and landfilling industry in NSW.

2. Project Methodology

The project engaged four community-based reuse and recycling enterprises, each of which used a combination of existing measurement methods, pallet jack scales and goods cages to make accurate weights measurements of goods being processed over a 6-week period. Additional information regarding the social impact of each enterprise (for example, employment outcomes) was

¹ Centre for Social Impact 2017, 'Community Recycling Enterprises NSW: Impact Measurement Project (Final Report)', available at <<https://researchbank.swinburne.edu.au/items/6cb6ce44-da9a-42a0-a072-5d5d243776ab/1/>>

also captured, using interviews with key staff, data from organisational Annual Reports, and data from internal databases such as point of sale systems and staff records.

2.1. Assumptions

2.2.1. Representativeness of Trial Period

A key assumption in this project is that the 6-week period during which data was collected can be taken as a representative sample of enterprise activity. This assumption was made for a number of reasons; chiefly, that current levels of data collection makes it impossible to track material flows from acceptance/ donation/ collection through to final the point of sale or landfilling. As such, it is assumed that goods accepted for reuse during the trial period would be reused eventually – although this might not have occurred during the trial period itself.

Further, it was assumed that quantities of material landfilled and given for recycling would be broadly representative across the 6-week period, meaning that an adjustment to reuse figures to account for landfilled items could be applied, using the known data of total weights sent to landfill during the trial period.

2.2.2. Weighbridge Data:

One of the participating sites (Moss Vale) utilised a Council weighbridge to collect the weights of donated items. The weighbridge scales were not able read any weights below 20kg. Where a donation under 20kg was recorded, a nominal weight of 10kg per non-weighed donation was used. (0.01 t).

There were 157 of 400 drop-off entries where numbers were illegible and/or did not match with weighbridge records. This was due to clerical errors, with reuse shop staff being required to enter an 8-digit ID number against each customer donation. In order to include material composition data for these non-weighted transactions, an average was taken of all correctly recorded weighbridge figures, equating to 40kg per transaction across 479 transactions. This average figure was then applied to the 157 non-readable entries. (0.04 t).

2.2.3. Item-Weight Data

The following material composition estimates of household items were used where material composition was not obvious from item description, and/ or item descriptions were provided without material breakdowns.

Material breakdown figures were adapted from item-weight research conducted by Resource Work Cooperative in 2015.²

Soft furnishings: 15% Foam/ Rubber, 5% Textile, 80% Wood.

General Whitegoods: 50% Metal, 50% Plastic.

Bric-a-Brac/ Generic/ Uncategorised: 10% Brick/Concrete, 10% Ceramic/ Pottery, 10% Foam/ Rubber, 10% Glass, 10% Metal, 10% Paper, 10% Plastic, 10% Textile, 20% Wood.

² Resource Work Cooperative 2015, Waste and Resource Recovery Audit of McRobie's Gully Landfill: Report to Hobart City Council.

2.2.4. E-waste:

At a number of sites, E-waste was segregated and separately weighed. In order to calculate the material composition of E-waste given for reuse, a modified weighted percentage of materials across all types of E-waste was used, based on a 2005 research study into global E-waste material composition³. These figures (rounded from the original study to the nearest 1%) were 12% Glass, 65% Metal, and 23% Plastic.

2.2.5. Landfill data:

Because landfill data is provided as a single figure, it was assumed that materials were landfilled in approximately the same percentages as they were accepted. For example, if plastic represented 40% of all accepted materials, it would be assumed that plastic also represented 40% of all landfilled materials.

2.2. Data Capture Process

Two distinct processes of data collection for reuse were used in this trial; in three of the participating sites, a material-weight system was used, whereby loads of goods accepted for reuse were weighed, and their material composition estimated. In one participating site, an item-weight system was used, whereby the type and quantity of each item accepted for reuse was recorded, and average weights and material composition for each item type applied to arrive at a total weight of diverted materials. For social indicators, including details of staff and workshops, data was sourced from anonymised Human Resources records.

For sites utilising weights-based measurements, data for reuse weights and material composition was recorded using a printed-out copy of the ZWN datasheet (Appendix A), with copies of the datasheet being kept onsite near measurement equipment. For the site using an individual item-weight system, records were kept by collection service drivers and at the point of donation, as per existing organisational processes.

The following diagram illustrates the flow of materials and data in a typical application of the pilot project approach, with blue representing material flows and green representing data flows.

³ R. Widmer et al., 'Global Perspectives on E-waste', Environmental Impact Assessment Review 25 (2005) 436–458

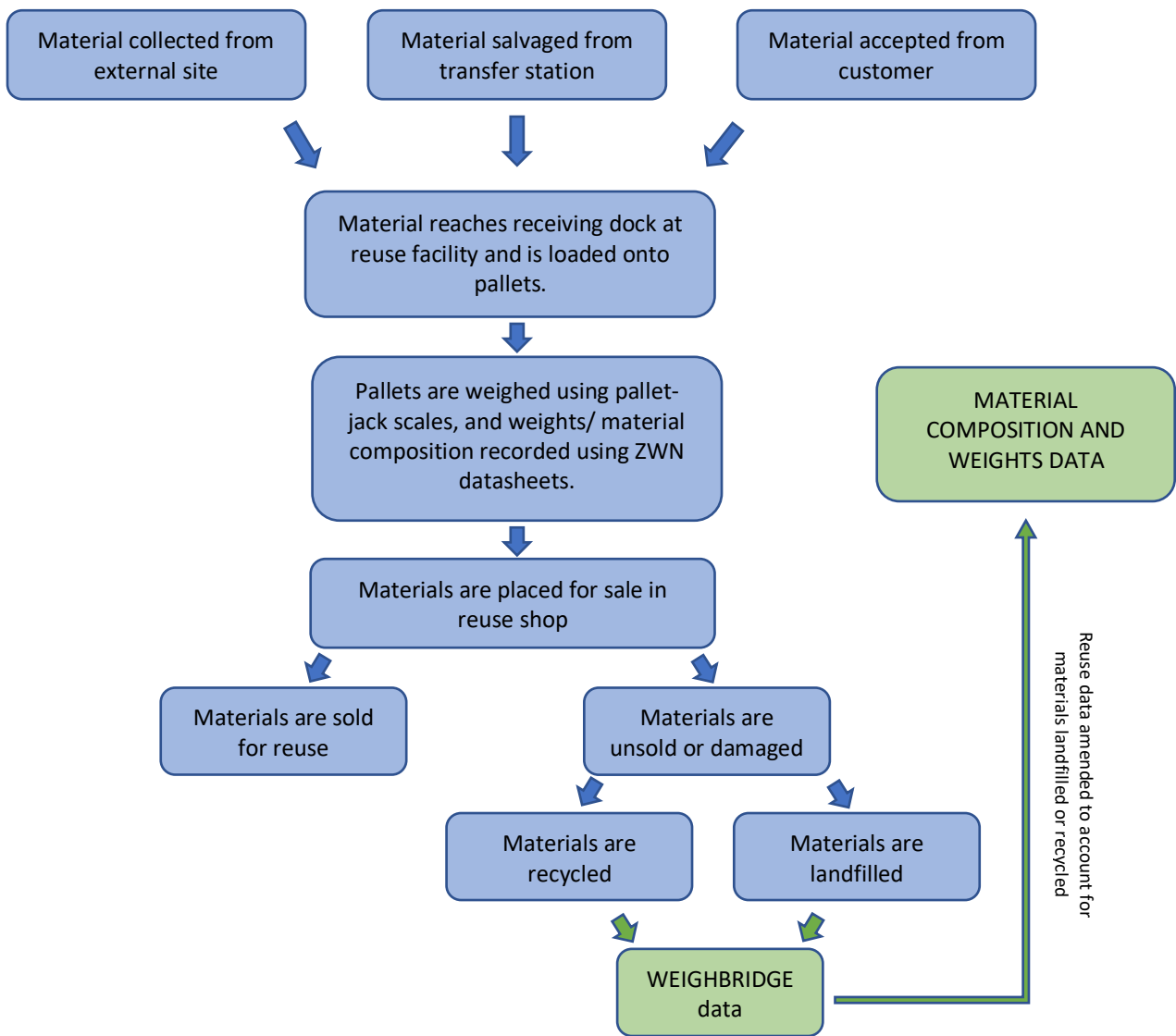


Fig. 1: Material and Data Flowchart for Pilot Project

2.2.1. ZWN Datasheet: Load details

Load Type	Description	Data Collection Method
DO (Drop-off)	Materials dropped off to the site by customers	Site staff collect Load ID information from council weighbridge or printout from pallet jack scales, and record the details of Load Composition. Load ID can later be matched with load composition by site staff or ZWN project staff.
REC (Recovery)	Materials recovered from landfill/ transfer station site	Site staff collect load ID information from council

		weighbridge or printout from pallet jack scales, and record load composition details alongside Load ID and total Load Weight.
COLL (Collection)	Materials collected from an external location (residence, business) by staff	Site staff collect Load ID or item-weight data upon receipt of items, and record weights (where relevant) alongside Load ID and Load Composition.
DUM (Illegal dumping on-site)	Reusable materials dumped at site without permission	If reusable, material weights and composition were estimated by site staff.

2.2.2. ZWN Datasheet: Load Composition

Pilot group sites were required to estimate the percentages of different materials that make up the loads they accept for reuse, with staff estimating what percentage of the total load weight was represented by each item type. When making these estimates, it was proposed that increments of 10% be used, and that staff ‘round up’ where an item was primarily composed of one material. For example, if 50% of a load was timber chairs with fabric trim and 50% was light metal, the load was recorded as 50% Wood and 50% Metal (light).

If an entire load was E-Waste, sites were instructed to write ‘E-Waste’ across the load composition row, rather than estimate the material composition of each e-waste load.

In addition, sites were instructed to enter a total percentage for materials that were to be recycled, not reused. Examples: polystyrene or bulk cardboard collected Council Transfer Stations. Further data regarding recycled materials was collected from the records of waste and recycling contractors servicing pilot group sites.

Material type	Description/ Examples
Bricks / Concrete	Bricks, mortar or concrete. Examples: bricks with mortar, concrete containing steel reinforcing. Excluding: fibre cement
Ceramics, tiles, pottery	Examples: terracotta roof tiles, pottery, porcelain products. Excluding: bricks and concrete.
Foam/ Rubber	Examples: Foam mattresses, wetsuits, rubber matting
Glass	Examples: glass in the following form - windows, bottles, plate glass, glass fines. <i>Excluding: perspex, fluorescent tubes, light bulbs.</i>
Metals (Heavy)	Examples: Scrap steel, car bodies, lead, copper, brass
Metals (Light)	Examples: Aluminium frames, light steel furniture
Paper or cardboard	Examples: Books, Stationary, Folders

Plastic	Examples: perspex, PVC piping, astro-turf, polystyrene, plastic weed matt, pool liners, polypropylene, extruded plastic, plastic crates.
Textiles	Clothing, artificial and natural fabrics, curtains, sheets etc.
Wood, trees or timber	Examples: Raw, treated or painted timber, furniture, wooden crates, wooden packaging, wooden pallets, MDF, chipboard, particle board, masonite. <i>Excluding: plastic coated timbers.</i>
Recycling	Items that have been recovered from landfill or donated by customers, but will not be reused or sold for reuse. Examples: Aluminium cans, polystyrene, cardboard, plastic bottles.

3. Process Summary

3.1. Rapid Prototyping

The rapid prototyping approach to design involves launching an early approximation of a final system or product, and refining it in a process of iteration and collaboration with users as they become more familiar with its application. In this project, the system under development has been a weights-based measurement system for reuse, utilising recording equipment and volumetric assessment to arrive at figures for materials given for reuse. Due to the limited capacity of participating sites to contribute to the early-stage design of this process, rapid prototyping was considered an ideal way to initiate data collection without waiting for an ideal off-the-shelf solution. While the quality and reliability of actual data collected is of importance for this project, it should be seen as secondary to the goal of developing, trialling and iterating a new approach to impact measurement for the community reuse and recycling sector.

In this project, the application of a rapid prototyping approach involved the adoption of an existing measurement system, whereby a pallet-jack scale was used to weigh all loads of incoming items. This system, although in use at a number of sites, did not record item type or material composition. ZWN project staff worked with participating sites to design a process for collecting this data that avoided double-handling of materials and minimised additional time required to process items. Due to the slightly different operational requirements of each site, four separate sets of data collection guidelines were developed (Appendix B). In order to ensure the integrity and comparability of data, no changes to collection methods were made over the course of the 6-week data collection period. Following the conclusion of this period, a feedback and design workshop was held with representatives from the participating sites, with their input forming the final stage of the project.

3.2. Challenges

A number of challenges were encountered in the data collection process, with a series of on-site visits with management staff being key to the project's success. This highlights the importance of grounding impact measurement approaches in experiences of the different conditions under which CREs operate. In a number of cases, changes in staffing resulted in delays to the project, or difficulties getting completed data sheets returned to ZWN staff. Clerically, the process of entering weights-based data in a spreadsheet is relatively time-consuming, and at one

participating site, a number of errors were made due to the requirement to correctly enter an 8-digit Load ID number for each load.

In terms of data accuracy, reuse presents an inherent challenge for accurate recording due to the sheer number and diversity of items accepted for reuse. Furthermore, there is limited publicly available data regarding the average weight and material composition of commonly reused items. There is also no accepted standard, either at a state or federal level, for validating that reuse has occurred. At the beginning of the project, it was assumed that items donated to reuse operations should be considered to have been reused once they arrive at the store, notwithstanding adjustments to account for shrinkage and landfill. However, an alternative argument is that items should only be considered to have been reused once they have been sold to a customer or donated to a third party. This highlights an inadequacy of current regulatory approaches to reuse, and the need for state governments to work with industry in developing standards for data capture and verifiability of reuse activity

An additional challenge emerged when deciding how to categorise different forms of impact, particularly in the area of community engagement. A number of participating sites deliver community workshops as part of their commitment to educating the general public about waste, consumption and resourcefulness. While these workshops do not necessarily contribute directly to the reduction of waste, they are nonetheless an integral part of the services provided by CREs. As such, for the purposes of this pilot project the provision of workshops was counted as a social impact metric, with any waste diversion recorded (through repair, reuse or upcycling workshops) added to the total reuse figures for the relevant organisation.

4. Impact Data

Through consultation with participating enterprises, sets of environmental and social impact indicators were developed. These indicators were based on the recommendations of Centre for Social Impact Swinburne’s 2017 study into the impact measurement approaches of CREs in the Sydney region (ref). Impact indicators used, alongside the measurement units and data sources, are listed below, followed by the results collected over the 6-week pilot project.

As the primary focus of this project was on reuse and repair, participating organisations were asked to segregate recycling data wherever possible; for example, counting only the employees who were engaged directly in reuse activity. As such, recycling data has not been presented for some sites, which conduct recycling operations separately to their reuse facilities and/or are not responsible for recycling operations on their site.

4.1. Environmental Impact

4.1.1. Environmental Indicators

Data type	Measures used	Source(s)
Reusable materials collected/ recovered <ul style="list-style-type: none"> • Via collection service(s) • Via counter drop-off • Via confirmed referral 	Weight in tonnes, categorised according to material composition.	Pallet scales, Council weighbridge, incoming materials databases – as per site-specific Data Collection Guides

Materials processed through repair facilities	Weight in tonnes, categorised according to material composition.	Pallet scales, participant evaluation forms
Materials sent to landfill	Weight in tonnes	Council weighbridge, waste contractor dockets
Materials sent for recycling (if relevant)	Weight in tonnes	Council weighbridge, waste contractor dockets

4.1.2. Environmental Data

Reuse (tonnes)	Site 1	Site 2	Site 3	Site 4	ALL SITES
Brick/ Concrete	0.2	0.4	1.08	0.41	2.09
Ceramic/ Pottery	0.56	0.8	1.53	0.87	3.76
Foam/Rubber	3.65	0.48	0.94	0.99	6.06
Glass	0.67	1.17	1.06	0.77	3.67
Metal	1.58	6.99	10.27	7.71	26.55
Paper/Cardboard	5.08	1.56	0.21	0.8	7.65
Plastics	6	3.16	2.51	3.05	14.72
Textiles	6.19	2.33	0.44	0.97	9.93
Timber	4.03	5.5	5.16	18.83	33.52
TOTAL	27.96	22.39	23.2	34.4	107.95

Recycling (tonnes)	Site 1	Site 2	Site 3	Site 4	ALL SITES
Paper/ Cardboard	0.24			0.14	0.38
Commingled	0.138			0.04	0.18
Metals	0.78			1.1	1.88
Timber	-			0.98	0.98
Chemicals	-			0.24	0.24
E-Waste	-			0.23	0.23
TOTAL	1.158	n/a	n/a	2.73	3.89

4.2. Social Impact

Participating sites were asked to present staffing, volunteer and other social-impact information for operations relating to reuse only, with reporting the impacts of recycling being outside the scope and purpose of this project.

4.2.1. Social Indicators

Data type	Measure used	Source(s)
Paid Staff	Number of staff employed and Total hours worked	Payroll / Timesheets
Volunteers	Number of volunteers	Timesheets

	engaged and Total hours worked	
Educational workshops	Number of workshops delivered and Details of workshop type, target age group(s) and length of workshop (if details available)	TBC with individual enterprises

4.2.2. Social Data

Staff (FTE)	Site 1	Site 2	Site 3	Site 4	ALL SITES
Regular	10.99	3.44	3.81	11.31	29.55
Vol	3.76	-	-	0.62	4.38
CSO/ WFD	-	-	2.18	6.35	8.52
TOTAL	14.75	3.44	5.98	18.28	42.45

Workshops	Site 1	Site 2	Site 3	Site 4	ALL SITES
Number	35	n/a	n/a	39	74
Total Attendees	2,716	n/a	n/a	n/a	2,716
Items (if relevant)	n/a	n/a	n/a	285	285

4.3. Data Analysis

4.3.1. Diversion Figures – Annual Projections for Sites

Projected annual diversion figures for participating sites were arrived at by calculating an average weekly diversion figure for each site, and multiplying that figure by 52.

Reuse (tonnes)	Site 1	Site 2	Site 3	Site 4	ALL SITES
Brick/ Concrete	2.6	5.2	14.04	5.33	27.17
Ceramic/ Pottery	7.28	10.4	19.89	11.31	48.88
Foam/Rubber	47.45	6.24	12.22	12.87	78.78
Glass	8.71	15.21	13.78	10.01	47.71
Metal	20.54	90.87	133.51	100.23	345.15
Paper/Cardboard	66.04	20.28	2.73	10.4	99.45
Plastics	78	41.08	32.63	39.65	191.36
Textiles	80.47	30.29	5.72	12.61	129.09
Timber	52.39	71.5	67.08	244.79	435.76
TOTAL	363.48	291.07	301.6	447.2	1403.35

4.3.2. Diversion Figures – Annual Projections for NSW

Projected annual diversion figures for all CREs in NSW were arrived at by calculating an average weekly diversion figure for all sites, multiplying that by 52 to arrive at an average

annual diversion figure for all sites, and finally, multiplying the average annual diversion figure for a single site by 40, this being the number of active CREs in NSW identified by the Centre for Social Impact's 2017 research.⁴

Reuse (tonnes)	Average	NSW projected
Brick/ Concrete	6.7925	278.4925
Ceramic/ Pottery	12.22	501.02
Foam/Rubber	19.695	807.495
Glass	11.9275	489.0275
Metal	86.2875	3537.7875
Paper/Cardboard	24.8625	1019.3625
Plastics	47.84	1961.44
Textiles	32.2725	1323.1725
Timber	108.94	4466.54
TOTAL	350.8375	14384.3375

4.3.3. Environmental Impact – Energy Conservation and GHG Emissions

The NSW EPA has an online tool, the Recyclator, to calculate the environmental impacts of recycling. This tool is not intended for calculating the benefits of reuse, and utilises a materials classification system that considers only those materials which are currently recycled through local government collection points. In the absence of any other more appropriate tool to calculate the environmental benefits of reuse in NSW, the projected figures for reuse activity in NSW were entered into the Recyclator tool. The following results were returned:

Material	Greenhouse benefits Tonnes CO₂ eq / tonne recycled	Greenhouse benefits Tonnes CO₂ eq	Cars permanently removed from roads	Black balloons saved (each black balloon is equivalent to 50 grams of carbon pollution)
Steel - other	0.44	1,556.72	373.9	31,134,400
Brick & tile	0.02	10.02	2.4	200,400
Concrete	0.02	5.56	1.3	111,200
Timber palettes / packaging	1.35	6,030.45	1,448.4	120,609,000
Sheet / laminated glass	0.02	9.78	2.3	195,600
Rubber tyres	1.07	863.49	207.4	17,269,800
Paper & boards	0.63	641.97	154.2	12,839,400
Mixed plastics (#7)	1.59	3,117.99	748.9	62,359,800

⁴ Centre for Social Impact 2017, 'Community Recycling Enterprises NSW: Impact Measurement Project (Final Report)', available at <<https://researchbank.swinburne.edu.au/items/6cb6ce44-da9a-42a0-a072-5d5d243776ab/1/>>

TOTAL				
TOTAL	-	12,235.98	2,938.77	244,720,000

While these figures indicate significant and largely unrecognised impacts of CRE activity in NSW, there are several gaps and inconsistencies, specifically:

- No impact figures were given for the recycling of textiles.
- Bricks and Tiles are grouped together in the Recyclator tool, whereas bricks and concrete are grouped together in the Impact Pilot Project. However, emissions impacts are the same for both these categories.
- The category 'rubber tyres' was used to calculate benefits for all foam and rubber products, despite the range of materials captured in this category.

These findings highlight the importance of developing a consistent methodology for assessing the true impacts of reuse and repair activity in NSW and Australia. A 2015 study in Scotland indicated that material consumption accounted for 68-74% of the country's total carbon footprint⁵. Given the increased attention being paid to issues of carbon emissions and climate change, it is essential that state and federal governments engage with the reuse, recycling and waste management industry as a central component of efforts to reduce carbon emissions and transition to a more sustainable economy.

4.3.4. Employment Intensity

According to a Federal Government study on employment levels in waste management⁶, recycling generates 9.2 FTE employees for every 10,000 tonnes of material processed, compared with 2.8 FTE employees for landfilling. A study conducted by the Queensland University of Technology in 2012⁷ found that Community Reuse and Recycling Enterprises created employment at a rate of 100 jobs per 10,000 tonnes of material processed. This figure includes CREs that manage both reuse and recycling operations, rather than just reuse operations.

In the current study, which sought to quantify the specific benefits of reuse, it has been possible for the first time to account for employment created as a direct result of reuse and waste diversion activity. In order to align the data collected with the metric of jobs per 10,000 tonnes, total hours worked by staff across the Pilot Project period were expressed as a weekly average, and an extrapolated annual total. These figures were expressed as full time equivalent roles (37.5 hours per week). A common multiplier was applied to both tonnage figures and FTEs for each site, to arrive at an FTE figure per tonne, and an FTE figure per 10,000 tonnes.

The following tables illustrate this process, with results in the final table:

Staff (hrs per year)	Site 1	Site 2	Site 3	Site 4	ALL SITES
Regular	21,433	6,717	7,423	22,057	57629.00
Vol	7,323	0	0	1,213	8536.67

⁵ Zero Waste Scotland, 'The Carbon Impacts of the Circular Economy: Summary Report', available at <https://www.zerowastescotland.org.uk/CarbonImpactsOfTheCircularEconomy>

⁶ Access Economics for The Department of the Environment, Water Heritage and the Arts 2009, 'Employment in waste management and recycling'.

⁷ Queensland University of Technology 2012, 'A Baseline Study of Australia's Community Recycling Enterprises', available at <https://eprints.qut.edu.au/58916/>

CSO/ WFD	0	0	4,242	12,376	16618.33
TOTAL	28,756	6,717	11,665	35,646	82784.00

Staff (FTE per year)	Site 1	Site 2	Site 3	Site 4	ALL SITES
Regular	11	3	4	11	29.55
Vol	4	0	0	1	4.38
CSO/ WFD	0	0	2	6	8.52
TOTAL	15	3	6	18	42.45

FTE / Reuse	Site 1	Site 2	Site 3	Site 4	ALL SITES
FTE/ Tonne (paid)	0.02942608	0.01183373	0.01262157	0.02402224	0.02056534
FTE/ 10k tonnes	294.260784	118.337322	126.215738	240.222383	194.759057

As these calculations show, reuse operations have an employment intensity 21 times greater than that of recycling, creating 195 FTE roles per 10,000 tonnes of material reused, compared with 9.4 FTE roles per 10,000 tonnes of material recycled. Although this figure may appear impossibly high, it should be considered alongside the aforementioned QUT research findings, which found a rate of 100 FTE per 10,000 tonnes for the combined reuse *and* recycling operations of CREs. It is reasonable to assume that the inclusion of recycling operations in the QUT study had the effect of bringing down the average FTE figure for each site, and that the figure of 195 FTE per 10,000 tonnes is accurate when reuse operations are considered on their own.

5. Collective Reporting Framework

A stakeholder workshop was held on 5th October to gather feedback from participating sites, discuss the demand for ongoing impact measurement efforts, and begin developing specifications for further impact measurement activity. The outcome of this workshop was an agreement that impact measurement and data collection was of critical importance to enterprises, both for the purpose of external stakeholder communications and for the purpose of better internal resource allocation and decision making.

It was suggested that a single process, with accompanying software interface, be designed that can adequately capture data on both incoming and outgoing material flows. Alongside this, enterprises will continue to capture data on the benefits of their community education and job creation activity.

5.1. Goals

A key driver of the desire to accurately measure material flows was that better data collection gives enterprises the ability to better manage stock, meaning that higher quantities of fast-selling and valuable items can be targeted. As such, any future measurement and data collection tool must integrate with, or be built around a point of sale (POS) system, in addition to having the ability to record the source of materials accepted for reuse. The goals of IMT Pilot Group participants in relation to ongoing data collection are:

- Show true diversion from landfill
- Access levy exemptions
- Demonstrate potential of reuse and repair, and differentiate from recycling

- Show the benefits of reusing whole items, compared with breaking them down into component parts
- Use data as a tool to educate stakeholders and community members
- Demonstrate employment hours created through reuse and repair initiatives
- Use data to accurately keep track of stock and perform basic retail warehousing functions (i.e. pricing, old stock turnover, segmentation of shop areas)

5.2. Technical Considerations

Following the completion of the Pilot Project, it is recommended that ZWN continue the development of a sector-wide system for recording and reporting reuse and recycling data alongside social, environmental and financial impacts (i.e. job creation, community education, waste diverted from landfill, transaction value, goods diverted to disadvantaged individuals and communities). This requires:

- Adoption of consistent measures to report on material, social and financial impacts, in line with findings of Pilot Project.
- Adoption of standard on-site data collection methods (i.e. handheld tablet, Point of Sale, Pallet Jack)
- Development and adoption of standard item-type classifications for enterprise Point of Sale systems, in order to link data from accepted/ donated materials (incoming) with item sales (outgoing).
- Implementation of a regular training, auditing and data validation program to ensure ongoing consistency and accuracy of data.

5.3. Design Brief: Data Collection and Harmonisation Tool

In order to provide members with a single, price-effective solution for data collection, a custom software tool will be required. From participant feedback and sector research, the ideal solution will be located at the point of sale, where sales data is already collected, and will involve the application of an item-weight system similar to that in use by FRN UK (Appendix A). Based the below specifications, an initial software offering has been developed for consideration by the Zero Waste Network. This offering is a modified version of an existing project produced by a company that develops and implements weighbridge and waste management software around Australia.

5.3.1. Interface and Data Entry

- Make transactions and entries quickly (under 10 secs per entry)
- Edit transactions on day and after end of day
- Compatible with touch-screen, mouse or keyboard interface
- Compatible with older computers to minimise cost
- Integration with USB-connected tills and EFTPOS systems
- Manual and automatic data input from incoming goods weight systems, including weighbridge and pallet scales.
- Integration of FRN UK item-weight system
- Ability to segment customers and donations by source, suburb etc.

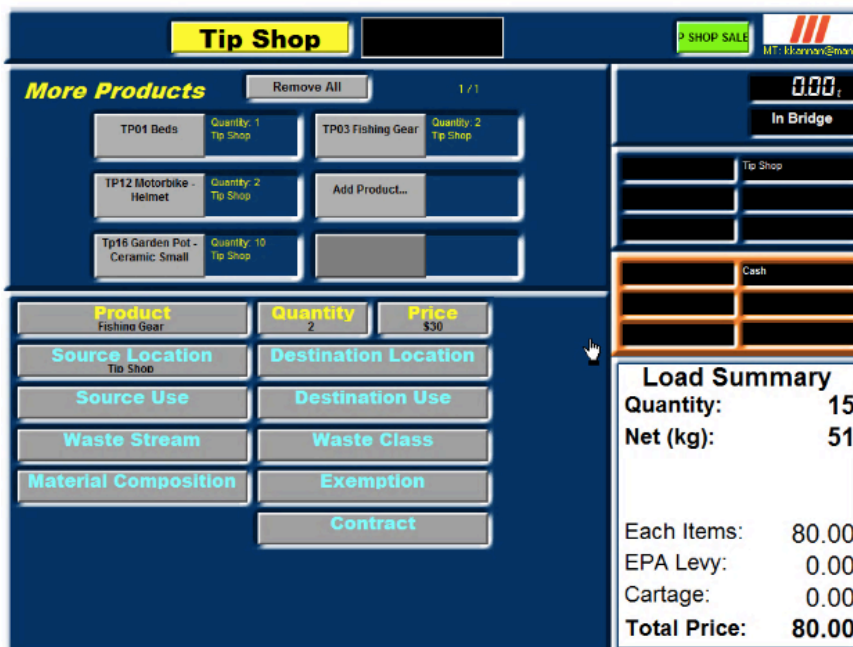


Fig. 2: Example of user interface for POS-based data collection

5.3.2. Data Harmonisation

- Translation of item-weight system into material categories for reporting to regulators (i.e. NSW EPA).
- Ability to align social, environmental and financial data at an enterprise, region, state and national level.
- Ability to indicate source of materials, where relevant – i.e. Commercial and Industrial, Domestic, Construction.

The screenshot shows a report titled 'Daily Sales' for the date '15/06/2018'. The report includes a table with columns for item names and numerical values. The table data is as follows:

Item Name	Value 1	Value 2	Value 3
Residual Waste Bin	2.00	0.50	0.00
Inbound Drop off Material Bin	3.00	0.75	0.00
Beds	2.00	0.08	40.00
Cabinets	1.00	0.05	12.00
Fan - Electric	2.00	0.02	30.00
Bikes	2.00	0.02	40.00
Doors	1.00	0.01	30.00
Tables - Dining	1.00	0.02	50.00
Tents	2.00	0.01	60.00
Fan - Electric	2.00	0.02	30.00
Fishing Gear	2.00	0.00	30.00
Fan - Electric	2.00	0.02	30.00
Table - Bedside	1.00	0.01	10.00
Cabinets	1.00	0.05	10.00
Table - Bedside	2.00	0.02	20.00
Cabinets	2.00	0.10	40.00

Fig. 3: Example of data aggregation and harmonisation report

5.3.3. Output

- Visual representation of data collected (graph, infographic etc)
- Ability to report on an individual site, organisation, region, state or national level.

- Ability for individual sites and organisations to view their own data with a password-protected login.



Fig. 4: Example of data visualisation from ZWN New Zealand.

6. Policy and Funding Considerations

6.1. Attribution of Impacts to Reuse and Waste Diversion

In the course of delivering the Impact Measurement Pilot Project, it has emerged that there exists no standard methodology in NSW for attributing environmental, economic and social impacts to reuse, repair and waste diversion. While reuse differs greatly from recycling in terms of its social, economic and environmental impacts, it is currently approached as a sub-sector of recycling rather than a discrete waste management pathway. Therefore, it is essential that an appropriate methodology be developed to differentiate reuse, repair and other waste diversion activities from recycling and landfilling. Points to consider include:

- Boundaries and chain of responsibility: When an item can be considered to have been 'reused'.
- Allocation of impacts to first, second and subsequent useful lives of an item
- Understanding the specific benefits and impacts of reuse when compared with recycling or landfill.
- Fund the development of a specific reuse impact measurement tool, based on the methodology developed by WRAP UK.

6.2. Measurement of Waste Diversion

A significant amount of reuse and repair activity in NSW occurs on small to medium sites where weighbridges may not be available, and which are not licensed landfill sites. On those sites with access to weighbridges and other weighing equipment, limited information is captured about the type, quantity and material composition of items given for reuse. Furthermore, it may not be space or cost-efficient for smaller operations to install large-scale measurement equipment. As such, it is recommended that the NSW EPA amend the funding criteria for the Weighbridge Fund to incorporate the following:

- Access to funding for small-scale weighing and measuring equipment.
- Funding for training and skills development in on-site measurement practices.
- Reduction of co-contribution from 50% to 25% for registered non-profits and charities.
- Removal of requirement for sites receiving funding to be licenced waste facilities collecting the EPA levy.

6.3. Development of Dedicated Funding Streams for Waste Diversion

Waste diversion is at the top of the waste hierarchy, and represents the most environmentally sustainable and employment intensive option for waste management. However, current funding models prioritise recycling, downcycling and other forms of resource-intensive processing, often involving the overseas export of waste materials generated in Australia. Following the announcement of China's new standards for imported recycling, the NSW Government has established an inter-governmental taskforce to develop a whole-of-government response and plan strategically for the future of the waste management industry in NSW. Furthermore, local governments in NSW, and particular in the Sydney region, are seeking to establish alternative pathways for goods and materials currently being sent to landfill. Both of these objectives require the engagement of residents, businesses and non-profits in a process of education and behaviour change, and represent a significant opportunity to address waste management as a cross-cutting social, environmental and financial issue. This requires dedicated funding streams and commitments from the NSW State Government, specifically:

- The development of a startup/ accelerator grants fund for sustainability-focused social enterprises to encourage innovation in processing methods, collection methods and sales channels.
- The allocation of EPA Waste Levy funds in accordance with waste hierarchy and circular economy principles, with the largest pools of funding being made available for activity at the top of the waste hierarchy.
- The adoption of specific targets for waste diversion, and the establishment of a dedicated team in the NSW EPA to drive strategy and policy on waste diversion.

7. Next Steps: Rollout of CRE Impact Measurement in NSW

While a number of research projects have been completed regarding the impact and scope of the CRE sector, this project represents the first attempt to institutionalise an ongoing data recording, management and reporting framework that accurately accounts for the true impacts of circular economy activity.

The immediate next step is for ZWN to develop a means of harmonising data management systems and providing reliable data to underpin planning, assessment and improvement in reuse and recycling activities in NSW. By working closely with enterprises that measure their impact against environmental, social and financial indicators, ZWN's approach will quantify the benefit of providing a given waste product for processing by the community sector. This will allow for accurate scenario comparisons and cost-benefit analyses that consider the triple-bottom-line impact of waste management activities, creating the opportunity for a whole-of-government approach to job creation and local economic development through resource recovery and waste management.

7.1. Project Outline

The purpose of this project is to enable and catalyse a whole-of-government approach to implementing circular economy and waste hierarchy principles, maximising job creation and economic development through waste diversion and resource recovery. In order to achieve this, the project seeks to quantify the benefit of providing 1 tonne of a given item for reuse or recycling, including the avoided environmental and economic impacts associated with an alternative (i.e. landfilling). The primary outcome of this project will be to enable an accurate comparison between various scenarios, specifically:

- 1) Business as Usual** (current situation, including current reuse and recycling)
- 2) Direct Reuse**

- Charity retail
 - Direct transfer
 - Internet
- 3) Preparation for Reuse**
- Through Community Recycling Centre facility
 - Through bulky waste collection service
 - Through direct donation to charity/ non-profit
 - Through commercial enterprise
- 4) Recycling**
- By charity
 - By commercial enterprise
- 5) Disposal**
- Landfill
 - Energy recovery

The following diagram from WRAP in the United Kingdom⁸ illustrates the flow of resources in the process of goods production, reuse and recycling. Through this project, impacts associated with inputs and outputs will be identified and quantified at each stage. At present, only those impacts associated with end-of-life recycling, landfilling and disposal are captured and quantified as relevant environmental impacts by the NSW government and environmental regulators.⁹

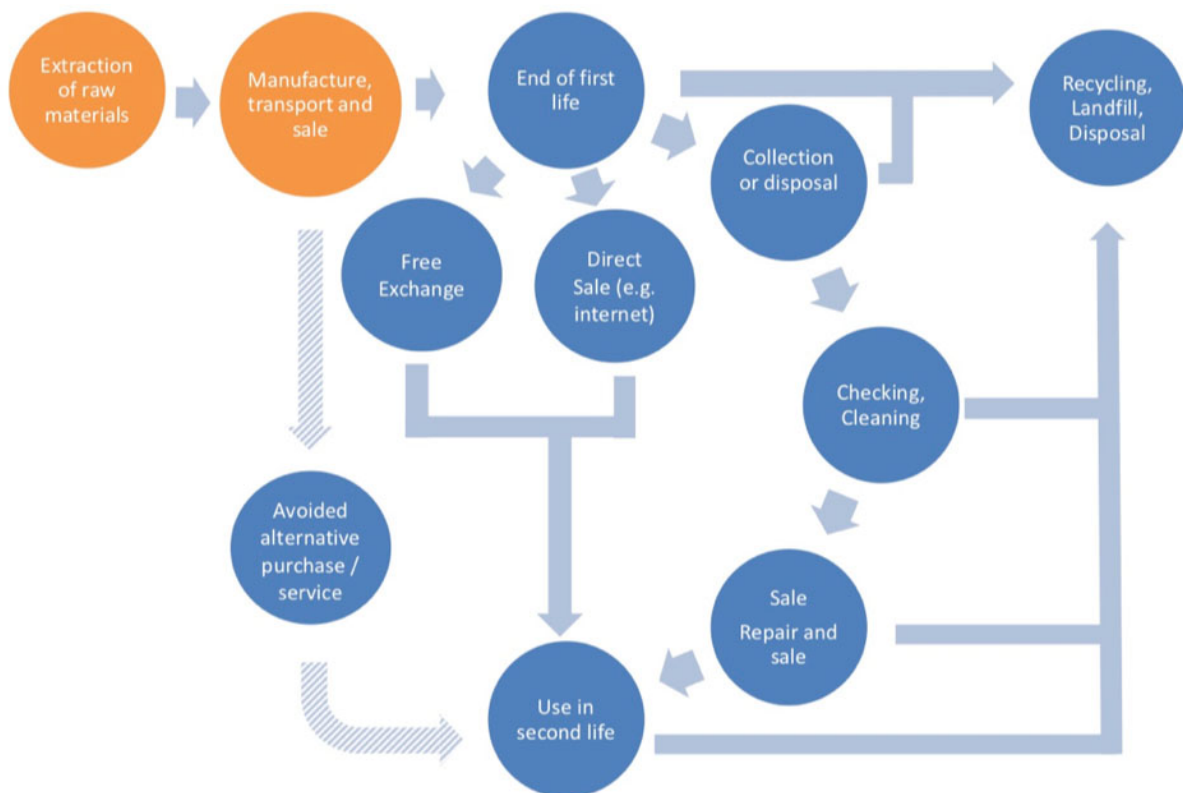


Fig. 5: Resource Flows in Reuse and Recycling System

⁸ WRAP 2011, 'A Methodology for Quantifying the Environmental and Economic Impacts of Reuse', available at www.wrap.org.uk/sites/files/wrap/Final%20Reuse%20Method.pdf

⁹ Environmental Protection Authority 2010, 'Environmental Benefits of Recycling', available at <https://www.epa.nsw.gov.au/publications/recyclereuse/100058-benefits-of-recycling>.

In order to accurately capture and attribute the social, environmental and economic impacts of reuse and recycling activities, and to produce standardised reporting across different government departments and levels of government, three interdependent components are required, as follows:

Data Collection: A sector-wide system for **recording** and **reporting** reuse and recycling data alongside social, environmental and financial impacts (i.e. job creation, community education, waste diverted from landfill, transaction value, goods diverted to disadvantaged individuals and communities). This requires:

- Adoption of consistent measures to report on material, social and financial impacts.
- Co-design of universal on-site data collection methods (i.e. handheld tablet, Point of Sale, Pallet Jack)
- Development and adoption of standard item-type classifications for enterprise Point of Sale systems, in order to link data from accepted/ donated materials (incoming) with item sales (outgoing).
- Implementation of a regular training, auditing and data validation program to ensure ongoing consistency and accuracy of data.

Data Aggregation and Analysis: A standard methodology and platform for the **harmonisation** and **analysis** of reported data, including a methodology for understanding the impacts of waste management activity in a range of scenarios, and reporting of data across government departments. This requires:

- The adoption of a standard protocol for attributing impacts to reuse and other waste diversion activities, preferably through the adaptation of the WRAP UK Reuse Methodology for application in NSW.
- A single data management platform with Application Program Interfaces (APIs) for different on-site data collection methods (i.e. Weighbridge, Pallet Scale, Point of Sale).
- Data to be managed centrally and securely, with tiered access available for various stakeholders.
- Consistent methodology to be used for analysis of material flows and impacts.
- Units of analysis and classifications of impact (material, financial, social) to correspond to those currently in use by NSW state government departments.

Reporting and Data Visualisation: A universal **reporting** and **data visualisation** system for CRE waste management activity, to allow comparison between different waste-management scenarios and to improve knowledge-sharing between enterprises and all levels of government. This requires:

- Aggregated data to be available local and state government departments, to facilitate forward planning and resource allocation.
- Operating sites to receive reports on their impacts in a standardised format appropriate for reporting to stakeholders.

Although this project utilises CREs as the principal research focus and use-case, outcomes from the project will not be sector-specific. It is intended that the data collection standard and methodology be appropriate for adoption and use by government waste services providers (including local government enterprises), commercial waste operators, and commercial reuse enterprises. The ultimate objective of this project is to drive increased sophistication and rigour in the reporting of outcomes from all activities associated with the circular economy, to account for the true impacts of this activity, and to encourage the adoption and reporting of social,

environmental and economic development indicators alongside current tonnage-based waste management metrics. In pursuing this approach, Zero Waste Network seeks to catalyse the pursuit of socially and environmentally productive approaches throughout the entire waste management sector.

7.2. Project Benefits

7.2.1. Government

This project will represent a considerable contribution to the sophistication and scope of the current data available to support prioritisation of resource recovery, economic development, and job creation activities in NSW. It is anticipated that the availability of this data will drive significant change in policy development, funding, and activities at a government, industry, and enterprise level. In particular:

- Understanding of 'true impacts' will allow better resource allocation and prioritisation across the waste management options of reuse, recycling, energy recovery and landfill.
- Data on specific waste streams will drive efficiencies in current resource recovery and waste management programs, with efforts being directed to where most impact can be achieved.
- Correlation of material, environmental, social and financial impacts will facilitate whole-of-government collaboration and planning.
- Application of the data management approach in other state jurisdictions will facilitate cross-border collaboration and improve the prospects for harmonising Australia's regulatory and strategic approach to domestic resource recovery and waste management.

7.2.2. Charitable and non-profit enterprises

Through participation in this project, the CRE sector will improve their reporting of diverted tonnes, environmental impacts achieved, and jobs/ opportunities created, resulting in:

- Improved access to social procurement opportunities at local and state government level.
- Opportunities to develop sector-specific impact investment products including special purpose vehicles and Impact Bonds that deliver on social and environmental outcomes.
- Opportunities to develop collaborations between waste management industry, social enterprise and government that deliver measurable triple-bottom-line outcomes.

7.2.3. Waste Management and Resource Recovery Industry

The availability of a universal data collection process and analytical method to quantify the impacts of circular economy activity will benefit the wider waste management and resource recovery industry in NSW, ensuring recognition, and encouragement of, socially and environmentally constructive initiatives in the sector. In particular:

- Access to detailed impact data will support the development of partnerships between social enterprises, non-profits and commercial businesses, providing access to emerging opportunities in social procurement and social impact investment
- The recognition of cross-cutting impacts of circular economy activity will facilitate and encourage the reporting of triple-bottom line outcomes achieved by commercial enterprises through CSR and shared value initiatives.

Appendix B: Data Collection Guidelines

IMT Data Collection Guidelines: Dunmore Reuse Shop

Dunmore Reuse shop receives donated materials from the general public via the driveway area, and also recovers materials from the Council transfer station. Materials donated by the public are weighed using pallet scales before being processed for sale in the shop, and materials recovered from the Council transfer station are weighed over the Council weighbridge.

Data for **reuse weights and material composition** at the Dunmore site will be recorded using a printed-out copy of the **ZWN datasheet**. One copy of the datasheet will be on a clipboard attached to the pallet scales, and one copy will be kept in the Reuse Shop truck with the Weighbridge Tickets. ZWN datasheets will be stored by Dunmore Reuse Shop staff, using a folder in their on-site filing cabinet, until the conclusion of the 6-week pilot when they will be collected by the ZWN-S coordinator. Dunmore Reuse Shop staff will also scan and upload the datasheets where possible.

One ZWN Datasheet can be used for multiple days if needed; however, please ensure that staff mark where the new data begins clearly on the sheet.

The ZWN datasheet comprises two sections: load details and load composition.

1. Load Details

In order to match up recorded weights with estimated load composition, and to ensure accurate data, it is important that all three **'Load Details'** columns are filled out for every load. The **'Load ID'** will be either the time/date stamp from the pallet-scale printout, or the last three digits of the transaction number from the Council Weighbridge.

Load Type	Description	Collection Method
DO (Drop-off)	Materials dropped off to the site by customers	Pallet scale with cage. Process: 1. Staff fill cages 2. Staff weigh full cages, recording weight and time-date-stamp on ZWN Datasheet.
REC (Recovery)	Materials recovered from landfill/transfer station site	Council Weighbridge. Process; 1. Staff collect items from transfer station 2. Staff pass over weighbridge, recording weight and last three digits of transaction number on ZWN Datasheet.
COLL (Collection)	Materials collected from an external location (residence, business) by staff	n/a for this site.
DUM (Illegal dumping on-site)	Reusable materials dumped at site without permission	n/a. If reusable, materials will be processed as drop-offs.

2. Load Composition

We are asking pilot group sites to estimate the percentages of different materials that make up the loads they accept for reuse. **Estimates will be done by volume, with staff estimating the amount of space taken up by different materials in each load of reusable goods.** When making these estimates, it is suggested that increments of 10% be used, and that staff 'round up' where an item is

primarily composed of one material. For example, if 50% of a load was timber chairs (with minor fabric trim) and 50% was light metal, the load could be recorded as 50% Wood and 50% Metal (light).

If the **entire** load is E-Waste, simply write 'E-Waste' across the load composition row.

If relevant, enter a total percentage for any materials that will be **recycled, not reused**. Examples: polystyrene or bulk cardboard collected from Council Transfer Station. For the purpose of this trial, it is not necessary to record each different type of recyclable material – the focus of the project is **reuse**.

IMT Data Collection Guidelines: Moss Vale Reuse Shop

Moss Vale Reuse shop receives donated materials from the general public via the driveway area, and also recovers materials from the Council transfer station. Members of the public drive over the Council weighbridge before presenting donations to Reuse Shop staff, who sign the weighbridge docket so that the transaction is correctly recorded when they are weighed back out of the site. Materials recovered from the Council transfer station are weighed using a forklift scale.

Data for **reuse weights and material composition** at the Moss Vale site will be recorded using a printed-out copy of the **ZWN datasheet**. One copy of the datasheet will be on a clipboard at the front counter, and one copy will be kept in the Reuse Shop forklift with the scale's printout tickets.

ZWN datasheets will be stored by Moss Vale Reuse Shop staff, using a folder in their on-site filing cabinet, until the conclusion of the 6-week pilot when they will be collected by the ZWN-S coordinator. Reuse Shop staff will also scan and upload the datasheets where possible.

One ZWN Datasheet can be used for multiple days if needed; however, please ensure that staff mark where the new data begins clearly on the sheet.

The ZWN datasheet comprises two sections: load details and load composition.

1. Load Details

In order to match up recorded weights with estimated load composition, and to ensure accurate data, it is important that all three '**Load Details**' columns are filled out for every load. The '**Load ID**' will be either the time/date stamp from the pallet-scale printout, or the last three digits of the transaction number from the Council Weighbridge.

Load Type	Description	Data Collection Method
DO (Drop-off)	Materials dropped off to the site by customers	Council weighbridge and Reuse Shop staff. Process: <ol style="list-style-type: none"> 1. Customer enters site (weigh-in) and is given a docket 2. Customer approaches Revolve staff with materials to donate 3. Reviva staff sign customer docket, and use data-sheet to record the last 3 digits of customer's Ticket Number, as well as the estimated composition of load (i.e. wood/ plastic/ metals/ textiles).

		<ol style="list-style-type: none"> 4. Customer exits site (weigh-out). 5. Council staff provide ZWNA staff with weight data.
REC (Recovery)	Materials recovered from landfill/transfer station site	Reviva forklift. Process; <ol style="list-style-type: none"> 3. Staff collect items from transfer station in cages 4. Staff weigh full cages, recording weight and time-date-stamp on ZWN Datasheet.
COLL (Collection)	Materials collected from an external location (residence, business) by staff	n/a for this site.
DUM (Illegal dumping on-site)	Reusable materials dumped at site without permission	If reusable, material weights and composition will be estimated by Reviva staff.

2. Load Composition

We are asking pilot group sites to estimate the percentages of different materials that make up the loads they accept for reuse. **Estimates will be done by volume, with staff estimating the amount of space taken up by different materials in each load of reusable goods.** When making these estimates, it is suggested that increments of 10% be used, and that staff 'round up' where an item is primarily composed of one material. For example, if 50% of a load was timber chairs (with minor fabric trim) and 50% was light metal, the load could be recorded as 50% Wood and 50% Metal (light).

If the **entire** load is E-Waste, simply write 'E-Waste' across the load composition row.

If relevant, enter a total percentage for any materials that will be **recycled, not reused**. Examples: polystyrene or bulk cardboard collected from Council Transfer Station. For the purpose of this trial, it is not necessary to record each different type of recyclable material – the focus of the project is **reuse**.

IMT Data Collection Guidelines: Reverse Garbage

Reverse Garbage receives donated materials from the general public via their driveway area. Materials donated by the public will be weighed using pallet scales before being processed for sale in the shop.

Data for **reuse weights and material composition** at the Reverse Garbage site will be recorded using a printed-out copy of the **ZWN datasheet**. A copy of the datasheet will be on a clipboard attached to the pallet scales. ZWN datasheets will be stored by Reverse Garbage staff, using a folder in their on-site office, until the conclusion of the 6-week pilot when they will be collected by the ZWN-S coordinator. Reverse Garbage will also scan and upload the datasheets where possible.

One ZWN Datasheet can be used for multiple days if needed; however, please ensure that staff mark where the new data begins clearly on the sheet.

The ZWN datasheet comprises two sections: load details and load composition.

1. Load Details

In order to match up recorded weights with estimated load composition, and to ensure accurate data, it is important that all three 'Load Details' columns are filled out for every load. The 'Load ID' will be either the time/date stamp from the pallet-scale printout, or the last three digits of the transaction number from the Council Weighbridge.

Load Type	Description	Collection Method
DO (Drop-off)	Materials dropped off to the site by customers	Pallet scale with cage. Process: 3. Staff fill cages 4. Staff weigh full cages, recording weight and time-date-stamp on ZWN Datasheet.
REC (Recovery)	Materials recovered from landfill/transfer station site	Council Weighbridge. Process; 5. Staff collect items from transfer station 6. Staff pass over weighbridge, recording weight and last three digits of transaction number on ZWN Datasheet.
COLL (Collection)	Materials collected from an external location (residence, business) by staff	n/a for this site.
DUM (Illegal dumping on-site)	Reusable materials dumped at site without permission	n/a. If reusable, materials will be processed as drop-offs.

2. Load Composition

We are asking pilot group sites to estimate the percentages of different materials that make up the loads they accept for reuse. **Estimates will be done by volume, with staff estimating the amount of space taken up by different materials in each load of reusable goods.** When making these estimates, it is suggested that increments of 10% be used, and that staff 'round up' where an item is primarily composed of one material. For example, if 50% of a load was timber chairs (with minor fabric trim) and 50% was light metal, the load could be recorded as 50% Wood and 50% Metal (light).

If the **entire** load is E-Waste, simply write 'E-Waste' across the load composition row.

If relevant, enter a total percentage for any materials that will be **recycled, not reused**. Examples: polystyrene or cardboard. For the purpose of this trial, it is not necessary to record each different type of recyclable material – the focus of the project is **reuse**.



Contact:

Matthew Allen
Executive Director &
Sydney-Region Network Facilitator

m +61 432 538 827

e matt@zerowastenetwork.org.au

w zerowastenetwork.org.au