Waste Stream Mapping

Opportunities for the Greater Capital Region

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Glossary of Terms and Acronyms

ABS Australian Bureau of Statistics.

ACT Australian Capital Territory

C&D Construction and Demolition waste: materials generated during construction or demolition of buildings, often containing significant quantities of sand, bricks, concrete, steel, plastic pipes, plasterboard, timber and also packaging materials.

C&I Commercial and industrial waste: comprises solid waste generated by the business sector as well as solid waste created by state and federal government entities, schools and tertiary institutions. Unless otherwise noted, C&I waste does not include waste from the construction and demolition (C&D) sector.

CO2-e Carbon dioxide equivalent. Greenhouse gases with the equivalent climatic impact of 1 unit (often measured in tonnes) of carbon dioxide.

Composting The biological process that turns organic material into a useful soil additive. This process diverts organic material from landfill and so prevents the production of methane (a powerful greenhouse gas).

HDPE High Density Polyethylene

LGA Local Government Agency

MRF Materials Recovery Facility. Mechanical sorting facility, generally used for commingled recyclables.

MWS Municipal Waste Stream

NSW New South Wales

SEROC South East Regional Organisation of Councils comprises the NSW Councils of Bombala, Boorowa, Cooma-Monaro, Eurododalla, Goulburn-Mulwaree, Harden, Palerang, Queanbeyan, Snowy River, Upper Lachlan, Yass Valley and Young, plus the Australian Capital Territory.

1 Executive Summary

Background

The ACT Government, NSW Government, South East Regional Organisation of Councils (SEROC), and South Inlands Regional Development Authority have initiated a joint project mapping waste in south east of NSW and the ACT region and looking at opportunities for new business developments in resource recovery and recycling.

In the Greater Capital Region there are a number of data collections for waste management and waste products. However the data is not collected in a consistent manner, has not been inclusive of ACT data collections and has not been analysed in a way that sees waste as a 'new resource' for enhancing development outcomes in non-metropolitan areas through transformative re-engineering.

This Waste Stream Mapping project aims to assist the Greater Capital Region utilise the relatively untapped resource which the various waste streams offer. Through this project the region sought to achieve the following objectives:

- Map the waste stream hierarchy in the Greater Capital Region utilising existing waste data and recycling activities;
- Identify business and economic development opportunities and their region-wide benefits that could be achieved, either through improved coordination of collection and / or aggregation of waste management across the region.

Waste as a Resource

The approach proposed in this project is to shift from the point of view that waste represents something to be disposed of, and rather consider waste as a resource to be utilised in a broader materials transformation process. In particular, such materials transformation should happen close to the source of disposal, rather than being transported elsewhere, thereby generating employment and economic activity within the region and leveraging two greatest assets available – space and knowledgeable and entrepreneurial people.

What Was Done

A series of workshops were held to identify a list of best practices in waste management that could potentially be applied in the Greater Capital Region. Based on this list, the following material types were identified as representing materials transformation opportunities potentially relevant for SEROC:

- Metals
- Glass
- Organics
- Bio-Solids
- E-Waste
- Mattresses
- Polystyrene
- Paper & Cardboard
- Thermo-plastics
- Textiles

Data from all the available datasets in the region was then merged into a single consolidated view of waste flows, mapping aggregated waste flows for the above material types against each area within the region.

For each material type, an analysis was undertaken to determine how best practice approaches could be used to generate economic opportunities for waste transformation within the region, with a bias towards de-centralised models that are less capital intensive. The data was also used to determine the possible region-wide economic impacts (employment and output value) through local processing in these areas.

The harmonised data formed the basis for assessing aggregate and local volumes for each material/waste type and therefore the potential demand for processing/transformation of that waste type. “Heat maps” showing waste intensity for each waste type were produced as a guide to assessment of business feasibility. In the case of glass, organics and mattresses, further analysis is provided around preparing the foundations of a business case as well as a regional case for more immediate action.

In addition to processing/transformation opportunities for the above material types, an opportunity was identified around the handling of the C&I waste stream as a whole.

Finally, an opportunity was also identified around hard waste collections and other discarded materials that fall outside the normal household and commercial collections, centred around the concept of “tip-shops”.

Inhibitors Identified

During the analysis of economic opportunities for material transformation, a number of inhibitors were identified that either prevent or make difficult the exploitation of those opportunities. The major inhibitors were:

- The true cost of landfill is not well understood, documented, measured or reported on.
- There is a need for councils to shift to variable cost models for landfill operation, whether it be in commercial arrangements with private operators, or internal operational and cost structures. Without this, it is difficult to expose, and therefore leverage, the potential for savings in landfill costs to be used to finance more economically desirable solutions such as the opportunities presented in this report.
- Data quality and data collection processes are generally inconsistent and inadequate to provide informed and timely analysis of opportunities on an ongoing basis.
- There is a gap between the raw data and those that could use it. The data needs to be aggregated in a form that commercial business cases can be prepared and evaluated, and relevant business and community groups engaged to highlight potential opportunities.

Economic Impact

A regional economic analysis was carried out to determine if a focus on developing processing industries in key new resource (waste stream) sectors could make a substantial contribution to the economy of the Greater Capital Region.

The consolidated waste stream data was applied to economic models to ascertain the wider regional economic implications for employment and output for the region. This was done by using available economic impact data from the same ‘typical’ waste processing industries based on a region of comparable structure for which detailed economic models are available.

If all waste stream processing was carried out locally to full capacity and all materials transformation opportunities were fully exploited, instead of direct disposal to landfill, *the potential economic impact including flow-on effects from income expenditure is estimated to be the creation of 990 jobs or $88M in regional economic value*.

While it may be unrealistic to expect this full capacity to be realised in the short term, it brings into clear focus the potential for embarking down this path. In particular, incremental steps forward can generate corresponding economic impact – there is no evidence that this is an “all or nothing” effect.

Key Recommendations

1. It is clear that a range of economic and business opportunities exist around local materials transformation. The challenge is how to realise the potential of these opportunities. The role of “Business Development Officer” is proposed to facilitate this process. This role can provide access to the data and assist government and business with the preparation of detailed business cases, as well as linking them back to the region.
2. Poor data quality and data collection processes can be addressed by establishing common systems and processes through a centralised data management function for the region, funded to provide data on an ongoing basis. A possible structure is proposed.
3. At least 3 materials transformation opportunities (glass, organics, and mattresses) would seem immediately viable on the basis of the data in this report - it is recommended that detailed business cases be undertaken immediately.
4. Councils in the region should use the data and approaches taken in this report to take advantage of existing or improved government enterprise development programs in such a way as to foster real outcomes.
5. Where possible, councils should adopt variable cost structures in the commercial and internal arrangements for landfill operation, so that actual cost reductions can be achieved where there is a reduction in additions to landfill, as the means for funding or subsidising alternative materials transformation opportunities.
6. The data indicates that aggregated demand for transformation opportunities can at the very least enable SEROC councils to negotiate better deals with waste and processing operators by leveraging their group “buying power”.

2 About the Project

2.1 Background

The Greater Capital Region, covering the Australian Capital Territory and the surrounding councils in South East NSW, is one of the fastest growing regions in Australia. However its ability to capitalise on the region's competitive advantages has been constrained by a number of factors, not least of which are the impacts of the ACT-NSW border and different regulatory regimes.

In December 2011, the ACT and NSW Governments signed the ACT-NSW Memorandum of Understanding (MoU) for Regional Collaboration. This included, as one of its priorities, an examination of economic opportunities, particularly when approaching the region as a whole rather than as two separate jurisdictions. The Australian Government, through the Regional Development Australia (RDA) committees of the ACT, Southern Inland and Far South Coast, provided funds to further identify economic opportunities.

Stage 1 – an Economic Opportunities Scanning Project – involved an initial examination of economic opportunities across the Greater Capital Region and identified waste management and resource recovery as an area of economic opportunity.

The RDAs, with financial contributions from the South East Regional Organisation of Councils, (SEROC), and South East Resource Recovery Group (SERRG) commissioned the Waste Stream Mapping project, looking at opportunities for new business developments in resource recovery and recycling.

As described in the consultancy brief[1], in the Greater Capital Region there are a number of data collections for waste management and waste products. However the data is not collected in a consistent manner, nor analysed in a way that provides a regional perspective and is inclusive of ACT data collections.

There is also a need to collect data that goes beyond waste collection records based primarily on waste disposal from households. While important for meeting regulatory requirements at a local level, there is also a need to collect data that is more closely related to identifying and developing new regional opportunities for commercial or community-based businesses.

Augmenting this data, SEROC has conducted a range of studies relating to identifying and quantifying the quantity and type of waste produced in the region, and concluded that there are business development opportunities that satisfy the dual objective of diverting waste from landfill (thereby

[1] Greater Capital Region Strategy, Part 2: Waste Stream Mapping Project, Consultancy Brief May 2013.

lowering costs) and generating employment in the region. However, the development of either a private sector or community-based business requires both accuracy and immediacy of data to enable reliable estimates of production outputs and through this potential profit and the lack of consistent and timely data is a major impediment to realising the potential of such initiatives.

For example, enquiries from an investor in the South East region in 1993 in regard to the development of a business based around HDPE milk bottles which could have employed up to six people, was ultimately abandoned due to the inconsistency of information on the quantity of material available. This has been the fate of many such enquires as landfill prices increased and pressure to respond to the WARR Strategy became more focussed.

Pursuing another example, the fact that in excess of 50% of all waste streams is organic material and that the Waste Less Recycle More Strategy of the NSW State Government is clearly focussed on diversion of organic material from landfill, new opportunities to reuse clean organic waste as compost either within or external to council will arise.

The accuracy and immediacy of data and potential consistency of inputs in regard to business opportunity is therefore imperative to sound business management in the South East.

The ever-increasing costs of establishing and maintaining landfill also supports the imperative of accurate and immediate data collection.

This Waste Stream Mapping project aims to assist the Greater Capital Region utilise the relatively untapped resource which the various waste streams offer. Through this project the region sought to achieve the following objectives:

- Map of the waste stream and hierarchy in the Greater Capital Region utilising existing waste data and recycling activities;
- Identify business and economic development opportunities of wider regional benefit that could be achieved, either through improved coordination of collection and / or aggregation of waste management across the region.

The key to achieving this is to create a consistent, region-wide data model, coupled with well-defined and consistent data collection processes. This can then be used to map out significant waste flows to identify potential business development opportunities.

2.2 Methodology

The project was conducted in three main phases:

1. Data collection
2. Opportunity Analysis
3. Economic analysis

2.2.1 Data Collection

Before looking at the data, a literature review was undertaken of previous related work provided by the Project Delivery Group, and each paper summarised in terms of its relevance to the project. This served as a useful reference and inventory of previous work, which it is hoped will be valuable for other projects undertaken in this area in the future. The reviewed document list included:

- *Regional Organic Waste and Resource Inventory*, The Organic Force, April 2009
- *Towards Developing a Regional Waste Management Strategy for NSW South East Region*
- *SEROC Regional Resource Recovery strategy options – including waste prevention*, June 2010
- *Transforming Waste in the SE Region of NSW*, Phil Hawley and Associates, August 2011
- *Best Practice in Regional Waste Management: Discovering Best Practice – Report on Findings*, CPE Associates, November 2011
- *Resource Recovery Infrastructure Needs Analysis*, GHD, November 2011
- *SERRG Regional Waste Stream Management Strategy 2012-2032*
- *Regional economic development implications of waste for the SEROC region*, Prof Steve Garlick, November 2012
- *The full cost of landfill disposal in Australia*, BDA Group, July 2009
- *Towards Developing a Regional Waste Management Strategy for NSW South East Region*, SEROC
- *The Groundswell Project – Implications & Opportunities for SEROC*, Simone Dilkara, 2011
- *ACT NOWaste Domestic Waste Audit Report*, APC Environmental Management, October 2009
- *ACT NOWaste ACT Landfill Audits – Combined Audit Report*, APC Environmental Management, July 2010
- *ACT NOWaste Skip Bin Waste Composition Audit Report*, APC Environmental Management, May 2011
- *Trimming Our Wastelines, Report to SERRG*, by Fabia Pryor, July 2013
- *Closed Loop Recycling Waste Program – Waste Audit Report (NSW)*, by Closed Loop, March 2012
- *Resource Recovery Infrastructure Needs Analysis - Background Report 2011, GHD, 2011*
- *Australian landfill capacities into the future, Hyder, 2009*

The list of available existing data sets and studies was identified by consultation with the SEROC stakeholders and Project Delivery Group. Some work has been done at state and national levels attempting to develop a common model for waste data, but this has been unsuccessful thus far. Thus each data set in the resulting data model has a different underlying model, different scope and coverage, and different accuracy and confidence, making it difficult to obtain a consistent region-wide view. The best of these efforts were used as a starting point for the harmonized model.

Based on the extensive experience of the domain experts in the team, a list was assembled of potential business and economic opportunity types (candidates) based on current best practice around the world. For each potential opportunity type, where possible, data inputs were identified that could be used to evaluate the opportunity in any given situation (for example, volume of waste of a particular type per annum). In other words, a set of necessary conditions for each opportunity type to be successful was identified, which in essence defines the data required to evaluate that opportunity type. Thus the list of opportunity types was used to build up the required data schema for evaluating opportunities, translating into a set of waste types for which aggregate data is required.

The data schema was then used to populate all existing available data into a form suitable for evaluating opportunities. This translates into aggregate data and its spatial allocation across each of the waste types identified, so that waste flows can be aggregated into more concentrated forms based on geographic proximity. Finally, “heat maps” were produced for each waste type to present this data in a more meaningful manner.

It was never an intention of this project to collect new data. Due to the time constraints, the key principle was to use available actual data where such data is being recorded, or use estimated or inferred data otherwise. Therefore there are two fundamentally different kinds of data sets - those based on measured, observed, or surveyed data; and those based on inferred data (for example, a population of X would be expected to produce Y amounts of waste of a particular type, or data taken from a national or international study and applied to the region). In general, our approach to harmonizing data is to give preference to observed data over inferred data, and to only use inferred data if there is no available observed data for that element. Combinations are also possible, for example we may have observed data on an aggregate waste stream, but then used inferred standard ratios to determine individual specific waste streams based on the observed aggregate.

A key outcome from this phase is to identify gaps in collected data and data collection processes, and recommendations are provided for how these gaps may be overcome.

2.2.2 Opportunity Analysis

Each of the opportunity types identified was analysed for applicability in the Greater Capital Region, based on the harmonized data to identify potential matches where the necessary conditions for success of an opportunity type may be met at a particular location, or in aggregate across the region. In some cases data is available to support the hypothesis that the opportunity does exist in the Greater Capital Region; in other cases there may be qualitative arguments for why the opportunity is either worth pursuing further or is not; or there may be insufficient data to form any conclusion at all.

Finally, three of the best candidate opportunities (the “low-hanging fruit”) were selected and considered in greater detail. This may form the basis of specific follow-on work and recommendations.

2.2.3 Economic Analysis

In addition to the “bottom up” analysis of potential opportunities, the original work of Prof. Steve Garlick was revisited to provide a “top down” view on the overall size of the economic opportunity from a region-wide perspective, updating his analysis to use the harmonized data set collated in the first phase instead of the inferred data of the original study. This provides the overall quantum of potential opportunity, and economic benefit in terms of employment and output value, across the region.

Finally, the impediments and economic levers relevant to the opportunities are identified, and recommendations on how best to facilitate regional adoption of those opportunities are provided.

2.3 Project Principles

This project could potentially have extremely large scope. To ensure that focus is targeted in the right areas, at the beginning of the project a set of guiding principles were defined in consultation with the Project Delivery Group

2.3.1 Data Collection

1. It is acknowledged that no one has ever undertaken such a mapping exercise before. Mapping shall not be just about collecting data sets (as that is what councils EPA survey does), but also identify issues in the collection process and with the collected data sets, looking at how to better collect and analyse data for it to be effective.
2. Do not collect new data, use data that is readily available or can be accessed with minimum effort. Where no data is available, use estimates. The brief is not to spend time searching for data, but to identify the gaps and provide recommendations on addressing the gaps.
3. Use data as a potential basis for economic development to form of local business.
4. Demonstrate the value of the data and data collection processes to councils and the private sector to leverage regional economic benefits, and highlight the importance of data collection.
5. Identify and highlight quality and breadth of data currently collected via survey and other means.
6. Where important data gaps or issues with data are identified, ask councils if they have further information to provide.

2.3.2 Look for De-centralised Models

In terms of identifying economic opportunities based on best practice, the team has placed a strong emphasis on de-centralised rather than centralised models where possible, using the principle of processing or otherwise dealing with “waste” as close as possible to the source.

2.3.3 Prefer Less Capital Intensive Approaches

In addition, and consistent with de-centralised models, preference has been given to less capital intensive approaches to waste management wherever possible, with the aim of leveraging the relatively low cost of labour and land (space) in non-metropolitan regional areas and the explicit desire to generate employment and economic activity in the region as a direct co-benefit of any new initiatives.

3 Literature Review

This section provides an overview of all background reports obtained from the Project Delivery Group that were considered for this study as either a source of data or a source of case studies for economic opportunities.

This material is not designed to provide complete summaries of each of the documents reviewed, but rather highlights the contents of each report that are relevant to the project.

Regional Organic Waste and Resource Inventory

The Organic Force, April 2009

This report contains a detailed analysis of the breakdown of organic waste flows within the SEROC area. An inventory is made of all organic waste sources, transfer stations and processing facilities. The report recommends mapping potential future locations of processing facilities and identification of suitable technologies for those locations. It also recommends business case analysis of market and investment return for potential facilities. It refers to 2008 waste audit results which break down what is going in to landfill in the region. An output of the activity was the production of the SERROC Organic Waste Database.

Resource Recovery Infrastructure Needs Analysis - Background Report

GHD, November 2011

In this study, available waste data from across NSW was collated, and projections developed for waste quantities per council area for the whole of NSW, broken down into organics, recyclables, and residual. This was then compared with the current and projected processing capacity, to identify the gaps in meeting these volumes. All projections are inferred by taking the current total volumes of waste per council area, and scaling up these volumes based on population projections and increased recovery rates due to planned facilities. They then set targets for recovery rates over the projection period and identify gaps between the current projections and the targets to identify missing infrastructure.

Best Practice in Regional Waste Management: Discovering Best Practice - Report on Findings

CPE Associates, November 2011

This report identifies a set of best practices for waste management. The work is based on a broad literature review of best practice activities around the world. Many of the practices involve regulatory changes that have an impact on improving waste management. Notable initiatives covered in the report include City to Soil and Groundswell, remote monitoring of bulk bins, resource exchange programs, sustainable schools, recycling alerts, alliances with commercial services for business, community recycling networks, and changed collection frequencies.

SERRROC Region Sustainability Hub – Concept paper

Geoff Pryor, April 2010

In this report, the potential for a regional sustainability hub in SEROC region is explored, based on the model established by the Centre for Education and Research in Environmental Strategies (CERES) in Brunswick, Melbourne. The report highlights the potential links for such an initiative with local schools, the gap that exists in broader education on sustainability principles across the SEROC region[2], and the potential for such an initiative to be self-funding at an operational level once established. Some financial detail is provided.

SERRROC Regional Resource Recovery Strategy Options - including waste prevention

Strategic Economic Solutions, June 2010

This report highlights the use of waste data in improving waste strategy. It summarizes the changes in regulations and legislation and the implications of these for future waste strategy. Of particular relevance to this study is the *Product Stewardship Act 2011 (Commonwealth)*. It then looks at socio-economic changes projected for the region and general trends in waste management and identifies the implications for longer term waste strategy and planning. The collection and use of waste data is discussed, with the following observations:

1. Data collection is ad-hoc and not consistent across councils;
2. Data accuracy, and the way it is measured and collected, varies considerably;
3. Improved data accuracy and availability would assist in planning and waste management;
4. There is a lack of benchmarking of data against best practice.

The report then provides a city and rural scenario for how the future could be improved 10 years down the track, and provides modelling of these scenarios in terms of projected waste flows.

Transforming Waste in the SE Region of NSW

PHIL HAWLEY & ASSOCIATES, August 2011

An analysis was undertaken of individual products found in regional waste streams in the SEROC region, to assess their potential for re-use, recycling, and transformation. The source of data for the analysis of waste streams was a Consultant's Report prepared for SEROC Councils in 2010 by Strategic Economic Solutions. The three main waste streams Municipal, Construction and Demolition, and Commercial and Industrial were combined together across the region by waste type. For each

[2] Excluding the ACT

waste type, recommendations are given for preferred options, including the marketability of transformed products. Finally, recommendations are given for actions that council can take to improve waste outcomes. The "Resource Use Guide and Waste Hierarchy" is used to prioritize preferred options. It concludes by recommending that Alternative Waste Treatment (AWT) and Energy from Waste (EfW) should only be used as a last resort, with source separation and treatment according to type being preferred from an energy and contamination perspective.

The Groundswell Project - Implications & Opportunities for SEROC

Simone Dilkara, 2011

This report provides a summary of the Groundswell project, which combined a novel way to encourage source separation of municipal waste called "City to Soil" with a simple but effective large scale composting process. The project provides blueprints and tools for replicating the model at larger scale across the region. A detailed breakdown of the costs associated with the changes in collection processes and the operation of the composting facilities is provided.

Towards Developing a Regional Waste Management Strategy for NSW South East Region

Geoffrey Pryor, SERRG, 2010

This document was prepared ahead of the development of the regional Waste Management Strategy to identify the key issues to be considered in developing the strategy. The first part of the report largely pulls together material and concepts from a range of other reports included in this literature review.

The second part of the report proposes a new model for waste stream management in regional communities, based on the establishment of local waste transformation sites in rural communities. The idea is to leverage the capabilities of mobile dirty Materials Recycling Facilities (MRF), and then process and transform waste products at local product transformation organisations associated with the local town or centre, or co-located near where MRF activities occur. The use of real time data to improve the efficiency of collections using a consumer demand model and sophisticated IT systems is also proposed. Although no economic models are explored, considerable thought is given to the practical issues in realising such a vision.

Waste-to-Energy Literature Review

Aurecon Australia, December 2011

This report provides an overview of the most widely utilised waste-to-energy (WtE) technologies that are available on the market. The potential advantages and limitations of each process are identified. It recommends that in the hierarchy of waste management activities, waste-to-energy should be regarded as the last resort before landfill. Of all the technologies considered, it concludes that anaerobic digestion is likely to be the most viable WtE technology available in the SEROC region. It also recommends that SERRG continue their investment in waste awareness and waste reduction campaigns, re-enforcing the message that WtE is considered as a last resort after other options have been exhausted.

Regional Waste Stream Management Strategy

Adopted by SEROC in October 2012

The high level waste strategy for SEROC region provides a good context for the other documents, by summarising waste volume trends and proposing 6 key action areas for tackling the challenge.

Regional economic development implications of waste for the SEROC region

Professor Steve Garlick, November 2012

This study assesses the extent to which waste stream management and resource recovery practice in the SEROC region can be used as a vehicle to enhance regional economic development outcomes.

It is generally concluded in the report that for a relatively small open economy like the SEROC region current economic activity could be increased by around seven per cent of manufactured output.

To capture the additional economic benefits from greater regional waste treatment and re-use this report advocates an assessment of opportunities from waste processing at the point of purchase/ sale and a focus on it being an important input into regional development strategies and processes.

The report provides a detailed analysis of waste projections in the region, by taking the existing gross data on waste streams in the region, breaking it down using the proportions identified in waste audit studies in the region, and then extrapolating into the future based on population projections. This detailed inferred projection is then used to estimate the size of the economic development opportunities arising from more innovative approaches to waste management, and the broader economic impact of exploiting these opportunities.

It concludes that the current levels of regional economic activity (output value) in the SEROC region could be increased by around seven per cent by boosting manufactured output through increased waste industry processing within the region. This is equivalent to an additional total output value of around $110m for the region as a whole (2006 prices).

The full cost of landfill disposal in Australia

BDA Group, July 2009

This study was prepared for the Department of the Environment, Water, Heritage and the Arts and it assesses the full cost of the disposal of landfill in Australia. It considers both the private costs incurred for landfill establishment, operations and end of life management as well as impacts on the environment, human health and social amenity that are not captured in the private costs and market transactions (i.e. externalities).

Waste to Energy – from Commercial, Industrial, Domestic and Agricultural Organic Waste

Active Research Pty Ltd, 2008

A high-level overview of distributed energy generation using organic materials.

ACT NOWaste Domestic Waste Audit Report

APC Environmental Management, October 2009

This is a study undertaken on behalf of the ACT government to determine the contents of a representative sample of domestic waste and recycling bins using methodology consistent and comparable with previous surveys. The audit was conducted during a week in May 2009 by sampling a representative number of waste bins and recycling bins to quantify a composition of various types of waste within the MWS for the ACT. The study also analyses and reports on trends and opportunities to further improve recycling.

ACT NOWaste ACT Landfill Audits – Combined Audit Report

APC Environmental Management, July 2010

This is a study undertaken on behalf of the ACT government to conduct landfill audits in the ACT. These audits were visual assessments of the quantities and composition of loads deposited at Mitchell Transfer Station, Mugga Lane Transfer Station and Mugga Lane Landfill between May 4 and May 12, 2009. The results showed that a significant proportion of the landfilled stream was comprised of waste in plastic bags, the contents of which could not be determined by visual assessment. The second part of the report provides assessment of the plastic bags content.

ACT NOWaste Skip Bin Waste Composition Audit Report

APC Environmental Management, May 2011

This is a study undertaken on behalf of the ACT government to conduct skip bin audits in the ACT. This audit was a consecutive 5-day visual assessment at Mugga Lane Landfill of all incoming skip bins and trash packs to determine composition. The report can be used as a reliable source of data and composition of the C&I and C&D waste streams for the ACT.

Discussion Paper Sources of Textile Waste in Australia

By Kerryn Caulfield, January 2012

This is a study undertaken on behalf of NACRO (National Association of Charitable Recycling Organisations) into the sources of textile waste in Australia, covering the barriers to textile recycling as well as the opportunities for recovery of textile fibre.

Trimming Our Wastelines

By Fabia Pryor, July 2013

This is the most detailed study undertaken to-date on various opportunities for recovery of textile fibre from the waste streams. It presents a number of international case studies of dealing with textile waste, including but not limited to clothes swapping, zero-waste design, take-back schemes as well as down-cycling recovered fabrics for various industrial processes.

Closed Loop Recycling Waste Program – Waste Audit Report

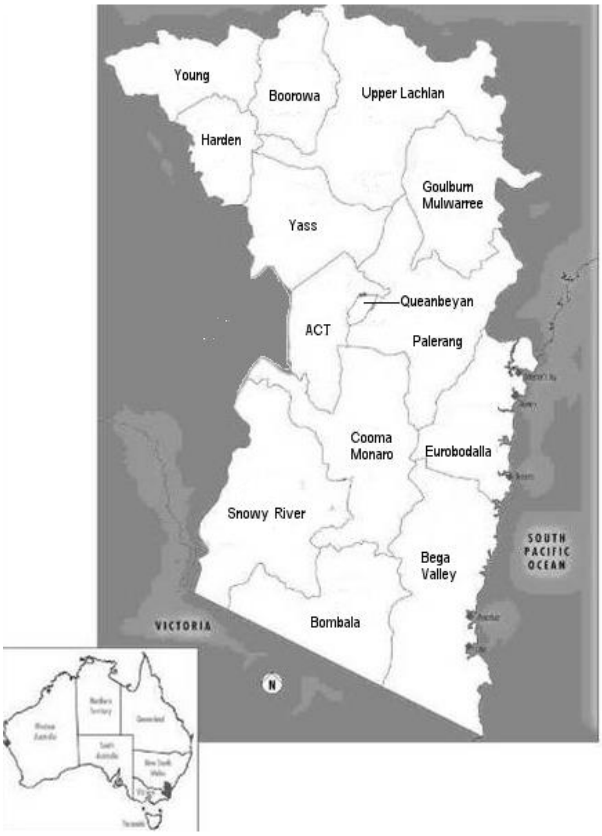
By Closed Loop, March 2012

This is a report on an implementation of a mobile MRF, a mobile waste sorting facility that compacts aluminium and plastics, bails cardboard and paper, crushes glass and captures biodegradable products for uses such as compost. The areas that participated in the study were towns of Crookwell, Boorowa, Young and Yass, where sampling of general waste and recyclable road side pickups were taken. The report's objectives were to identify the percentage of recyclable materials coming through in road side collections, quantify the volume of waste and recyclables, as well as to make notes of the current waste infrastructure and procedures and identify any areas for improvement.

4 The Region

There is extensive academic and practical literature covering the core elements which underpin successful regional development in Australia. The common theme found in this published material is that Greater Capital Region as a regional community should operate on the basis of supporting the growth of local human capital, utilise available local resources in a sustainable manner and tie such actions closely to the worldwide knowledge economy.

These days, the profile of the region has been increasingly influenced by the inclusion of the ACT as well as by tourism from Sydney. It is in fact a prime example of a mixed country region, with elements of rural, tourism and ex-urban activity. It has connections to the knowledge economy via both Sydney and the ACT.



Also while the Greater Capital Region has a relatively low debt, nevertheless it is not a cashed up region. It is not a source of manufacturing, and the availability of so called “knowledge workers” is only due to the proximity to Sydney and the ACT. Another important factor is that the region is ageing significantly, with younger demographic moving to the knowledge centres, in particular to Sydney.

The territory covered by Greater Capital Region Councils has a population of 574,000, with over half of that (350,000 people) living in the ACT. With the exception of the ACT, approximately 220,000 people live in shires with varying characteristics and where population numbers vary considerably.

Non-metropolitan regional development in NSW is influenced particularly by NSW government policies such as the former NSW State Plan, development of the Sydney-Canberra corridor as well as the key growth locations identified by the NSW Department of Planning e.g. Goulburn and Queanbeyan.

Major towns in the region are Queanbeyan, Bega, Merimbula, Batemans Bay, Goulburn, Yass, Young, Braidwood, Bungendore, Cooma and Jindabyne. Smaller towns are Bombala, Boorowa, Moruya, Harden, Berridale, Crookwell and Gunning. There are also significant numbers of small villages.

The table below contains the current and projected population for the Greater Capital Region:

Table 1 – Greater Capital Region Population

Council Name	Overall Population * (2011)	Projected Population (2020)
Bega Valley	34,035	37,321
Bombala	2,612	2,587
Boorowa	2,482	2,090
Cooma-Monaro	10,524	10,650
Eurobodalla	37,846	45,057
Goulburn Mulwaree	28,924	29,073
Harden	3,679	3,381
Palerang	14,834	19,798
Queanbeyan	41,686	51,092
Snowy River	8,255	9,418
Upper Lachlan	7,592	7,376
Yass	15,450	19,281
Young	13,135	13,865
ACT	353,182	409,689

* Source: ABS, census 2011

Based on the figures above, the whole region can be grouped into 3 distinct clusters:

- Small rural shires (population under 5,000): Bombala, Boorowa, Harden.
- Medium regional shires (population between 5,000 and 25,000): Cooma-Monaro, Palerang, Snowy River, Yass, Young.
- Large regional centres (population over 25,000): Bega Valley, Eurobodalla, Goulburn Mulwaree, Queanbeyan, the ACT.

The conclusion is that the Greater Capital Region is characterised by a diversity of population centres, but, with the exception of the ACT, population density overall is low. It is also noticeable that by 2020 small rural councils will see a decrease in their population, whilst large regional centres are projected to have increases to their population, with some being quite substantial. For medium regional shires the population will either remain relatively stable or will see small increments. Servicing such a population spread is a costly and challenging task when compared to the compactness of larger urban centres such as SMA. Economic development is also a challenge when many of those coming to the region are older people, while young people are moving out at the very age when they are needed as key labour force.

All the considerations above set a very important context for discussion of strategies for resource recovery in the region.

5 Data Collection

5.1 Available Data Sets

The following section contains all the data sets that we have reviewed and used in order to produce a harmonised data model for the Greater Capital Region.

Table 2 - List of data sets used

Stream	Type	Area	Sources of data
MWS	Kerbside Household Generation	Greater Capital Region, except ACT	Australian Bureau of Statistics [www.abs.gov.au]
			NSW local government waste and resource recovery data report, 2010-2011 [EPA]
			Domestic Waste Audit Report for QUEANBEYAN CITY COUNCIL [APC, 2013]
			Organic Waste and Resource Inventory Report [Organic Force, 2009]
		Greater Capital Region (ACT)	Australian Bureau of Statistics [www.abs.gov.au]
			ACT NOWaste Domestic Waste Audit Report [APC, 2009]
			ACT NOWaste Landfill Audit Report [APC, 2010]
			ACT NOWaste Skip Bin Waste Composition Report [APC, 2011]
			Waste and Recycling in Australia [Hyder, 2011]
	Clean Up & Drop-off Services	Greater Capital Region, except ACT	Australian Bureau of Statistics [www.abs.gov.au]
			NSW local government waste and resource recovery data report, 2010-2011 [EPA]
		Greater Capital Region (ACT)	Australian Bureau of Statistics [www.abs.gov.au]
			ACT NOWaste Domestic Waste Audit Report [APC, 2009]
			ACT NOWaste Landfill Audit Report [APC, 2010]
			ACT NOWaste Skip Bin Waste Composition Report [APC, 2011]
			Waste and Recycling in Australia [Hyder, 2011]
	Other	Greater Capital Region	NSW local government waste and resource recovery data report, 2010-2011 [EPA]
			ACT NOWaste Skip Bin Waste Composition Report [APC, 2011]
			Waste and Recycling in Australia [Hyder, 2011]
			The Diversion of Mattresses from the waste stream in the Illawarra, Southern Highlands, South East and ACT region: A Preliminary Study [Australian Institute of Sustainable Communities, University of Canberra, 2006]
			Council interviews
C&I	Various	Greater Capital Region	C&I Waste and Recycling in Australia [Encycle Consulting, 2013]
			Organic Waste and Resource Inventory Report [Organic Force, 2009]
			Council interviews
C&D	Various	Greater Capital Region	Construction and Demolition Waste Guide – Recycling and re-use across the supply chain [Edge Environment Pty Ltd, 2012]
			Council interviews

5.2 Harmonised Data Model

A series of workshops were held to identify a list of best practices in waste management that could potentially be applied in the Greater Capital Region, in line with the principles outlined in Section 2.3. The candidate list was based on the work previously outlined in the previous report *Transforming Waste in SE Region of NSW, Phil Hawley & Associates, 2011*, which served as a precursor to the work undertaking by this project. Based on this list, the following material types were identified as representing opportunities potentially relevant for Greater Capital Region:

- Metals
- Glass
- Organics
- Bio-Solids
- E-Waste
- Mattresses
- Polystyrene
- Paper & Cardboard
- Thermo-plastics
- Textiles

In addition to these material types, an opportunity was identified around the handling of the C&I waste stream as a whole (see Section 6.10), but this had no bearing on the above material type breakdown.

Finally, an opportunity was also identified around hard waste collections and other discarded materials that fall outside the normal household and commercial collections (see Section 6.11), but as no data was available specifically for this it was not included in the above material breakdown.

The MWS, C&I, and C&D waste streams were split and aggregated into the above target waste types as shown on Figure 1 below. For simplicity, the figure does not show additional mapping that was done from the various supplementary reports and studies.

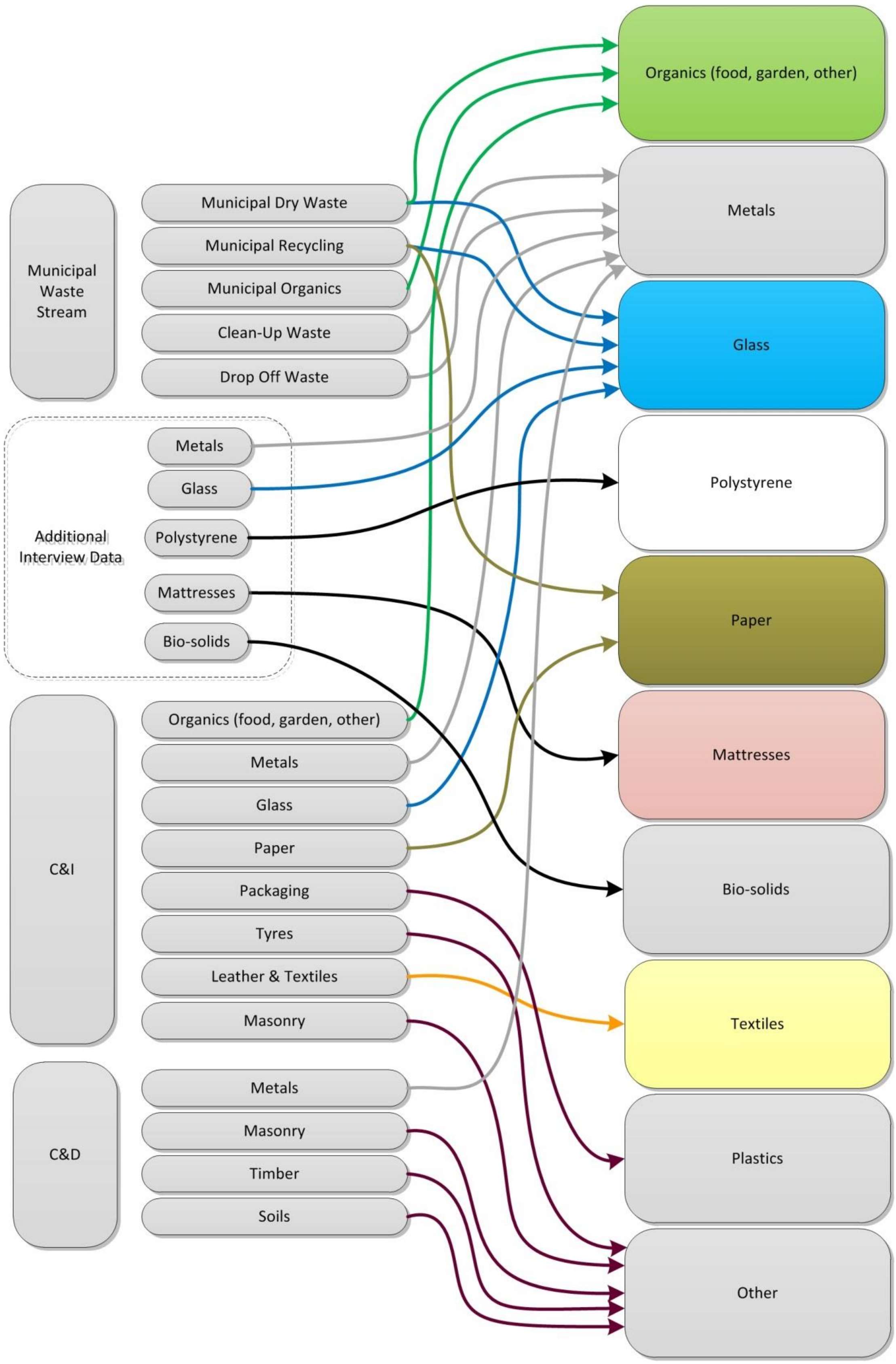


Figure 1 - Waste Streams Map

The aim was to produce accurate estimates for the amounts of each material type and its source location across the Greater Capital Region, regardless of originating waste stream, so that opportunities for exploiting that waste type can be properly evaluated.

5.3 Waste Stream Data

To highlight the level of confidence around each data element, in our data model we have used the following annotations:

123,456.00	Council actual data
1,000.00	Council estimate, not an actual or inferred data
25,100.00	Inferred estimate
	No data available, unable to quantify

5.3.1 MWS - Kerbside Household Generation

The tables below contain the kerbside household waste data collected for all Greater Capital Region councils. We have mapped the EPA NSW survey data with the MWS data available for the ACT.

Table 3 - Kerbside Generation Data

Council Name	**Kerbside Generation**			
	Total Number of Individual **Households in LGA**	Kerbside Collection Tonnes	**Council Yield kg/yr/hh**	**Council Yield kg/wk/hh**
Bega Valley	15,704	12,195	777	14.9
Bombala	1,410	610	433	8.3
Boorowa	676	532	788	15.1
Cooma-Monaro	4,865	2,160	444	8.5
Eurobodalla	22,770	13,663	600	11.5
Goulburn Mulwaree	10,383	8,864	854	16.4
Harden	1,692	1,114	658	12.7
Palerang	6,019	2,016	335	6.4
Queanbeyan	15,964	14,064	881	16.9
Snowy River	4,410	1,658	376	7.2
Upper Lachlan	2,735	2,300	841	16.2
Yass	4,765	2,858	600	11.5
Young	5,914	3,106	525	10.1
ACT	129,423	114,208	882	17.0

Table 4 - Household Residual Waste

Household Residual Waste 2011-12				
Council Name	Households with **kerbside Residual Waste** service	Total **Residual Waste** Collected from **Kerbside**, tonnes	**Council Yield kg/yr/hh**	**Council Yield kg/wk/hh**
Bega Valley	14,317	5,958	416	8
Bombala	802	462	577	11
Boorowa	676	500	740	14
Cooma-Monaro	2,984	1,562	523	10
Eurobodalla	20,640	6,106	296	6
Goulburn Mulwaree	10,383	3,560	343	7
Harden	950	589	620	12
Palerang	3,100	1,049	338	7
Queanbeyan	15,416	8,032	521	10
Snowy River	3,309	1,188	359	7
Upper Lachlan	1,920	1,700	885	17
Yass	3,801	1,976	520	10
Young	3,994	1,512	378	7
ACT	129,423	64,271	497	10

The detailed table in Appendix A provides the average bin composition of the residual waste stream for the region.

Table 5 - Household Recyclable Waste

Recyclables 2011-12				
Council Name	Households with **kerbside Dry Recycling** service	Total **Dry Recyclables Collected** from **Kerbside**, tonnes	**Council Yield kg/yr/hh**	**Council Yield kg/wk/hh**
Bega Valley	12,473	3,972	318	6.1
Bombala	757	148	196	3.8
Boorowa	676	32	48	0.9
Cooma-Monaro	2,984	591	198	3.8
Eurobodalla	20,590	4,954	241	4.6
Goulburn Mulwaree	10,383	3,655	352	6.8
Harden	950	260	274	5.3
Palerang	2,359	967	410	7.9
Queanbeyan	15,416	4,148	269	5.2
Snowy River	3,726	470	126	2.4
Upper Lachlan	1,920	600	313	6.0
Yass	3,801	882	232	4.5
Young	3,994	1,594	399	7.7
ACT	129,423	49,937	386	7.4

The detailed table in Appendix A provides the average bin composition of the recyclables waste stream for the region.

Table 6 - Household Garden Organics

Council Name	Garden Organics			
	Households with **kerbside Garden Organics** service	Total **Garden Organics** Collected from **Kerbside**, tonnes	**Council Yield kg/yr/hh**	**Council Yield kg/wk/hh**
Bega Valley	10,455	2,265	217	4.2
Bombala	-	-	NA	NA
Boorowa	676	-	-	-
Cooma-Monaro	100	8	75	1.4
Eurobodalla	20,590	2,603	126	2.4
Goulburn Mulwaree	10,383	1,648	159	3.1
Harden	950	264	278	5.3
Palerang	-	-	NA	NA
Queanbeyan	12,676	1,883	149	2.9
Snowy River	-	-	NA	NA
Upper Lachlan	-	-	NA	NA
Yass	-	-	NA	NA
Young	-	-	NA	NA
ACT	-	-	NA	NA

The following assumptions were made for mapping of the above data types:

- For all areas except the ACT, data from the 2010-11 EPA report was sufficient to map out Municipal Waste Stream data into subcomponents.
- For the ACT, we have used the 2009 data from the domestic waste audit report, however due to the fact that the total ACT estimate was aggregated based on the 2006 ABS data (118,000 households), we felt that for the purpose of accuracy and to provide a fair comparison between all Greater Capital Region councils this data needed to be adjusted to use the 2010-11 ABS baseline of the number of households in the ACT (overall population of 353,182 living in 129,423 households). The 9.6% increase is a considerable but fair revision of the total kerbside household waste estimate for the ACT.
- The ACT NOWaste Domestic Waste Audit Report [APC, 2009] also notes a discrepancy in the amount of the recycling generated from the average ACT household and a significant drop from 6.33kg in 2007 to 4.97kg in 2009). This is considerably lower than other Greater Capital Region councils. This could be due to a number of external factors, but is most likely due to seasonal differences in beverage consumption and/or economic downturn. Therefore we have also taken data from the Waste and Recycling in Australia [Hyder, 2011] Report and adjusted the ACT recycling per household rate to align it to the national report.

5.3.2 MWS – Clean Up & Drop-off Services

The table below contains the clean-up data for the Greater Capital Region.

Table 7 – Clean Up Data for Municipal Waste Stream

Council Name	Dry Recycling tonnes	Garden Organics tonnes	Metals tonnes	Others tonnes	Residual Waste tonnes	Total Recyclables tonnes	Total Clean Up tonnes	Comments
Bega Valley	-	-	-	-	-	-	-	
Bombala	-	-	-	-	-	-	-	
Boorowa	-	-	-	-	-	-	-	
Cooma-Monaro	-	-	-	-	-	-	-	
Eurobodalla	-	-	201	-	308	201	509	
Goulburn Mulwaree	-	-	-	40	90	40	130	
Harden Shire	-	-	-	-	-	-	-	
Palerang	-	-	-	-	-	-	-	
Queanbeyan	-	10	122	-	544	132	676	Available on demand, has to be booked in
Snowy River	-	-	-	-	-	-	-	
Upper Lachlan	-	-	-	-	-	-	-	
Yass Valley	-	10	133	-	104	143	247	
Young Shire	-	-	-	-	-	-	-	
ACT	-	-	-	-	-	-	-	Tried second hand Sunday, participation <1%, $80K expenditure

Some LGAs have a regular collection service, while others have an on-demand service that has to be booked. It is understood that no clean-up service is provided to the ACT residents, it has been trialled but the participation rate was low.

The table below contains the data for the drop-off services in the Greater Capital Region.

Table 8 - Drop-off Volumes for Municipal Waste Stream

SEROC Drop Off Figures 2011 - 2012					
Council Name	**Waste (Tonnes)**	**Recycling (Tonnes)**	**Organics (Tonnes)**	**Total Recyclables (Tonnes)**	**Total Drop off (Tonnes)**
Bega Valley	4,595	1,064	1,358	2,422	7,018
Bombala	255	23	-	23	278
Boorowa	15	54	9	63	78
Cooma-Monaro	1,489	579	860	1,439	2,929
Eurobodalla	1,874	1,472	3,418	4,889	6,764
Goulburn Mulwaree	24	280	-	280	304
Harden Shire	65	531	204	735	800
Palerang	8,817	2,939	293	3,232	12,049
Queanbeyan	-	165	3,129	3,293	3,293
Snowy River	673	666	348	1,014	1,687
Upper Lachlan	2,800	-	-	-	2,800
Yass Valley	2,000	250	1,000	1,250	3,250
Young Shire	900	4	1,800	1,804	2,704
ACT	-	1,396	25,000	28,000	28,000

The detailed table in Appendix A provides the average composition of the dropped-off waste for the region.

5.3.3 Commercial and Industrial (C&I)

Accurate and actual data on C&I waste stream is not as readily available as many of the councils are not directly involved in managing the C&I stream, and this is done by private contractors.

Without ongoing monitoring and evaluation, C&I waste and recycling performance will not improve significantly.

According to the study undertaken by Encycle Consulting in 2012 and published as "*A study into commercial and industrial (C&I) waste and recycling in Australia by industry division*", it is possible to identify the key materials in the C&I waste stream and their major sources.

Table 9 - National Commercial and Industrial Data

National Data							
Type	**Generated**, tonnes		**Landfilled**, tonnes		**Recycled**, tonnes		**Recycling rate**
Masonry	463,000.00	3.68%	239,000.00	3.50%	224,000.00	0.04	48.38%
Steel	961,000.00	7.64%	159,000.00	2.33%	802,000.00	0.14	83.45%
Aluminium	111,000.00	0.88%	21,000.00	0.31%	90,000.00	0.02	81.08%
Other metals	900.00	0.01%	100.00	0.00%	800.00	0.00	88.89%
Food organics	1,915,000.00	15.22%	1,499,000.00	21.97%	416,000.00	0.07	21.72%
Garden organics	56,000.00	0.44%	56,000.00	0.82%	-	-	0.00%
Timber	775,000.00	6.16%	498,000.00	7.30%	277,000.00	0.05	35.74%
Other organics	656,000.00	5.21%	439,000.00	6.43%	217,000.00	0.04	33.08%
Cardboard	2,637,000.00	20.95%	803,000.00	11.77%	1,834,000.00	0.32	69.55%
Office paper	1,095,000.00	8.70%	394,000.00	5.78%	701,000.00	0.12	64.02%
Other paper	546,000.00	4.34%	264,000.00	3.87%	282,000.00	0.05	51.65%
Plastic packaging	387,000.00	3.08%	346,000.00	5.07%	41,000.00	0.01	10.59%
Other plastics	444,000.00	3.53%	368,000.00	5.39%	76,000.00	0.01	17.12%
Packaging glass	76,000.00	0.60%	22,000.00	0.32%	54,000.00	0.01	71.05%
Other glass	142,000.00	1.13%	31,000.00	0.45%	111,000.00	0.02	78.17%
Leather & textiles	134,000.00	1.06%	107,000.00	1.57%	27,000.00	0.00	20.15%
Tyres / rubber	53,000.00	0.42%	40,000.00	0.59%	13,000.00	0.00	24.53%
Unknown	2,133,000.00	16.95%	1,536,000.00	22.52%	597,000.00	0.10	27.99%
Totals	12,584,900.00	100.00%	6,822,100.00	100.00%	5,762,800.00	1.00	45.79%

As part of our project, we have interviewed a number of councils in regards to the C&I data collection. Some councils were able to provide estimates of their C&I stream volumes, which helped in determining the rest. The following councils responded to the interview:

- Bombala
- Cooma-Monaro
- Eurobodalla
- Goulburn-Mulwaree
- Palerang
- Upper Lachlan
- Young

We used the actual numbers for those councils who provided their estimates, and used their indicative population size to determine the indicative size of the waste stream per capita, which is different depending on the size of the population. Those indicative sizes of the waste stream were then used to estimate the size of the C&I stream for those councils who did not have estimates.

Table 10 - Annual Commercial and Industrial quantities

Annual C&I Quantities (2011-12)							
Council Name	**Interviewed**	**Annual Quantities Tonnes**	**Annual Landfilled Total Tonnes**	**Total Processed**	**Total Recoverable**	**Indicative size of the waste stream per capita, Tonnes**
Bega Valley	N	11,656.53				
Bombala	Y	31.50	31.50			0.01
Boorowa	N	850.05				
Cooma-Monaro	Y	2,184.00				0.21
Eurobodalla	Y	10,504.96	7,950.85	10,504.96	808.02	0.28
Goulburn Mulwaree	Y	9,906.08	9,906.08	9,906.08		0.34
Harden	N	583.83				
Palerang	Y	2,600.00				0.18
Queanbeyan	N	14,276.89				
Snowy River	N	1,310.00				
Upper Lachlan	Y	1,204.78				
Yass	N	2,707.97				
Young	Y	2,084.41				0.16
ACT	N	120,960.07	65,570.78			0.34
Total (SEROC)		180,861.07				
Total (NSW)		2,550,000.00				0.35

For simplicity, VENM soils were excluded from tonnage where data was available, as it is not a material of interest.

It is possible therefore to derive the estimated quantities of each resource type from the C&I waste stream for the Greater Capital Region, based on the composition rates and the total estimated quantities. The table in the Appendix contains that derived data.

5.3.4 Construction and Demolition (C&D)

Accurate and actual data on the C&D waste stream is even less readily available than for C&I. However, we have managed to infer and estimate the annual quantities using the national reports and studies, as well as interview data where councils were able to quantify C&D data. We have then calculated an indicative size per capita of the C&D waste stream and normalised it across the region.

Table 11 - Annual Construction and Demolition quantities

Annual C&D Quantities (2011-12)						
Council Name	**Interviewed**	**Annual Quantities Tonnes**	**Annual Landfilled Total Tonnes**	**Total Processed**	**Total Recoverable**	**Indicative size per capita**
Bega Valley	N	26731.87	13365.94			
Bombala	Y	78.00	78.00			0.03
Boorowa	N	1949.42	974.71			
Cooma-Monaro	Y	3,765.00	1882.50			0.36
Eurobodalla	Y	5,058.75	2,504.56	11,785.91	398.60	0.13
Goulburn Mulwaree	Y	14,064.62	7032.31	14,064.62		0.49
Harden	N	2889.57	1444.79			
Palerang	Y	9,300.00	4650.00			0.63
Queanbeyan	N	32741.14	16370.57			
Snowy River	N	6483.67	3241.83			
Upper Lachlan	Y	5962.93	2981.47			
Yass	N	12134.79	6067.39			
Young	Y	493.00	246.50			0.04
ACT	N	277397.28	138698.64			

Based on the annualised volumes, it is possible to derive the estimated quantities of each resource type from the C&D waste stream for the Greater Capital Region, based on the composition rates and the total estimated quantities. The table in Appendix A contains that derived data.

5.4 Aggregated Data

This section contains the data aggregated across all the MWS, C&I, and C&D waste streams for each category of waste, according to the harmonised data model:

- Mattresses – aggregated from the MWS data, report on mattresses as well as council surveys;
- Metals – aggregated from the council surveys as well as estimated;
- Organic – aggregated from the MWS data and the C&I reports;

- Paper & cardboard – aggregated from the MWS EPA surveys and C&I reports;
- Plastics – aggregated from the MWS EPA surveys and C&I reports;
- Glass – aggregated from MWS EPA surveys and C&I reports;
- Bio-solids – from stakeholder interviews;
- Leather & textiles – aggregated from C&I reports and report on textiles;

Table 12 - Aggregated regional data by type

Council Name	Waste Type								
	Mattresses, Units	**Metals**, tonnes	**Organics**, tonnes	**Paper & Cardboard**, tonnes	**Plastics**, tonnes	**Polystyrene**, tonnes	**Glass**, tonnes	**Bio-solids**, tonnes	**Leather & textiles**, tonnes
Bega Valley	824	1,109.57	6,356.72	6,099	1,041	14	1,360.1	-	302.9
Bombala	67	177.80	257.34	90	12	1	71.0	-	14.2
Boorowa	64	73.41	498.80	306	58	1	24.2	-	24.1
Cooma-Monaro	627	487.23	1,430.79	1,060	185	4	570.0	994.0	70.1
Eurobodalla	2,303	1,557.85	9,953.83	2,665	338	16	2,155.6	322.2	295.0
Goulburn Mulwaree	757	161.58	2,633.74	1,966	249	12	1,065.7	2,000.0	212.3
Harden	94	61.28	474.96	338	56	2	86.0	-	23.9
Palerang	315	264.40	1,267.02	1,404	238	6	327.0	-	59.1
Queanbeyan	905	1,400.52	8,180.94	7,085	1,226	18	1,456.7	-	393.0
Snowy River	211	132.46	993.06	698	119	3	159.8	-	49.6
Upper Lachlan	143	129.24	1,240.33	732	120	3	195.8	-	63.8
Yass	396	269.85	1,795.17	1,395	239	7	304.1	-	88.1
Young	336	700.00	1,376.72	1,566	246	6	597.7	-	67.5
ACT	7,664	11,660.49	62,006.19	70,431	10,334	149	21,800	13,000	14,700
Total	14,706	18,185.68	98,465.6	95,837	14,461	243	30,174	16,316	16,364

This data forms the basis for assessing aggregate and local volumes for each waste type and therefore the potential demand for processing of that waste type. The data is also presented as "heat maps" in the relevant analysis sub-sections of Section 6.

5.5 Data Collection Issues

The analysis and mapping of aggregated data undertaken in this project was complex and difficult. In particular, we identified the following data collection issues and gaps:

1. Whilst each council must respond to the annual EPA survey and provide details of their waste collection and management activities over the past year, this data does not cover all waste streams.
2. The data collected by the EPA survey does not include economic aspects of waste that may be specific to each council, e.g. actual landfill cost (expenditure) in each area.
3. Data accuracy, and the way it is measured and collected, varies considerably.
4. There is no consistent data set covering all waste streams, nor is there a feedback mechanism for the EPA to follow through and fill in the gaps.
5. After data is collected, the EPA confirms and processes the data from all NSW councils to produce the annual Waste and Resource Recovery (WARR) report. The production of the report may take up to 10 months after the last council submits their survey results. By the time the findings of the WARR report are made available to the region, this data is already at least 12 months old.
6. The WARR report itself does not provide a breakdown of data per council in an easily extractable format that can be extrapolated by the regional authority to “compile” a regional snapshot on waste.
7. The existing data collection process does not cover all types of waste, and there are significant gaps around specific waste types, including:
    a. Polystyrene
    b. Bio-solids
    c. Mattresses (although it is understood the EPA survey will now be including a question on mattresses)
    d. Textiles
    e. Medical waste

As part of this project, we investigated if there is a rationale for a better “to be” state for data collection and addressing the existing data gaps. A discussion of this and a suggested approach are presented in Section 9.4.

6 Opportunity Analysis

6.1 Approach

In all government areas in the Greater Capital Region the two greatest assets available are space and human capability. Tied to the value of these assets is the importance of obtaining the best price for any recycled or value-added good.

It is also important that if the focus is to be on the development of new regional business opportunities and employment based around resources recovered from waste streams, then a different perspective needs to be given to these materials other than the traditional one of a 'problem' requiring a solution.

Waste Management has been a very necessary and fundamental obligation of government over many decades. Traditionally waste was mixed together in the interests of efficiency and the comingled and compacted resulting mess confined to a landfill to protect human health.

However much has changed since the council position of "health and building inspector" was taken from the courses provided by Technical Colleges and moved into the new university field of Environmental Science. It is no longer appropriate to think of discarded material simply as 'waste'.

In such a light we need to ask if it is still appropriate that this resource base should remain in the field of waste and health or should it not be considered as a valuable input by the managers of businesses and assets. Thus we seek here to apply business economics to resources that could potentially be utilised in more sustainable ways. The data presented earlier provides the underlying basis for this analysis.

In this section, ideas for sustainably considering these resources are explored in the light of good practices in waste management, with a bias towards de-centralised models that are less capital intensive. Each potential opportunity is centred on a particular waste type or stream, for which data has been aggregated and collected in Section 5.

For each opportunity, background is provided on ways that the resource could be exploited, and the economic size of the opportunity is determined based on the potential for landfill cost avoidance and revenue from processed product. In the case of glass, organics and mattresses, further analysis is provided around preparing the foundations of a business case for more immediate action.

6.2 Glass

6.2.1 Background

Glass was the reuse infant of the recycling movement. At the turn of the century when glass was a rare and valuable commodity it was common practice in rural Australia to use milk bottles as drinking glasses. The wide-necked squat one-pint bottles would have paraffin soaked string tied around the area where the neck met the body and the string allowed to burn with the bottle standing upright. Once it was hot the bottle was submerged in water and the sudden change in temperature would snap the neck off, leaving a large tumbler. The lip was sanded back to a smooth edge and a drinking glass created.

The value of glass bottles remained for many years. They could be refilled up to 20 times or more without losing quality or clarity. In most centres they attracted a deposit and were hunted by children for pocket money.

It was not until the advent of the ‘stubbie’ and ‘lightweighting’ of glass product that the majority of bottles were crushed and remade.

The market for glass is relatively stable and the processing equipment relatively cheap. To save space it is generally broken up to a crushed product and moved to market en masse. Optical sorting equipment at larger facilities has removed much of the human component of hand sorting of colours and contaminants.

6.2.2 Assessment

Based on the data from the Table 12 - Aggregated regional data by type, the region has the following profile in relation to available glass within the waste stream:

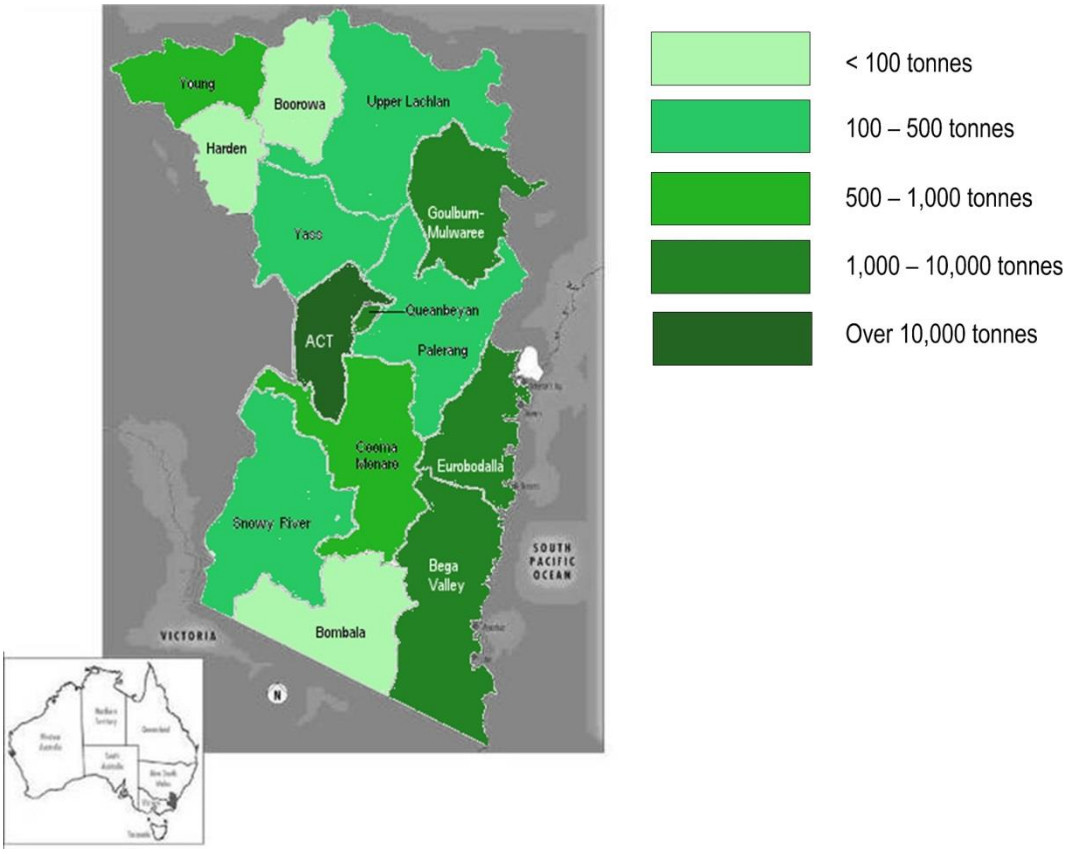


Figure 2 - "Heat map" for glass within the waste stream

As an inert material glass has a great number of uses in the local community. A cheap glass-crushing machine can produce a relatively inexpensive product which can replace the use of virgin extracted material as a filtration medium and as packing product under drain pipes.

It can be stored in vast quantities for many years without any depreciation in quality. As such the principle asset of rural landfills comes into play - space. The product (crushed or uncrushed) can be stored until such time as sufficient quantity is accumulated to market the end product or otherwise consume it in economic quantities.

The options for processing glass are:

- selling back to the glass market
- using crushed glass in construction in local council areas
- developing a local annealing process to manufacture moulded or slumped glass products in either art or practical applications

In terms of selling the accumulated glass back to the glass market, data shows that around 30% of collected glass cannot be recycled back into glass bottles due to breakage and/or contamination.

For glass that cannot be sold back to the glass market another market exists in which this glass can be reprocessed into a viable product for use in civil construction. Recovered crushed glass or RCG has similar properties to natural sand and is an ideal substitute aggregate to natural sand, where the latter is used in a range of civil construction applications such as:

- Pipe bedding
- Road base
- Asphalt
- Drainage
- Earthworks

Fact Sheet:

Recovered Crushed Glass (RCG)

RCG is a 100% crushed glass material that is generally more angular than natural sand. When crushed to specifications, it exhibits properties similar to course sand. The higher angularity may also provide the capacity to enhance stability of asphalt mixes, particular in areas where only fine sands are available. It is as safe to handle as other fine aggregates.

RCG can be used to form a solid road base and produce long wearing road surface. It adds strength to the asphalt mix and can reduce the cost of road construction depending on local markets.

Degradation testing shows that RCG is **up to 30% stronger** than natural sand. And at the Waverly Council demonstration site, performance tests have reported that the road part where RCG was 40% of the sand content in the concrete surface demonstrated an **increased strength of 4%**. 12 months post construction this concrete is still showing brush marks whereas the control strip with no RCG added is already smooth.

This market is quite substantial, given that 85.6% of Australia’s 888,000 km of road surface are managed by LGAs, with the local governments in NSW alone managing over 160,000 km of roads.

There are already good examples and case studies of projects where recovered crushed glass has been used successfully (see inserts). The results highlight the feasibility of RCG in civil construction projects:

- In various parts of NSW, projects have used a control section with no RCG additive, and two sections with 2.5% and 5% RCG addition. 12 months post construction there have been no obvious deterioration occurred in asphalt and concrete surfaces.
- In one case in Victoria, 15% RCG (15 tonnes) was used on a typical suburban road with 2,800 vehicles per day with no sign of deterioration 12 months post implementation.
- All road projects undertaken conform to the relevant Australian Road Standards (e.g. AS 2150) as well as relevant AusRoads and AAPA specifications. This is important to alleviate concerns some stakeholders may have regarding the suitability of the technology.
- In Victoria, there have been 6 demonstration sites developed for shared pathways using 15% and 30% RCG specifications.

Case Study:

RCG Demonstration Sites

Blair St, Bondi, NSW

The road has traffic of **16,000** vehicles per day, including **300** bus movements per day. The project used a control section as well as a section with **44%** RCG and **56%** sand. The concrete with RCG is exhibiting 4% improved performance comparing to the standard section.

Clarence City Council, TAS

The council has used 53 tonnes of RCG for 3 different types of road works:

- On a road surface **15%** RCG and 8% sand mixture was used.
- On concrete pavement **24%** RCG was used.
- For pipe bedding **100%** RCG was used.

The cost of a glass crusher from Silica Glass Crusher NZ is $30,000 plus ancillary equipment of $30,000, requiring a total initial capital expenditure between $60,000 and $90,000 (Source: www.crushedglass.co.nz).

This is an indication only and as the equipment is not complex and is basically a hammer mill connected to a motor it could be manufactured at any regional engineering premises.

In council's public works, crushed glass can be used as a replacement for crushed blue metal, which is priced in Canberra at $54 per tonne.

Below is the recovery benefit analysis of the opportunity, using the data made available by the Glass Recovery and Recycling product Stewardship Forum. The economic data has been compiled as provided by a waste industry representative in each of the levy areas, including non-regulated areas.

Table 13 – Economic data of Recovered Crushed Glass

Area	Levy (per tonne)	Average disposal cost, incl. levy (per tonne)	Processing cost[3] (per tonne)	Cost benefit from avg. landfill cost savings	Local sand cost, per tonne	Total cost benefit as a replacement product, per tonne
Sydney Metropolitan Area	$ 95.20	$ 160.00	$ 35.00	$ 125.00	$ 28.00	$ 153.00
Extended Regulated Area	$ 93.00	$ 160.00	$ 35.00	$ 125.00	$ 28.00	$ 153.00
Regulated regional Area	$ 42.20	$ 150.00	$ 35.00	$ 115.00	$ 32.00	$ 147.00
Non-regulated Area	$ -	$ 70.00	$ 35.00	$ 35.00	$ 30.00	$ 65.00

The processing costs are based on the average glass crusher output of 5 tonnes per hour, including 2 staff, excluding capital costs. Thus for a 6 hour operating day, a single crusher can process 30 tonnes. For the opportunity to be viable, the gross benefits minus a reasonable profit margin and interest costs would need to be able to pay back the capital costs over (say) 5 years.

The table below takes analyses the volumes of glass available in each council area of the Greater Capital Region and gives a recovery benefit analysis using the cost structures provided above. The recovery benefit analysis for each Council only takes into account the cost of diversion from landfill, as data on the volumes of mined sand purchased by each Council was not available at the time of writing the report.

Note that the cost benefit analysis above is indicative only as it has been undertaken based on average landfill costs. There may be slight variations once the following factors are taken into account:

- Actual local landfill cost per tonne as this figure can vary at different landfill sites;
- Local cost of the sand supply;
- Transportation costs for the sand as this is dependent on distance and hence is not included in the cost benefit analysis.

[3] Processing costs does not include the capital cost to set up the facility.

Table 14 - Recovery Benefit Analysis for glass

Council Name	**Glass**, tonnes	Estimated Average Disposal Costs	Estimated Processing Cost	Average Cost Benefit from landfill savings
Bega Valley	1,360.1	$ 95,206	$ 47,603	$ 47,603
Bombala	71.0	$ 4,970	$ 2,485	$ 2,485
Boorowa	24.2	$ 1,691	$ 845	$ 845
Cooma-Monaro	570.0	$ 39,900	$ 19,950	$ 19,950
Eurobodalla	2,155.6	$ 150,895	$ 75,448	$ 75,448
Goulburn Mulwaree	1,065.7	$ 74,597	$ 37,299	$ 37,299
Harden	86.0	$ 6,020	$ 3,010	$ 3,010
Palerang	327.0	$ 22,888	$ 11,444	$ 11,444
Queanbeyan	1,456.7	$ 101,972	$ 50,986	$ 50,986
Snowy River	159.8	$ 11,184	$ 5,592	$ 5,592
Upper Lachlan	195.8	$ 13,706	$ 6,853	$ 6,853
Yass	304.1	$ 21,284	$ 10,642	$ 10,642
Young	597.7	$ 41,841	$ 20,921	$ 20,921
ACT	21,800.0	$ 1,526,000	$ 763,000	$ 763,000
Total	30,173.6	$ 2,112,154	$ 1,056,077	$ 1,056,077

Based on these figures, to process all glass in the region would require 1016 crusher-days per year. Therefore 3 crushers would handle the entire load if fully utilised. Since the crushers are mobile, glass can be stockpiled at each site and processed in batches by rotation of mobile crushers, with possible permanent installation of a crusher at the larger sites.

Also note that given the projected savings in landfill costs, even ignoring the value of the processed material, three units of glass-crushing equipment could be paid off in less than one year of operation of such equipment, even if only 30% of the total glass volumes were converted to RCG. It is also clear that some councils would benefit from their own dedicated equipment as they have enough volume of glass to justify the one-off cost, whereas others may need to stockpile and share the equipment between the neighbouring LGAs.

Based on the above analysis using average figures for each area, it can be concluded that for the Greater Capital Region a positive cost benefit from using recycled crushed glass can be achieved compared to the use of naturally occurring and mined sand. Factors that contribute to achieving such benefit are:

- Diversion of glass from landfill and cost savings from disposal;
- Saving transport costs for transporting naturally mined sand;
- Reduced requirement to import, mine and transport virgin materials (i.e. naturally mined sand) and therefore cost savings.

To more fully develop a business case for this opportunity, the following would be needed:

- Approximate volumes of sand consumed by each council;
- More accurate landfill costs for each council;

- A rudimentary operating model to more accurately estimate total operating costs and overheads, which are likely to be underestimated in the above simple analysis;
- Firm pricing on crusher plant and ancillary equipment;
- Cost of waste separation where this is not already occurring;
- Proportions of glass currently sold back to the glass market.

6.3 Organics

There is a persuasive argument for removing more organics from the waste stream, which could result in an up to 70% reduction by weight and has various other additional benefits in terms of sustainability and greenhouse gas emissions – such as improving soil quality and reducing emissions from methane.

Regardless of whether LGAs choose to deal with organics by aggregating the product and taking it elsewhere, or through local processing and value adding, there is consensus that organics should be taken out of the waste stream.

Based on the data from the Table 12 - Aggregated regional data by type, the region has the following profile in relation to available organics within the waste stream:

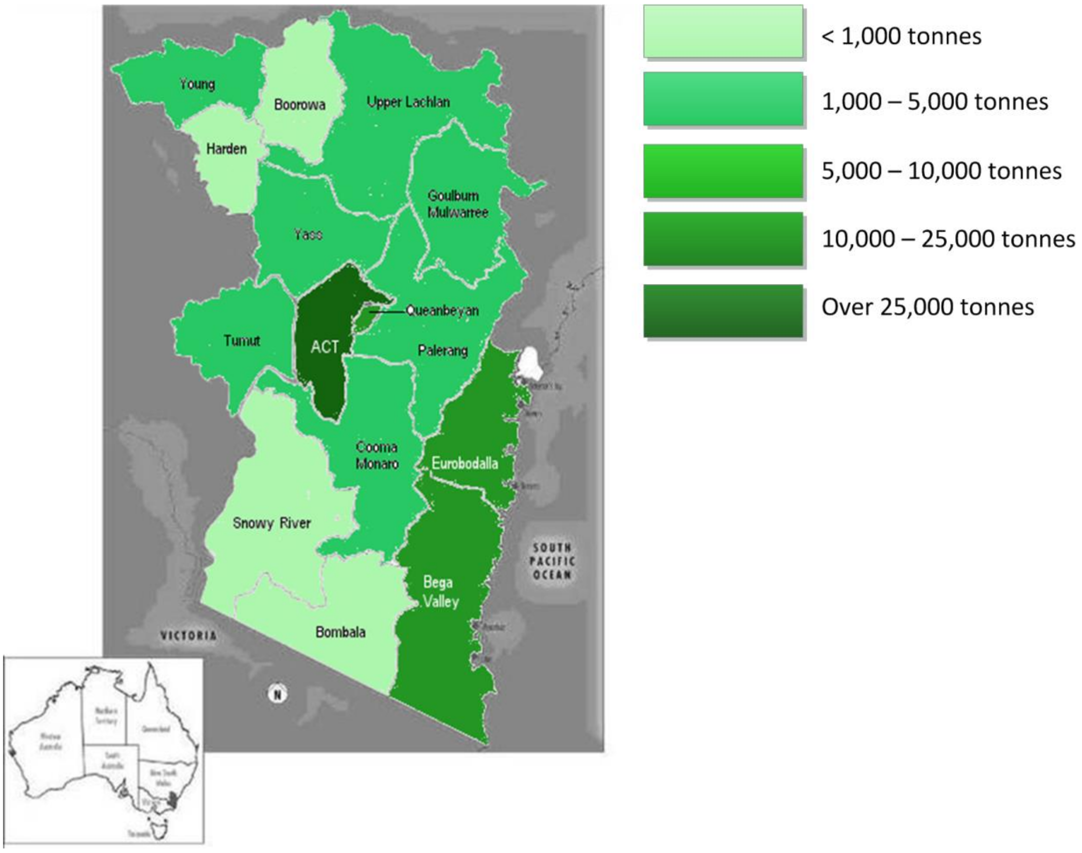


Figure 3 - "Heat map" for organics within the waste stream

Organic waste represents a high proportion of the total waste stream for the region, with almost 100,000 tonnes of organics disposed each year. The value of the diversion from landfill can be estimated by the cost per tonne for disposal into the landfill, estimated in rural and regional landfills to be between $41 and $100 per tonne (BDA Group Report, 2009, page 5), with $41 being the best practice landfill only. We have estimated the diversion benefit to be about $70 per tonne on average, although this figure can vary depending on whether a particular LGA own their landfill or not (see section 8.4 for further details). At an average representative value of about $70 per tonne, this is a substantial expense of about $7 million for the region each year. It should also be noted that the range estimate used in the BDA report was based on the costs of landfill that are 5 years old and did not include the external[4] costs which according to the same report are estimated to add between $5 and $30 per tonne depending on the location. In another report released in 2011, the cost of $130 per tonne of waste disposed in Goulburn-Mulwaree has been quoted. Therefore a disposal cost per tonne of $70 for 2013 should be conservative. (See Section 8 for a more detailed discussion on the true cost of landfill).

Table 15 - Organic waste disposal cost estimates

Council Name	Organic Waste								
	Municipal			C&I			Total		
	Volume, tonnes	Disposal cost (2013)	Disposal cost (2020)	Volume, tonnes	Disposal cost (2013)	Disposal cost (2020)	Volume, tonnes	Disposal cost (2013)	Disposal cost (2020)
Bega Valley	3,206	$ 224,398	$ 480,853	3,151	$ 220,573	$ 472,656	6,357	$ 444,971	$ 953,509
Bombala	249	$ 17,418	$ 37,324	9	$ 596	$ 1,277	257	$ 18,014	$ 38,601
Boorowa	269	$ 18,831	$ 40,352	230	$ 16,085	$ 34,468	499	$ 34,916	$ 74,821
Cooma-Monaro	840	$ 58,828	$ 126,060	590	$ 41,327	$ 88,558	1,431	$ 100,155	$ 214,618
Eurobodalla	3,285	$ 229,967	$ 492,787	6,669	$ 466,801	$ 1,000,287	9,954	$ 696,768	$ 1,493,074
Goulburn Mulwaree	1,916	$ 134,095	$ 287,346	718	$ 50,267	$ 107,715	2,634	$ 184,362	$ 395,061
Harden	317	$ 22,200	$ 47,571	158	$ 11,048	$ 23,673	475	$ 33,247	$ 71,244
Palerang	564	$ 39,492	$ 84,627	703	$ 49,199	$ 105,426	1,267	$ 88,691	$ 190,053
Queanbeyan	4,322	$ 302,509	$ 648,233	3,859	$ 270,157	$ 578,908	8,181	$ 572,666	$ 1,227,141
Snowy River	639	$ 44,726	$ 95,840	354	$ 24,789	$ 53,119	993	$ 69,514	$ 148,959
Upper Lachlan	915	$ 64,025	$ 137,197	326	$ 22,798	$ 48,852	1,240	$ 86,823	$ 186,050
Yass	1,063	$ 74,420	$ 159,472	732	$ 51,242	$ 109,804	1,795	$ 125,662	$ 269,276
Young	813	$ 56,928	$ 121,989	563	$ 39,443	$ 84,520	1,377	$ 96,371	$ 206,509
ACT	29,308	$ 2,051,545	$ 4,396,168	32,698	$ 2,288,888	$ 4,904,761	62,006	$ 4,340,433	$ 9,300,929
Totals	47,705.5	$ 3,339,382	$ 7,155,820	50,760.2	$ 3,553,212	$ 7,614,025	98,465.6	$ 6,892,594	$ 14,769,845

A significant proportion of the total organic waste comes from the C&I stream (in some areas such as Eurobodalla this proportion is over 60% of the total organic waste). The regional average is 51%.

[4] External costs are also known as spill over effects or off-site impacts (such as greenhouse gas emissions, air pollutants, leachate, amenity impacts etc.

Increasing landfill costs in the coming years will mean that this area represents a huge economic opportunity, irrespective of the type of the organic waste diversion strategy chosen. And if we factor in the external costs also known as spill over effects or off-site impacts (such as greenhouse gas emissions, air pollutants, leachate, amenity impacts etc.), then it is reasonable to assume a much higher disposal cost of at least $150, which can be used to estimate the potential cost to the region in the future, if business-as-usual scenario was adopted.

One of the opportunities is to implement a *Zero Waste System*[5] comprising of a *City to Soil collection process*[6] and a diversion method such as *Zero Waste Composting Process*[7], in particular in smaller council areas. The *Zero Waste System* does not need establishment of large scale operations, has low mechanical and labour requirements and can significantly contribute to communities such as Bombala, Boorowa or Cooma-Monaro where it is not economically viable to implement large scale organic diversion methods. The output product can be used either internally by council to replace purchased topsoil products or sold directly to ratepayers.

The economics of a *Zero Waste System* are well understood and can be illustrated based on the existing programs run by Armidale as well as the original pilot projects run by Queanbeyan City Council, Goulburn Mulwaree, Palerang and Lachlan using the data collected as part of these projects. Appendix B of this report includes a detailed cost modelling and assumptions for establishing and scaling a Zero Waste System implementation project.

The data collected as part of this project gives an ability to assess the feasibility of setting up such system in each council, as a distributed implementation for organic waste diversion would be the most viable, so as to reduce the transportation cost. In some instances, it may be economically viable to establish a hybrid model whereby a collective of councils each have their own City to Soil collection processes, but establish a shared Zero Waste System implementation so as to achieve further economies of scale. Such hybrid approach may still be economically viable despite higher transportation costs, given than an increase in the transportation distance of 50km would add only around $10 per tonne to the total disposal cost[8].

The first table below contains an analysis of the initial capital expenditure for establishing a Zero Waste System:

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[5] The term *Zero Waste System* refers to a combination of *City to Soil collection process* and a diversion process such as *Zero Waste composting process.*

[6] The term *City to Soil collection process* refers to the source separation process of organic waste material modelled on the source separation process of organic waste for households, which has been implemented in Armidale and Queanbeyan.

[7] The term *Zero Waste composting process* refers to the composting process of organic material using the composting methodology developed by Zero Waste Australia as described in the [13] The Economics of Groundswell [M & M Management, 2011].

[8] Source: Australian landfill capacities into the future, Hyder, 2009

Table 16 - Estimated capital expenditure for establishing a Zero Waste System

Council Name	CAPEX					
	Max Air Bins	240L Bin	Bio-bags	Compost Tarps	Communications	Total
Bega Valley	$ 47,112	$ 628,160	$ 157,040	$ 13,500	$ 25,126	$ 870,938
Bombala	$ 4,230	$ 56,400	$ 14,100	$ 4,500	$ 2,256	$ 81,486
Boorowa	$ 2,028	$ 27,040	$ 6,760	$ 4,500	$ 1,082	$ 41,410
Cooma-Monaro	$ 14,595	$ 194,600	$ 48,650	$ 4,500	$ 7,784	$ 270,129
Eurobodalla	$ 68,310	$ 910,800	$ 227,700	$ 13,500	$ 36,432	$ 1,256,742
Goulburn Mulwaree	$ 31,149	$ 415,320	$ 103,830	$ 9,000	$ 16,613	$ 575,912
Harden	$ 5,076	$ 67,680	$ 16,920	$ 4,500	$ 2,707	$ 96,883
Palerang	$ 18,057	$ 240,760	$ 60,190	$ 4,500	$ 9,630	$ 333,137
Queanbeyan	$ 47,892	$ 638,560	$ 159,640	$ 18,000	$ 25,542	$ 889,634
Snowy River	$ 13,230	$ 176,400	$ 44,100	$ 4,500	$ 7,056	$ 245,286
Upper Lachlan	$ 8,205	$ 109,400	$ 27,350	$ 4,500	$ 4,376	$ 153,831
Yass	$ 14,295	$ 190,600	$ 47,650	$ 4,500	$ 7,624	$ 264,669
Young	$ 17,742	$ 236,560	$ 59,140	$ 4,500	$ 9,462	$ 327,404
ACT	$ 388,269	$ 5,176,920	$ 1,294,230	$ 117,000	$ 207,077	$ 7,183,496
Totals	$ 680,190	$ 9,069,200	$ 2,267,300	$ 211,500	$ 362,768	$ 12,590,958

In our estimates we assumed establishing a Zero Waste System for municipal organic waste collections only, using the volumes of municipal organic waste available in each LGA. This however does not mean to suggest that such a system cannot be used for commercial organic waste. The reason why a municipal organic waste stream was chosen as an illustration of the business case potential was because this is where the Zero Waste System and City to Soil collection process have already been deployed and therefore accurate costing data was available.

The assumptions used in estimating the costs of establishing a Zero Waste System are detailed in Appendix B.

Analysis of the cost structures above suggests that generally establishing a Zero Waste System in a LGA requires an initial outlay which is several times the annual cost of disposing of its municipal organic waste (with the cost ratio in the range between 2.2 for Boorowa and 5.8 for Young). This however is compensated by the lower ongoing annual cost of maintaining such as system (e.g. 0.7 cost ratio for Queanbeyan), and then additionally offset by the value of the output product (such as compost). A key observation can be made, however, that for councils where the rate of organic waste per household is higher, such as Boorowa, Tumut and Upper Lachlan, the return on investment and the break-even point can be achieved sooner. Figure 4 provides an annual rate of organic material per household in kg for each LGA.

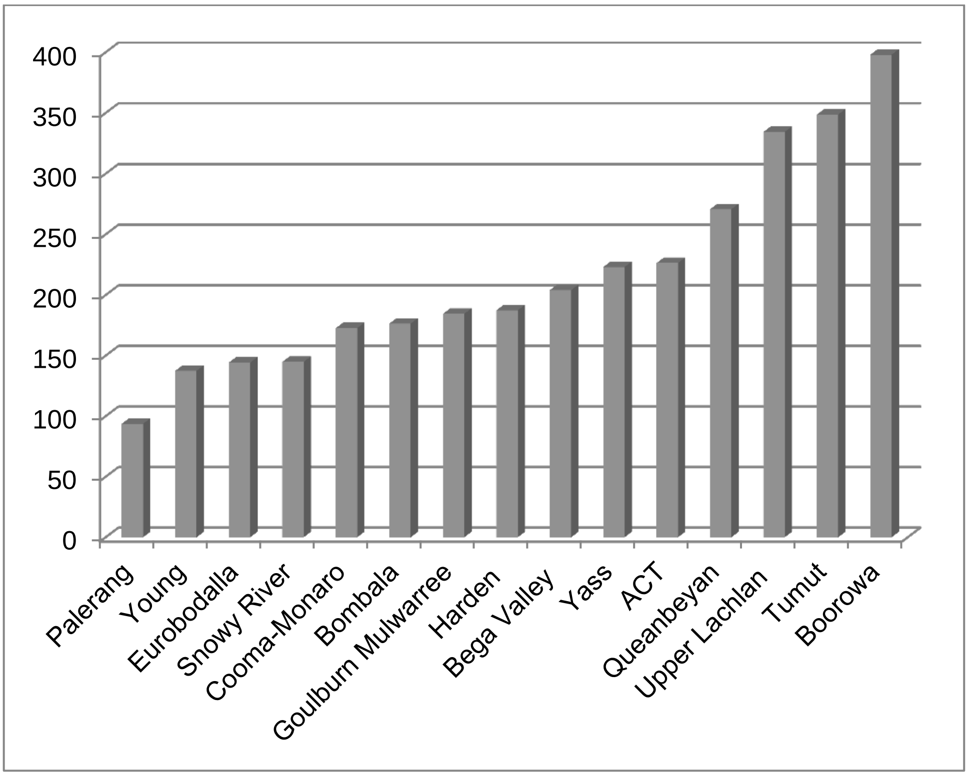


Figure 4 - Annual rate of organic material per household

The following table analyses ongoing operational expenditure to run a City to Soil program, if each council were to assume individual responsibilities for running a Zero Waste composting process:

Table 17 - Estimated annual operational expenditure of a Zero Waste System

Council Name	Replacements: Max Air Bins	Replacements: 240L Bins	Bio-bags	Screening & Certification	Communications	Inoculant	Plant & equipment for composting*	Staff salaries** (composting)	Total
Bega Valley	$ 942	$ 12,563	$ 157,040	$ 1,600	$ 12,563	$ 3,853	$ 16,640	$ 14,560	$ 219,762
Bombala	$ 85	$ 1,128	$ 14,100	$ 400	$ 1,128	$ 312	$ 4,160	$ 14,560	$ 35,873
Boorowa	$ 41	$ 541	$ 6,760	$ 400	$ 541	$ 328	$ 4,160	$ 14,560	$ 27,330
Cooma-Monaro	$ 292	$ 3,892	$ 48,650	$ 400	$ 3,892	$ 1,014	$ 8,320	$ 14,560	$ 81,020
Eurobodalla	$ 1,366	$ 18,216	$ 227,700	$ 1,600	$ 18,216	$ 3,947	$ 20,800	$ 14,560	$ 306,405
Goulburn Mulwaree	$ 623	$ 8,306	$ 103,830	$ 800	$ 8,306	$ 2,309	$ 12,480	$ 14,560	$ 151,215
Harden	$ 102	$ 1,354	$ 16,920	$ 400	$ 1,354	$ 390	$ 4,160	$ 14,560	$ 39,239
Palerang	$ 361	$ 4,815	$ 60,190	$ 400	$ 4,815	$ 686	$ 4,160	$ 14,560	$ 89,988
Queanbeyan	$ 958	$ 12,771	$ 159,640	$ 2,000	$ 12,771	$ 5,195	$ 24,960	$ 14,560	$ 232,855
Snowy River	$ 265	$ 3,528	$ 44,100	$ 400	$ 3,528	$ 780	$ 4,160	$ 14,560	$ 71,321
Upper Lachlan	$ 164	$ 2,188	$ 27,350	$ 400	$ 2,188	$ 1,108	$ 8,320	$ 14,560	$ 56,278
Yass	$ 286	$ 3,812	$ 47,650	$ 800	$ 3,812	$ 1,279	$ 8,320	$ 14,560	$ 80,519
Young	$ 355	$ 4,731	$ 59,140	$ 400	$ 4,731	$ 983	$ 8,320	$ 14,560	$ 93,220
ACT	$ 7,765	$ 103,538	$ 1,294,230	$ 12,000	$ 103,538	$ 35,178	$ 153,920	$ 72,800	$ 1,782,970
Totals	$ 13,064	$ 181,384	$ 2,267,300	$ 22,000	$ 181,385	$ 57,361	$ 282,880	$ 262,080	$ 7,621,209

It should be noted that for these projections we used data published from the small scale programs run in the original pilots[9]. Significant economies of scale may be achieved when establishing a system with larger coverage, so we believe our cost estimates are conservative.

To further explore a cost-benefit analysis consider one small-size council as an example (a similar exercise can be undertaken using existing data sets in this report for all other councils):

Table 18 - Example of a basic cost benefit analysis of a Zero Waste System

Upper Lachlan		CAPEX	Year 1	Year 2	Year 3	Year 4	Year 5	TCO
Dispose organic waste to landfill	Landfill costs	$ -	$ 64,025	$ 64,025	$ 64,025	$ 64,025	$ 64,025	$ 320,127
	Compost value	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Net	$ -	$ 64,025	$ 64,025	$ 64,025	$ 64,025	$ 64,025	$ 320,127
Zero Waste System	Operating cost	$ 153,831	$ 56,278	$ 56,278	$ 56,278	$ 56,278	$ 56,278	$ 435,220
	Compost value	$ -	$ 30,488	$ 30,488	$ 30,488	$ 30,488	$ 30,488	$ 152,442
	Net	$ 153,831	$ 25,789	$ 25,789	$ 25,789	$ 25,789	$ 25,789	$ 282,778
		-$ 153,831	-$ 115,595	-$ 77,359	-$ 39,123	-$ 887	$ 37,349	

In the scenario above the system breaks even after a period of 4 years, and ongoing positive returns can be achieved thereafter. However, if higher landfill disposal costs were used, then the system could break even earlier. The above cost benefit analysis is for a scenario where the costs of operating a Zero Waste System come very close to the current costs of disposing of the same quantity of organic material, achieving a break-even within 4 years of establishing such a system.

The analysis above makes a number of assumptions:

- Since the purpose of this analysis is to illustrate business case potential all dollar figures are in 2013 dollars. Applying a discount rate for the future cost of money (net present value) does not significantly change the conclusions, but should be undertaken for a full business case analysis;
- Landfill disposal costs and compost / top soil sale price do not change over the 5 year period;
- The cost of organic waste collection has been taken out of the equation on the assumption that it will be incurred regardless, and assuming that City to Soil collection process does not increase the frequency of collections (see Appendix B for details on the costing modelling);
- Conversion rate of waste to compost is around 50% as recorded by existing trials, with bulk density approximately at 600 kg of compost per cubic metre;
- We have used a sale value of compost at $40 per tonne, as our analysis has shown that top soil is purchased by councils at about $40 per tonne;
- If there is not a sufficient market for compost amongst residents and farmers, the offset value assumption would still be valid as the compost can at least replace the top soil currently being

[9] Queanbeyan City Council, Goulburn Mulwaree, Palerang and Lachlan.

purchased by councils. For instance, Queanbeyan City Council has purchased 570 cubic metres of top soil in 2012 at the total cost of $24,100 (average price $42 per cubic metre) to the council. There may also be an opportunity in selling compost from councils that produce a surplus to councils that have additional demand (for example, Queanbeyan could be selling to the ACT).

There can be additional parameters considered to achieve a break-even point sooner:

- The organic waste stream from the commercial sector can be included into the scope of a Zero Waste System for councils where the annual volume of municipal organic waste is low and/or where the rate of organic waste per household is below average, so as to achieve economies of scale. In this case, the system will not require changes to relatively fixed parameters such as staff salaries or equipment hire cost, but will increase the total throughput of organic material going through the system as well as the value of the output product;
- We generally argue in favour of a decentralised model for waste processing so as to reduce transportation costs, and whilst for some councils it will be feasible to establish a self-sufficient Zero Waste System, this may not be achievable for all councils. Therefore in some situations there may be a case for an amalgamated system where materials from neighbouring councils are sourced and processed in one place, to further increase economies of scale. Although increasing the cost of transportation of the raw material, this can be viable in areas where greater demand for resulting product is required (for example, in the ACT).

Local market development is also essential in considering organics processing. There are, for example, large government organisations that are willing to buy and transport organic material for projects such as catchment remediation in areas where that material could be supplied through a local market.

The Houghton agronomy trials report (2011) demonstrated that the compost produced in the established implementation of a Zero Waste Process is of a very high quality and density, with low impurities, and meets the AS 4454 standard[10]. The report also notes that there is a need for ongoing quality assurance and due diligence to maintain this standard. It further recommends that all compost that is sold on to farmers should provide a nutrient analysis, information on the source of the material and evidence that the product does not contain pathogens, heavy metals or pesticide residue.

It is acknowledged that the Zero Waste System is the result of one of the author's work (Gerry Gillespie, President of Zero Waste Australia). While there is a conflict of interest in recommending this approach specifically, any similar approach could also be used and the specific case of the Zero

[10] In order to maintain high quality waste collection, effective community education is central. This needs to be backed up by well-trained staff, suitable (albeit minimal) equipment and an appropriate testing regime. Quality control is crucial throughout the process. It is not hard, but it is essential, to comply with AS4454

Waste System is used here as an illustration of what can be achieved, rather than a prescription for a preferred solution.

6.4 Bio-Solids

6.4.1 Background

Bio solids in most country centres where industry is usually light, are generally a high quality product with little contamination of any great concern (with relatively low levels of zinc, copper and lead). Containing exceptionally high levels of nutrient, they can be combined with council green waste to make excellent compost with very high humus levels if managed correctly.

The most important concern is that the process used and the finished product produced complies with all relevant regulations and standards. This is not difficult to do and the Zero Waste compost process mentioned elsewhere in this document has consistently produced an ‘unrestricted use’ standard product on numerous occasions.

6.4.2 Opportunity

There is usually a license change requirement necessary to enable councils to be able to compost their bio-solids at their local landfill. The EPA will nominate what is to be done to meet the necessary requirements.

As with composted organics in Section 6.3, the product can be used in local council landscaping where it will readily replace the need to purchase top soil for use in council gardens.

Based on the data from the Table 12 - Aggregated regional data by type, the region has the following profile in relation to bio-solids within the waste stream:

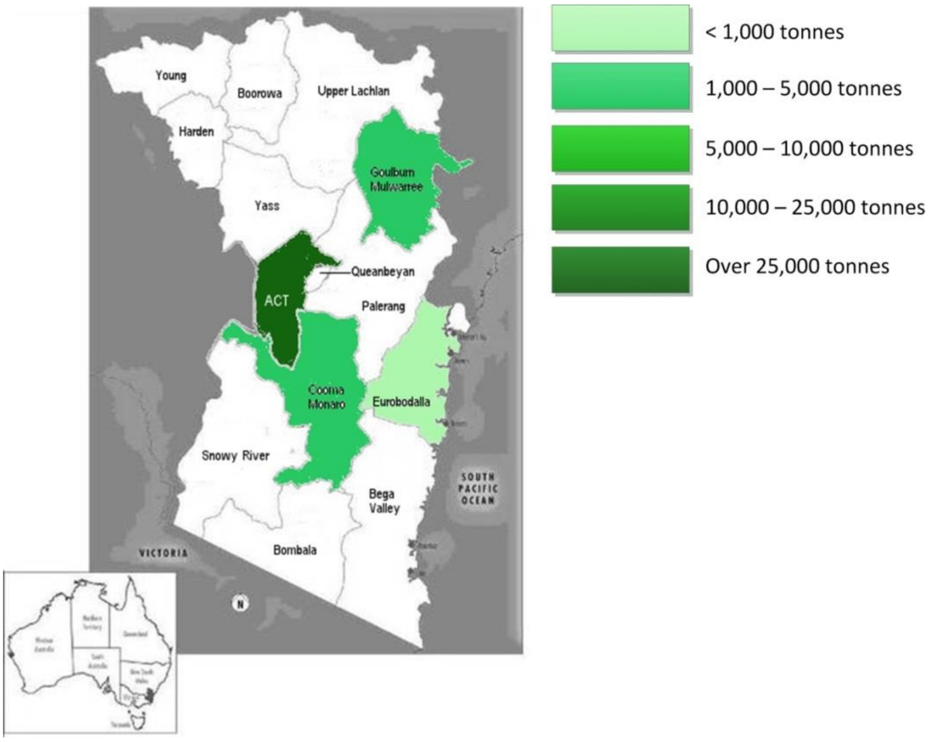


Figure 5 - "Heat map" of annual bio-solids volumes in the waste stream

Of all the LGAs interviewed, only 5 had available data on bio-solids:

- Cooma-Monaro provided data on bio-solids waste from Cooma sewage treatment plant, which is made into grade B compost for land remediation at Cooma Landfill. It was advised that the plant operations were revenue neutral, although detailed operating costs were not provided for the study.
- In Eurobodalla STPs are being upgraded and the exact volumes of bio-solid generation is unknown at this time.
- Goulburn-Mulwaree is understood to ‘dewater’ approximately 2000 dry tonnes of bio-solids annually. Currently this material is not going to landfill. However, as of recently, Sydney Catchment Authority has specified that all bio-solids are to go to landfill.
- Palerang has various existing processes, including a sewage and water treatment plant and bio-solids to landfill. No further details were provided.
- ACT has an inert sludge processing plant from the Mount Stromlo Water Treatment Plant, processing between 3000 and 4200 tonnes annually.

The lack of detailed available data, in particular around establishing and operating a bio-solids treatment plant, has not allowed pursuing this analysis any further. However it is recommended that a further detailed investigation is undertaken in this area (see section 9.3

6.5 Mattresses

Mattresses are a very big problem when disposed to landfill in that they cannot be easily compacted and, like tyres, if put into a landfill they tend to float back toward the top. In addition they take up a very large amount of space and with the increasing price of landfill and its replacement value this space will only become more valuable. A large double mattress will take the equivalent of a cubic metre of landfill space, meaning that the value to any community is the comparative cost of one cubic metre of space in the landfill where it currently disposes of waste.

With this ever-increasing cost, it is imperative that recycling systems be refined to divert mattresses from landfill and reuse their component resources to the best commercial community effect possible.

6.5.1 Background

Mattress recycling has been relatively slow to grow in Australia. It has been present in the US and UK markets for many years. It is interesting to note that in many instances in the US this has happened despite very low landfill disposal fees.

It is perhaps now more popular in Australia because of the relative ease of the process and has been demonstrated by clever management through agencies such as Soft Landing, operated by Mission Australia at Thirroul near Wollongong.

There are limitations to mattress recycling and value-adding which are unique to this small sector of the materials stream. Many mattress designs are the subject of IP and patents and as such it is impossible to rebuild and resell some mattresses without legal conflict. In these instances it is simply better to dismantle the mattress into its component parts and recycle it.

Soft Landing maximises value-adding wherever possible. The flock and stuffing is used as a fill for punching bags and the remaining materials recycled, where Dreamsafe had developed an inner spring metals shredder to enable value-adding by space reduction.

Like other businesses in resource recovery the development of one process like mattress recycling in close association with another is often the determining factor of success.

Mattress recycling as a large-scale business first came to attention in Australia following visits by Terry Macdonald of St Vincent de Paul in Eugene Oregon. Terry's business overcomes many of the issues of mattress recycling by the placement of the business in a context of community benefit. It also works as a part structure in a furniture operation which includes second hand furniture and the construction and sale of desks, chairs, tables and other furniture made from kitchen offcuts.

St Vincent de Paul operates for the purposes of providing services to underprivileged people and as such it offers a range of services from emergency food and clothing supplies to housing, budgets and financial advice which are all supported by the agency's strong interest in resource recovery and value adding.

St Vinnes' Eugene has overcome many of the obstacles normally associated with mattress rebuilds and remanufacture by supplying directly to its own stores and into its own 1000 plus units of housing accommodation. Other successful and mature mattress recycling businesses include FEAT Enterprises in Dundee, Scotland, Goodwill in Duluth Minnesota, and the St Vinnes operation in Eugene which is now supported by a second factory in San Francisco.

6.5.2 Assessment

It is clear that mattress recycling, from the overseas evidence and the good work of Soft Landing in Australia, could have a very substantial future in the south east region either in partnership with Soft Landing, who at one time were interested in the south east and a secondary site or as a stand-alone enterprise. The Greater Capital Region has all the necessary elements of population, reducing landfill space, increasing landfill costs, input material and unemployment.

Based on the data from the Table 12 - Aggregated regional data by type, the region has the following profile in relation to mattresses within the waste stream:

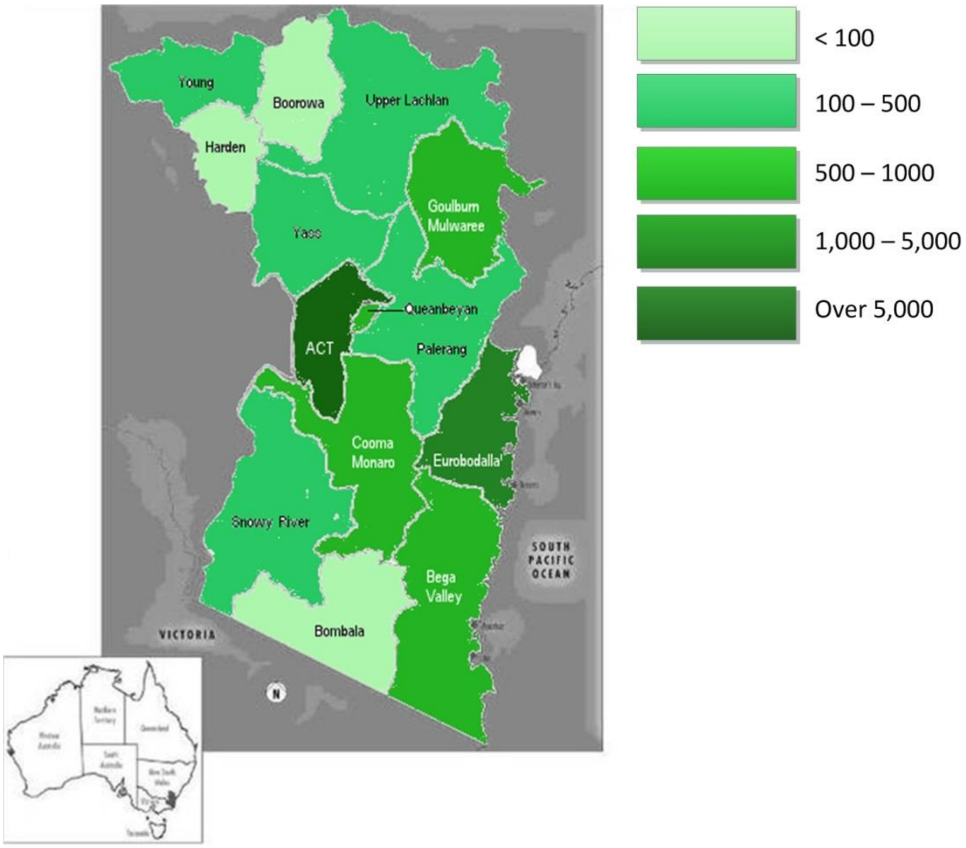


Figure 6 - "Heat map" of annual mattresses volumes within the waste stream

Accurate numbers of mattresses received at landfill could not be determined for all LGAs as only a few LGAs (Cooma Monaro, Eurobodalla, Bega Valley, Goulburn Mulwaree, Palerang, Queanbeyan, Upper Lachlan and the ACT) record the number of mattresses disposed at their facilities. An earlier report on mattress recycling in Australia [10] only contained actual data from 4 councils (Cooma-Monaro, Bega Valley, ACT/Queanbeyan), with the numbers suggesting a disposal rate of **23** per thousand of population per annum. In our project, as we managed to collect further actual data from more LGAs, we revisited the disposal rate based on the larger sampling base and more recent population figures, and have arrived at a disposal rate of **26** per thousand of population per annum. The assumptions made during these calculations are as follows:

- We have used the combined 2007 data for ACT/Queanbeyan and extrapolated it based on the current population figures of 2011.
- We have then calculated the data for ACT and Queanbeyan pro rata. These figures were used in conjunction with data from Cooma Monaro, Eurobodalla, Bega Valley, Goulburn Mulwaree, Palerang and Upper Lachlan to calculate the disposal rate per thousand of population.
- We have then calculated the estimates for the remaining LGAs based on the estimated disposal rate.

The resulting data is provided in the section 5.4.

The top 3 sources of mattresses are from:

- Individual drop off from residents
- Individual drop off from businesses

- Illegal dumping

Very few mattresses are received from 'at call' bulky goods pick up service and annual council clean up.

Whilst there is some degree of re-use of mattresses to cheaper accommodation within the same business, there is evidence suggesting an interest in the mattress recycling service:

- 60% of accommodation services would be interested in having a business or organization collect their used mattresses at no charge;
- 23% of accommodation services would be willing to pay a charge;

Unpublished data from reports in the region in 2004 and 2007 highlight the potential viability of a factory in the Greater Capital Region of NSW.

This recycling service may:

- Donate mattresses in good condition
- Recycle the metal
- Shred the mattresses
- Sell the foam

The total estimates suggest that there are up to 15,000 mattresses available for disposal in the Greater Capital Region each year. The majority of those mattresses are in the ACT/Queanbeyan and Eurobodalla area, as well as Goulbourn and the alpine tourist regions such as Snowy River. In volumetric terms, this number of units equates to approximately 11,000 cubic metres per annum of landfill airspace being consumed by this material within the region. Various studies on mattress recycling in Australia and overseas confirm the existence of markets for the commodities that arise from the disassembly of mattresses, highlighting the opportunity currently forgone to recover further amounts of approximately 130 tonnes of metal, 20 tonnes of timber; and 15 tonnes of foam for recycling each year.

Case Study:

Mission Australia

Mission Australia seems to have the biggest presence in Sydney and surrounds. Stan Brooks, of their subsidiary, SOFT LANDING, indicated that they have a 14 truck fleet with truck driver and offsider combing the area, collecting and processing **150,000 units** per annum (the estimated SEROC volumes are 10% of this). They recycle about 95% of the total input and have local markets for commodities arising from their operations at Smithfield and Wollongong, where they have cutting rooms with 8 operators. They have markets for the steel, wood and wadding material.

Leaving aside the value of the recovered commodities, which might conservatively be valued at in excess of $15,000, the airspace forgone could generate in excess of $100,000 in gate fee revenue, were it used for general waste.

It may be also be possible to charge a reasonable disposal fee of between $10 and $20 for mattresses, suggesting that costs of between $150,000 and $300,000 could be recovered through the disposal fee. In addition, based on the average weight of a mattress of 50 kg, this could result in up to 750 tonnes of waste diverted from landfill or additional $150,000 cost saving to the region per annum. This basic analysis suggests a total recoverable cost between $300,000 and $750,000 per annum.

Steel springs, a wood frame, stuffing and fabric with buttons can be recycled or reused. Steel in particular is a great material for recycling as mattresses have anywhere from 300 to 600 steel coils depending on the size of mattress. Assuming between 5kg and 10kg of steel per mattress, this is an additional stream in excess of 100 tonnes of steel, which can be stockpiled and recycled.

A full investigation is required to analyse the best location for such a facility. However, the data suggests that the demand exists and the required resource is available. Further development of a business case will require a business/asset manager to take it forward, rather than relying on existing waste management functions.

6.6 Metals

6.6.1 Background

Scrap metal prices are subject to international forces and during the Global Financial Crisis there were reports of serious disruptions to the market for recovered scrap. While the price that re-processors pay for mixed steel scrap is highly variable, the current ballpark figure is around $100 per tonne. Interviewed councils have sited prices as low as $80 per tonne, but also as high as $130 per tonne. Only 3 of the interviewed councils had actual data available on metals, and another 2 provided their best estimates. It was not possible to confirm how accurate those estimates were.

In the C&D sector, the majority (about 90 per cent) of metals recovered comes from commercial demolition sites. Of this material, up to 95 per cent is steel and the remaining materials (about 5 per cent) are non-ferrous metals. This non-ferrous component mostly includes aluminium (1 to 2 per cent), stainless steel and copper piping or wire. Ferrous metals like steel can be easily recovered from the waste stream using relatively inexpensive magnets.

In [4] Waste and Recycling in Australia [Hyder, 2011], it has been highlighted that across all sectors the recovery of metals is quite good, one of the highest of all waste types:

- Steel has 83% recovery rate
- Aluminium has 81% recovery rate
- For other metals the recovery rate is 89%

6.6.2 Assessment

Based on the data from the Table 12 - Aggregated regional data by type, the region has the following profile in relation to metals within the waste stream:

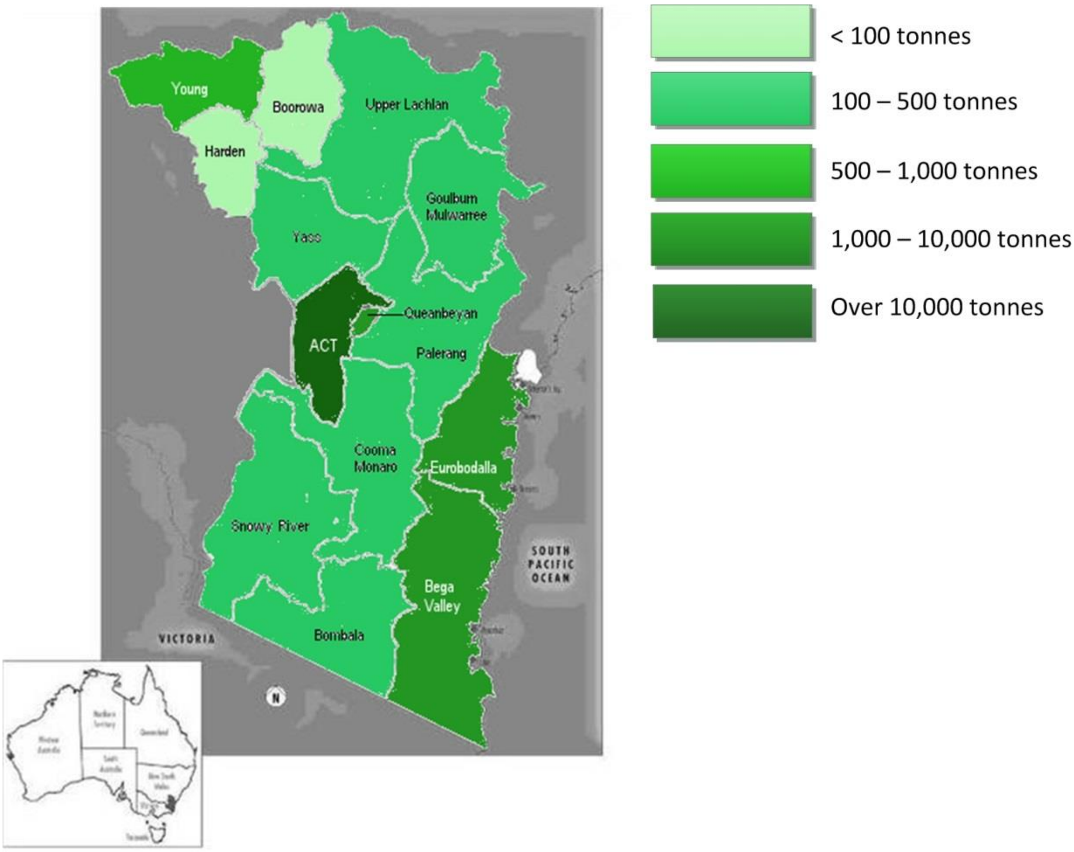


Figure 7 - "Heat map" for annual volumes of metals in the waste stream

The total estimated volume of metals for the region is around 50,000 tonnes annually, of that it is estimated that 40,000 tonnes are already being recovered. Therefore we estimate there is approximately 10,000 tonnes of metals annually that can be additionally recovered.

The table below provides a simple recovery benefit analysis of the potential for recovering this additional volume of metals. We have used an average landfill disposal cost of $70 and an average sale price of $100 per tonne.

Table 19 - Recovery Benefit Analysis for metals

Council Name	Metals, tonnes	Estimated Additional recoverable volumes, tonnes	Cost benefit from landfill diversion	Estimated Sale Cost	Total Cost benefit
Bega Valley	1,169.4	233.9	$ 16,371	$ 23,387	$ 39,758
Bombala	177.8	35.6	$ 2,489	$ 3,556	$ 6,045
Boorowa	73.4	14.7	$ 1,028	$ 1,468	$ 2,496
Cooma-Monaro	487.2	97.4	$ 6,821	$ 9,745	$ 16,566
Eurobodalla	1,557.9	311.6	$ 21,810	$ 31,157	$ 52,967
Goulburn Mulwaree	161.6	32.3	$ 2,262	$ 3,232	$ 5,494
Harden	61.3	12.3	$ 858	$ 1,226	$ 2,083
Palerang	264.4	52.9	$ 3,702	$ 5,288	$ 8,990
Queanbeyan	1,400.5	280.1	$ 19,607	$ 28,010	$ 47,618
Snowy River	132.5	26.5	$ 1,854	$ 2,649	$ 4,504
Tumut	212.5	42.5	$ 2,975	$ 4,250	$ 7,226
Upper Lachlan	129.2	25.8	$ 1,809	$ 2,585	$ 4,394
Yass	269.9	54.0	$ 3,778	$ 5,397	$ 9,175
Young	700.0	140.0	$ 9,800	$ 14,000	$ 23,800
ACT	43,100.0	8,620.0	$ 603,400	$ 862,000	$ 1,465,400
Total	49,897.5	9,979.5	$ 698,565	$ 997,950	$ 1,696,515

Additional metals can also be recovered from the mattresses in the municipal and C&I waste streams, although these volumes are not as significant. This this will be covered in the following sections.

As can be seen from the above table, there is a strong economic incentive to fully recover this material stream, especially when coupled with the value of avoided landfill disposal costs. Based on the estimated availability of metals and the estimated recovery rate of 80% we estimate an additional $1.7 million of benefit is available to the region, using the current sale price. As recovery can be done relatively cheaply by running magnets over the landfill, we recommend further exploration of this area.

6.7 Polystyrene

The greatest difficulties facing polystyrene recycling are its weight relative to its bulk, the difficulties in handling the light material and the corresponding sale price of recycled product.

A variety of attempts have been made to compact these materials using heat and extrusion, but the majority of them involve a relatively expensive process, considerable manual labour and sale of the material to an off-site vendor, whereby the local community loses the majority of the value of the collected product.

6.7.1 Background

Polystyrene like most other plastics is made from crude oil. It is produced as a rigid or semi-rigid foam and in this form is generally known in the packaging industry as Styrofoam or expanded polystyrene.

It is robust in that it can be formed to the shape of any products it is intended to protect and will take considerable rough handling before damage occurs to it. As Styrofoam it is used for a variety of functions including protection in and for large appliances such as refrigerators, washing machines, dryers, printers and their various component parts.

Polystyrene has great insulating qualities and in this form is used in products such as insulated disposable cups, meat trays and panel insulation.

Several attempts have been made by the packaging industry to replace polystyrene with like products and simulated cardboard materials. These included one notable material in bead form made from vegetable matter that simply dissolved when moisture was applied to it. In the main these have not been able to offer the qualities of polystyrene, and despite the marketing disadvantage that it is made from a non-renewable resource, it would not appear to have any product with similar packaging, protection and insulating qualities at the current time.

6.7.2 Opportunity

Data on available polystyrene within the waste stream is hard to come by. Most councils interviewed replied that they do not keep records on polystyrene collected, which is clearly a data gap. Of all LGAs responded to the interview questions, only Eurobodalla commenced receiving and processing polystyrene late 2012 as part of EPA grant, and only for the source separated amounts. Therefore it is expected that more polystyrene will be available in mixed waste.

Eurobodalla also has a polystyrene machine at Surf Beach, therefore were able to provide estimates of volumes but only covering the period from October 2012 until June 2013.

Based on the lack of data on polystyrene, we have attempted to estimate the amounts, however those estimates should be considered as guidance only.

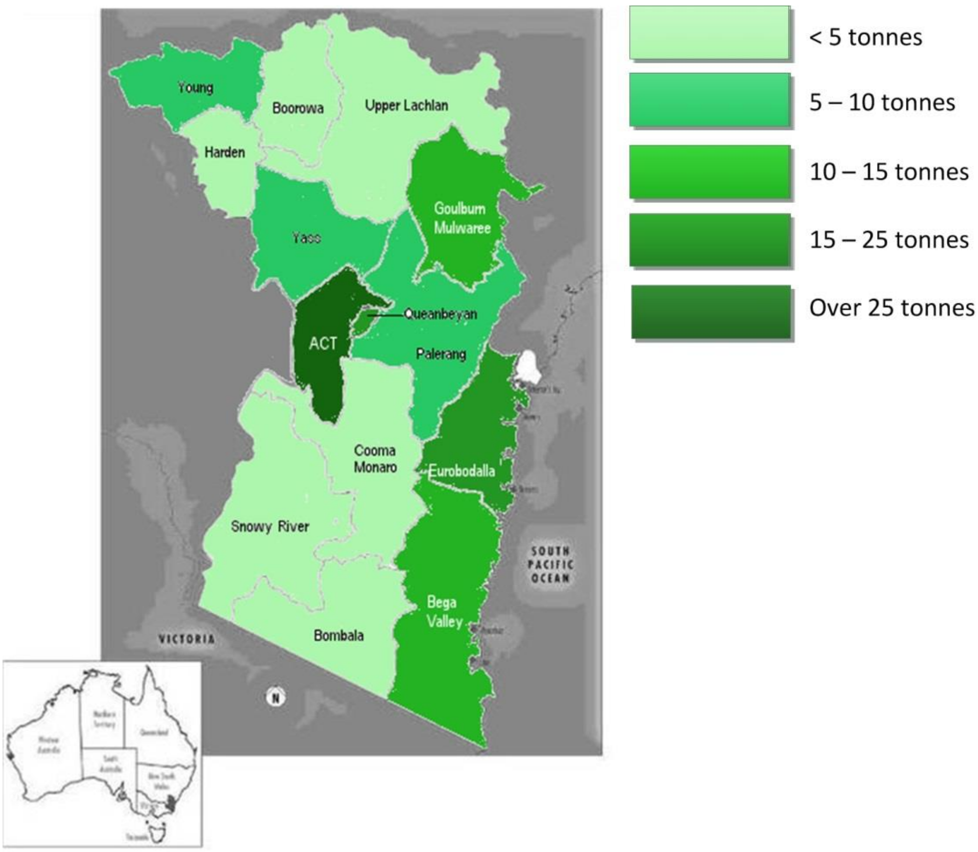


Figure 8 - Heat map" of annual volumes of polystyrene within the waste stream

The NSW Government through staff in the EPA have been offering regional centers the opportunity to increase recycling rates for expanded polystyrene (EPS), with the assistance of the Australian Packaging Covenant with grants to 19 organisations to a total value of $933,000 to build new EPS recycling infrastructure across NSW. These machines would seem a relatively inexpensive method of reprocessing EPS especially given that the value of the product is lost to the community. It does however reduce waste to landfill.

Other options for polystyrene recycling include those where more value can be added to the product at considerably reduced cost. Ecocycle in Boulder Colorado at their Centre for Hard to Recycle Materials (CHaRM) have a very simple bulk bin where EPS is dropped though a hole in a wall. The material is then broken back to simple beads through a light hammer mill arrangement once the bin is full. The polystyrene is then pressured back into a rectangular bale using a mud brick press and the baled material sent to market on a standard transport pallet, given more value back to

> **Case Study:**
>
> **Lismore City Council**
>
> Lismore City Council now recycles Christmas packaging made from polystyrene. A polystyrene extruder crushes the material and heats it to 150 degrees, then spits it out of the bottom of the machine. The material hardens quickly into what looks like fiberglass, reducing the bulk size by about **90%**. The coils are the sent to Sydney and then to a company in South Korea that use it to make plastic picture frames and skirting boards.
>
> The machine costs $43,000 and with about 500 cubic metres of polystyrene going to landfill each year, it is expected to save the councils **$77,000** a year in landfill space.

the local community at considerably less cost than the heat extruder model. The sale price is currently $360US ($A400) per tonne.

Another innovative local value solution for polystyrene is the Poly Palace in Porirua, New Zealand: http://www.polypalace.com

Polystyrene is dropped off at the Palace at a disposal fee depending on quantity. It is then broken down and reformed into large blocks. The blocks are then cut into a range of products using a small computer driving a heat wire cutter. They make under-floor insulation for wood floors, concrete slab under-floor insulation and other drainage and concrete products. Now in its tenth year of operation Poly Palace relies principally on a local population of 53,000 for its business base.

6.8 Paper & Cardboard

In [4] Waste and Recycling in Australia [Hyder, 2011], it has been highlighted that across all sectors the recovery of paper is above average:

- Cardboard has 70% recovery rate
- Office paper has 64% recovery rate
- For other paper the recovery rate is 52%

Based on the data from the Table 12 - Aggregated regional data by type, the region has the following profile in relation to paper within the waste stream:

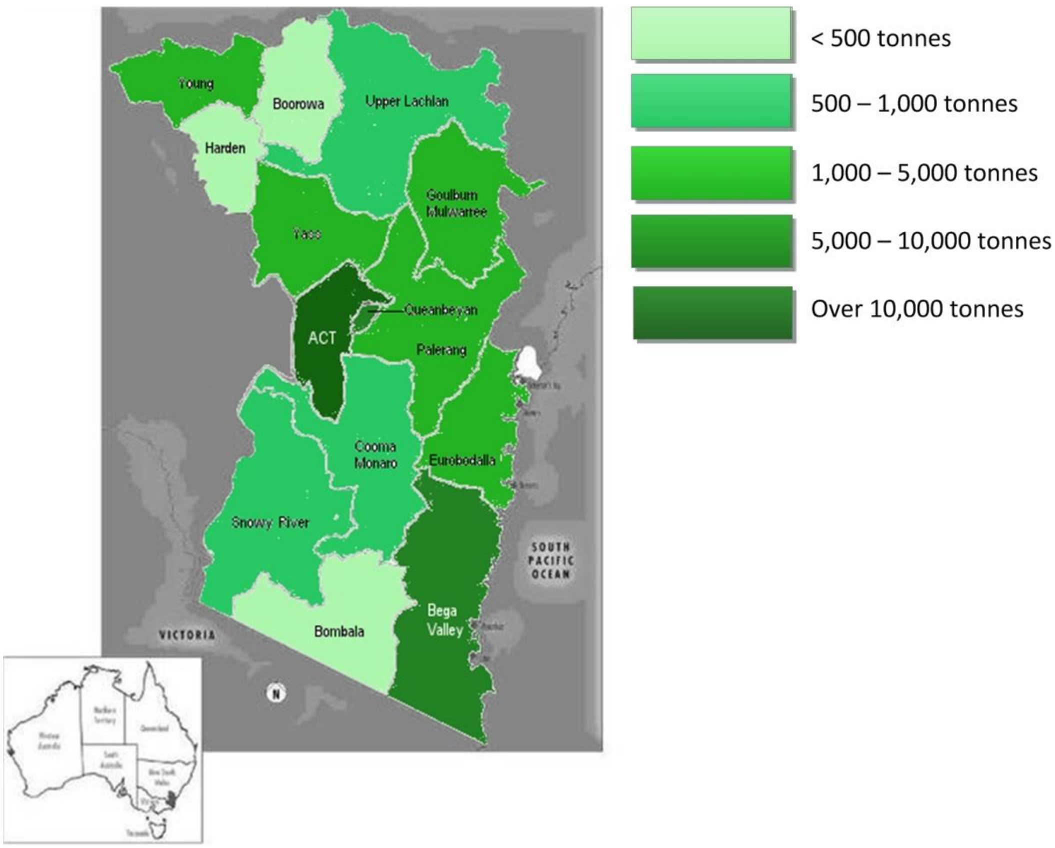


Figure 9 - "Heat map" of annual volumes of paper within the waste stream

The total estimated volume of paper for the region is around 110,000 tonnes annually, of that it is estimated that 80,000 tonnes are already being recovered. Therefore we estimate there is approximately 30,000 tonnes of paper annually that can be additionally recovered.

The table below provides a simple recovery benefit analysis for recovery of this additional volume of paper, using an average landfill disposal cost of $70.

Table 20 - Recovery Benefit Analysis – Paper

Council Name	Paper, tonnes	Estimated Additional recoverable volumes, tonnes	Cost benefit from landfill divertion	Estimated Sale Cost	Total Cost benefit
Bega Valley	6,099.2	2,357.3	$ 165,008	$ 282,870	$ 447,878
Bombala	90.3	93.9	$ 6,574	$ 11,270	$ 17,844
Boorowa	306.4	184.7	$ 12,932	$ 22,170	$ 35,102
Cooma-Monaro	1,060.3	529.1	$ 37,034	$ 63,488	$ 100,522
Eurobodalla	2,664.9	1,197.5	$ 83,827	$ 143,704	$ 227,531
Goulburn Mulwaree	1,966.2	698.3	$ 48,880	$ 83,794	$ 132,674
Harden	338.5	175.1	$ 12,260	$ 21,017	$ 33,277
Palerang	1,404.0	470.8	$ 32,956	$ 56,496	$ 89,452
Queanbeyan	7,084.5	3,031.2	$ 212,186	$ 363,747	$ 575,933
Snowy River	698.2	366.5	$ 25,655	$ 43,980	$ 69,634
Tumut	1,180.1	725.3	$ 50,770	$ 87,035	$ 137,805
Upper Lachlan	732.3	456.3	$ 31,939	$ 54,752	$ 86,691
Yass	1,395.0	663.7	$ 46,458	$ 79,643	$ 126,101
Young	1,566.0	509.0	$ 35,631	$ 61,082	$ 96,713
ACT	70,430.9	19,341.0	$ 1,353,871	$ 2,320,922	$ 3,674,794
Total	97,016.7	30,799.7	$ 2,155,982	$ 3,695,969	$ 5,851,951

The international price of recycled paper generally follows the cyclic trend of pulp prices. Domestic prices for recycled paper follow international prices, and range between $95 and $150 per tonne. As recovered paper is typically mixed, average weighted prices are in the order of $120 per tonne[11].

As it is obvious from the above table, there is an economic incentive to fully recover the paper waste stream, as based on the value of avoided landfill disposal costs we estimate between $2.1 million and $5.8 million could be available to the region. Given the significant volumes of paper within the C&I

[11] - Survey of Paper and Cardboard Recycling in South Australia

stream, we recommend engagement programs with businesses to encourage paper recovery, particularly in the council areas with high C&I volumes.

6.9 Textiles

6.9.1 Background

Like all wastes, textile waste originates from the community via a number of streams including fibre, textile and clothing manufacturing industry, consumers, the commercial and service industries. Textile waste in landfill contributes to the formation of leachate as it decomposes, which has the potential to contaminate groundwater. Another product of decomposition of textiles in landfill is methane gas. The decomposition of organic fibres and yarn such as wool also produces large amounts of ammonia. Ammonia is highly toxic in both terrestrial and aquatic environments, and can be toxic in gaseous form. Cellulose-based synthetics decay at a faster rate than chemical-based synthetics. Synthetic chemical fibres can prolong the adverse effects of both leachate and gas production due to the length of time it takes for them to decay[12].

While history of textile production goes back centuries, so does recovery of textile waste, which is as old as the art of spinning and weaving. For instance, according to historical records in 1860 in Italian town of Batley textile recovery employed 550 people. Nowadays, recovering textile waste is a multi-billion dollar global industry that performs a vital social and environmental function and provides employment for millions of people all around the world. An internet search on “textile waste” will elicit more than 2,664 products or listings, including headings such as hosiery cuttings and clips, polyester tow, cotton shoddy, used clothing wiping rags, denim/jean clippings, 100% cotton yarn waste, silk fibre waste, etc.

In Australia the organised recovery of post-consumer textile waste is mainly undertaken by charities such as the Brotherhood of St Laurence, St Vincent De Paul and Life Line, although in recent times a small number of private operators have entered the market. Collection is mostly of second hand clothing (post-consumer waste) by means of community donations deposited into charity bins, thousands of which are located across Australia, and/or drop-offs directly to charity shops.

6.9.2 Opportunity

The limited and inadequate data available in Australia and in the Greater Capital Region regarding the amounts and types of textile waste is an impediment to intelligent and effective recovery of textile waste. In the absence of comprehensive national data on textile waste – the paper [18] *Discussion*

[12] www.wasteonlie.co.uk

Paper Sources of Textile Waste in Australia, by Kerryn Caulfield, January 2012 advocates the collection of such data – this report has attempted to estimate the amount of textile waste available in the Greater Capital Region, based on other national waste studies.

A number of waste composition studies in Australia indicate that unrecovered textile waste accounts for approximately 4% of the content of our landfills. These statistics are an aggregate of all sectors in the industry (i.e. pre-consumer, post-consumer and industrial).

According to the data mapping in Table 12 - Aggregated regional data by type, the region produces around 16,000 tonnes of textile waste per annum, at a cost of over $1 million to the region:

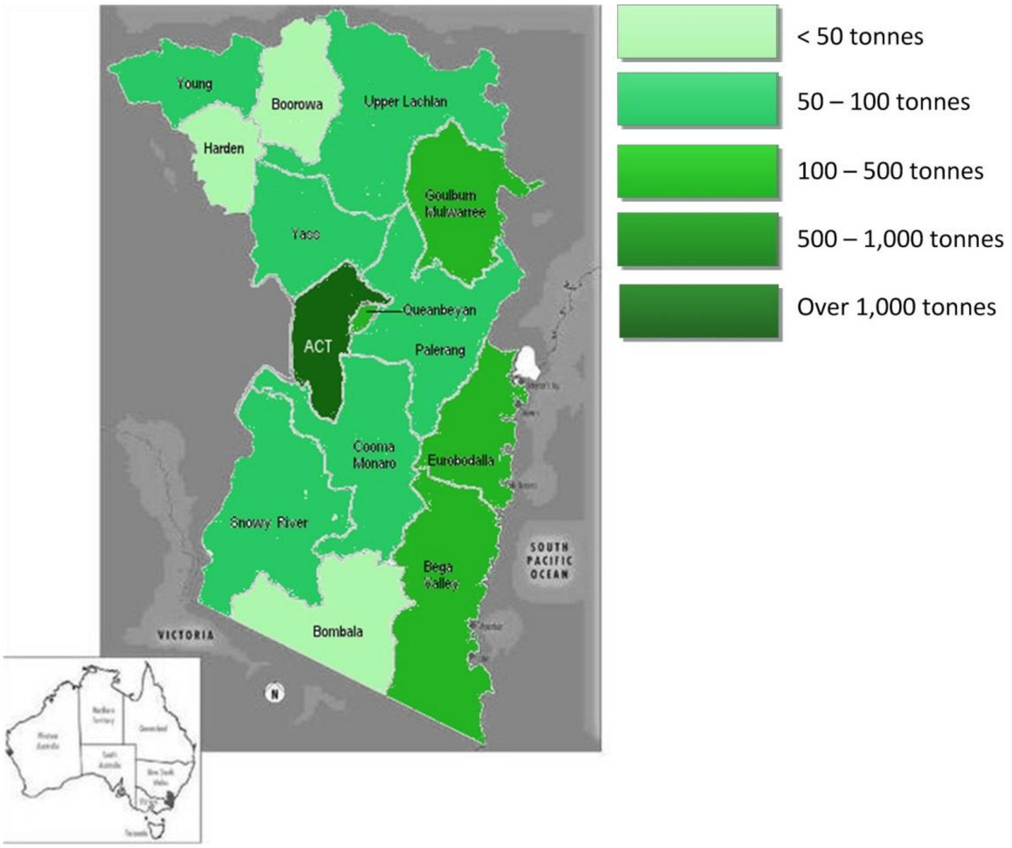


Figure 10 - "Heat map" of annual volumes of textiles within the waste stream

It is not possible to identify the breakdown of the total textile waste by fibre types or source. However, textile waste breakdown is generally consistent and is an unrealised source of valuable raw materials that can be repurposed or regenerated into saleable and usable products by intelligent collection, sorting, reengineering and reprocessing. Products made by regenerating textile waste include acoustic textiles used for soundproof blocks, insulation, roofing felt, bank stabilisation, and as pollution control filters.

Sorting to separate fabric composition and fibre types is a critical process in recovering textiles. Complex compositions of fibres make separation more difficult and more costly, and this has implications for the profitability of textile recycling. There may be an additional source of textile fibre from mattresses processing, this however has not been included in the estimates.

Until the 1 July 2011, The Smith Family owned a nonwoven textile operation plant in the Sydney suburb of Villawood, used to convert poor quality second hand clothing and textile waste into numerous non-woven products. A component of the Smith Family Commercial Enterprise, the operation converted textiles into a variety of products, including 'carpet underlay, furniture removal felt, weed suppression and water retention felts'. In 2011 the Smith Family sold the manufacturing plant to Australian-owned company United Bonded Fabrics. This company produces building products, geotextiles, carpet underlay, acoustic absorption sound panels, mattresses, furniture, insulation and cleaning cloths. It has four manufacturing facilities spread across Sydney, Queensland and Western Australia and states it 'works closely with charities and other manufacturers to collect and recycle cotton, wool and polyester fabrics'. Its manufacturing process strives to generate minimal or zero waste.

Given the cost to the region of over $1 million to dispose of textile waste, which is significant but may not be enough to establish local operations, it may be feasible to look into options for stockpiling textile waste and then shipping it to one of the above-mentioned facilities. Alternatively, if the region were to accept additional volume of textile waste from neighbouring regions which are not part of SEROC, establishing such a facility within the region may become economically viable. As this report's principles were to look at low-cost regional options, we were unable to obtain detailed cost structures of a facility such as United Bonded Fabrics to explore this further. Our recommendation however is to explore such options in greater detail as part of the role of the proposed Business Development Officer (see section 9.3).

Case Study:

Cotton From Green To Blue

Cotton from Green to Blue is a United States-based denim recycling initiative, turning disused denim into housing insulation distributed to communities in need. They have partnered with Bond Logic, a natural fibre insulation manufacturer to turn the denim into Ultratouch™ Denim Insulation. Other partners include non-for-profit organisations such as Habitat for Humanity for the insulation to be used in housing construction projects for communities in need. By September 2012 the project had collected almost **850,000** pieces of denim, diverting **531 tons** of waste from landfill.

Other opportunities with low establishment costs that warrant further investigation include:

- Converting textile waste into insulation (see insert) or industrial cloths;
- Clothing exchange swap meets – this idea is part of 'collaborative consumption' and over past decade has become increasingly common. It can work like this: patrons buy a ticket (typically around $25) and can bring up to 6 good quality garments to swap. It is recommended that this be trialled in the ACT, given its significant population of over 353,000.

6.10 Tackling C&I Stream

6.10.1 Background

The C&I sector is responsible for generating around one third of Australia's total waste stream, and there is significant scope for improved resource recovery performance. According to the National Waste Report 2010, of the total 43.8 million tonnes of waste generated in Australia (using 2006-07 data), 14.5 million tonnes (or 33%) was attributed to the commercial and industrial (C&I) sector. The report also shows that 44% of the C&I generated waste (or 6.5 million tonnes) was disposed to landfill[13]. This figure is 6.8 million tonnes (or 54% from the total C&I waste of 12.6 million tonnes) based on the 2011-12 data[14], resulting in the C&I recovery rate of only 46%.

At the same time, the C&I recovery rates in NSW and the ACT are amongst the lowest compared to other states and the national benchmark, and there is a significant scope for improved resource recovery performance given the large volume of C&I waste disposed to landfill (see Table 21).

Table 21 - C&I Recovery Rates by Jurisdiction

Jurisdiction	C&I Waste generation, tonnes			C&I recovery rate (current)	C&I recovery rate (target)	Target deadline
	Generated	Landfilled	Recovered			
New South Wales	5 440 000	2 550 000	2 890 000	54%	63%	2014
ACT				53%	No specific C&I target. Overall target 80% by 2015	
Victoria	3 120 000	1 190 000	1 930 000	62%	80%	2014
Queensland	1 700 000	710 000	990 000	58%	40%	2014
South Australia	770 000	280 000	490 000	64%	75%	2015
Western Australia	1 510 000	990 000	520 000	34%	55%	2015
Tasmania				13%	No specific C&I target	
Northern Territory				Unknown	No specific C&I target	

The Review of Waste Strategy and Policy in New South Wales 2010 (the Richmond Review) notes, "C&I waste is diverse, making it technically difficult and expensive to sort and recover materials". In addition to this, around half of the C&I waste stream is biodegradable, leading to potentially significant greenhouse emissions implications.

There are also significant differences between the C&I waste stream and the other two general solid waste streams, being construction and demolition (C&D) waste and municipal solid waste (MSW). Programs and policies designed to increase resource recovery from the MSW or C&D streams may not be as effective at influencing the C&I stream.

[13] National Waste Report, 2010.
[14] A study into commercial and industrial (C&I) waste and recycling in Australia by industry division. 2012.

Based on the national data in section 5.2.3, the following conclusions can be made for the C&I waste stream:

- Bio-degradable organic materials are a large part (over 30%) of the C&I waste stream.
- Compostable or recoverable food organics are sent to landfill in significant quantities. The recovery rate for food organics is only 22%.
- Metals are generally well recovered from the C&I waste stream, largely due to their economic value.

6.10.2 Opportunities

C&I waste is often the source of large quantities of specific waste streams that can be recycled but are not being separated from general waste due to poorly established mechanisms for recycling and lack of knowledge about recycling opportunities.

Unlike the diversion from landfill of metals, paper and cardboard, food waste is a harder material to divert for recycling. Part of the reason for this is there is not adequate infrastructure to process all of the material potentially available for processing. The material value can be very low in many areas of Australia and difficulties in on-site handling, storage and in collection also add to the challenge for effective processing of food organics. Many food service businesses are aware of food waste generation, but they either do not know where to recycle or are unable to recycle this waste type.

This creates an opportunity for the delivery of a commercial collection of source-separated organic material directly from food outlets especially in circumstances where a large number of food-based businesses are co-located.

In recent years in the ACT, Womboin Worms, Able Organics and others have developed a business model where waste organics office and institutional collections have been offered on a fee for services basis. Collected materials are either composted or worm processed to create products for sale. It could be readily argued that the viability of these businesses is dependent at least in part on the ever-increasing cost of landfill disposal in the ACT.

Increasing landfill fees in larger urban centres and regulatory controls on the transport of waste in NSW should ensure that this market increases in coming years. Linked to an improved awareness of the need for organic material in Australian soils these factors should see increased innovation in this sector and investigations into business options in other parts of the world.

An example was a commercial Canadian service identified at the 2012 ORBIT conference in France and interviewed by Zero Waste Australia, has developed a food maceration service where collections are conducted with a 'Milk Truck' tanker which pumps the shredded source-separated materials into a holding tank where they are measured in similar fashion to milk collections from dairies by the litre.

A collection process to suit such a model is currently under development using the City to Soil community engagement program in conjunction with a certificate in Source Separation and a business accreditation program certified by Zero Waste Australia.

This program could be delivered by any existing licensed waste operator with the appropriate equipment on the basis of a reduced cost per tonne disposal to landfill.

Such shredded material in solution could be ground injected to comply with waste regulation or used as an additional nitrogen and nutrient source into a compost process.

Use of the City to Soil engagement strategy and the ability to control inputs into the maceration process through source separation, training and certification can be used to ensure a clean product is collected at all times.

In smaller council areas the availability and use of the Zero Waste composting process currently in use in Armidale-Dumaresq, Harden-Murrumburrah and Cooma-Monaro Councils, which has low mechanical and labour requirements, will prove beneficial in the production of quality products which can be used both internally by council to replace purchased topsoil products or sold directly to ratepayers. These councils are being encouraged to exchange information on the implementation of this process to enable other council’s staff to operate similar systems.

Once a system has been implemented to collect clean source-separated material and a compost process or compost processor identified, council and the local community needs to determine the optimum market for finished product.

Market prices will vary according a range of factors. The Armidale-Dumaresq Council makes very high quality compost with good humus levels, which it sells back to the community at $25 per cubic metre. Whilst the potential sale value of the product is much higher and can be up to $125 per cubic metre, Council sees this as their part of an agreement with the community, who have committed to providing clean, uncontaminated product for the compost process.

The value of the diversion from landfill can be estimated as per section 8.4 *Variable disposal costs*.

A cubic metre of finished compost, which loses roughly half of its bulk in the Zero Waste composting process, is equivalent to one tonne of input material. This means that not only does the community save a cubic metre of landfill space, which is constantly increasing in value, but the total financial value of a cubic metre of compost is the diversion value plus the sale value.

Commercial sale prices of compost also vary dramatically depending on the focus of the compost maker and the quality of the product made. Generally, commercial prices range between $40 and $135 per cubic metre.

Off-site and on-site composting options are often considered to be more difficult for smaller businesses than larger ones but ‘boutique’ composting services can be established via cooperation of small organisations or by establishing new small business opportunities.

An example is Organic Waste Solutions in WA. Organic Waste Solutions is a family business that provides services to the local community and local businesses in helping them to divert their organic waste from landfill. They provide small organic waste bins to be placed in the tearooms, lunch rooms or cafeterias of the local businesses. These bins are marked for ‘ORGANIC WASTE ONLY’ and are cleared twice weekly to avoid any unpleasant odours developing in the bins. The organic waste is taken to OWS worm farms where it is converted into a soil conditioner for use in local community gardens.

They charge a service fee varying from $8 to $10 per bin, depending on the volume involved.

Another alternative which may be viable for C&I waste is conversion of organic waste into energy, using facilities such as high rate fixed film anaerobic digestion to recover bio-gas, water and nutrients. The difference of such system to a Zero Waste System is that it requires significant capital to establish, which may only be viable in highly populated areas where source separation as a preferred method cannot be achieved. Amortisation of such facility can be achieved within a 2-3 year period, but with the cost of generated electricity surging towards $100/MWh it is possible that such amortisation can be achieved sooner.

6.10.3 Recommendations

- Improve measurement and reporting of C&I waste and recycling data;
- Encourage collaboration between small businesses; and
- Investigate the development of commercial food waste collection systems based on a fee below combined skip bin and landfill costs.

6.11 Tackling Discarded Municipal Waste

6.11.1 Background

There are discarded materials in the Municipal Waste Stream that fall outside the normal household and commercial collections but which at the same time present some difficult and expensive problems to authorities in the SEROC group. Hard waste collections, where materials were normally discarded to the street, were considered in recent community waste strategy consultations in the South East to be one of the largest urban amenity issues the community faced.

For many years, local governments either anticipated that homeowners would solve the problem of disposal themselves or council would often provide an annual or biannual hard waste street collection as a service within the cost structure of community rates.

Difficulties began to arise however, when itinerants would move house and simply pile unwanted materials on the footpath, or in the instance of organised collections, householders would often place goods out for collection well-ahead of the collection date. Although this did account for a reasonable percentage of the 'dumped' material finding a new home, it does raise concerns for the more 'civil minded' in the community who see the process as unsightly and degrading for community ambience.

Attempts have been made to address this issue either by having a specific day where unwanted materials could be placed in the driveway of the home disposing of the material to be collected by anyone who wanted it or by having the home owner organise a specific collection of unwanted goods on a 'fee-for-service' basis by council. Participation rates in such schemes have been notoriously low for the large expense involved and the potential issues of public liability insurance risks given the materials transferred from one owner to another and the nature of the way in which this happens.

It should also be considered that not only do these processes once again remove responsibility from the person who purchased the material and by indirectly removing goods from the sales market, it also directly impacts on the ability of the local tip shop and second hand dealers and repairers to generate a living.

The NSW Government is currently considering the development of a series of Drop-Off Centres in regional rural NSW to take 'hard to recycle' items and toxic materials. The model chosen to date is very Sydney-centric in that it suggests of a drop-off point every 100 kilometres. Due to the issues and dangers associated with transporting the materials over such distances, this model may not be ideal for a regional area like SEROC.

Such an arrangement carrying potentially toxic goods is both dangerous and non-sensible in rural regions given that it is the most likely area to have noxious chemicals for clean-up and the possibility of councils providing and supporting such a service brings up issues of equity and public liability.

6.11.2 Opportunity

The difficulty with any of these options, given that the focus of this strategy is looking at potential value in material streams, is that it takes away any responsibly on the part of the owner, save a small 'fee-or-service'. In addition it degrades the value of the goods both in terms of placement in the weather and the notion of personal ownership and liability for the original purchase.

Given the success of a number of ”tip shops” in Australia and overseas, it is possible to build on this model to create an extended business opportunity for local businesses.

The provision of these services, if managed in conjunction with existing “tip shops” and the provision of 'inspection' sites where materials could be classified into 'saleable' or 'non-saleable recyclable' material would result in the establishment of a basis of small scale, first stage 'Sustainability Hubs' in all councils. This concept is explored further in Section 9.3.

Such facilities could provide the same fee-for-service collection currently provided by some of the councils and in other instances totally replace the 'hard rubbish collections' with a paid council service. In both instances the costs of the service would be similar, but the net outcome would be a total review of any goods prior to disposal to an enable resale, repair, recycling prior to landfill.

Analysis and estimates conducted of prior hard waste collections calculated a potential diversion rate of between 60 and 70 per cent of material placed on footpaths.

If council were to commit a percentage of estimated landfill disposal and space savings as a base input cost into the provision of such a service it could readily supply several employment positions in at every transfer station and landfill in the south east, provided the state government transferred its budgetary allocation for Household Hazardous Waste collections in conjunction with the funds for regional 'Drop Off' centres into this one function.

Tip shops have been very successful on or associated with landfills in Australia. Many are operated by NGO's under the guidance of the Community Recycling Network: www.communityrecycling.com.au

One of the more successful NGO operations has been at Great Lakes Council: http://www.resourcerecovery.org.au

While its Tip Shop is only one of a number of elements in its business portfolio, this business does demonstrate that award-winning success can be achieved when several business operations are co-located.

This is now being developed into Resource Recovery Australia, which will be helping councils across Australia develop similar community employment models: http://www.resourcerecovery.org.au

Another example was the parent of many of Australia's tip shops, the charity Revolve. In its best year Revolve in Canberra turned over $1.2 million. With a full time staff of 16 full-time staff it would take donations of around 2000 tonnes of material per year.

Keeping in mind that any diversion from landfill is a community cost saving, the 2000 tonnes of waste diverted from landfill in Canberra would have been conservatively valued as a landfill space saving of $200,000 in any one year.

Staff costs were approximately $69,000 per year including wages, workers compensation and insurances.

Another example of success at a regional level is that of the Scrapmart at the Cooma Landfill. Opened in 2009 and operated by council staff it has generated many thousands of dollars which have gone back into council as landfill cost savings (see the insert).

Councils, with the support of State government, under their current Transfer Station and Landfill arrangements could carry insurance liabilities as a community service with negligible increases in cost.

Such a program should see a dramatic reduction in toxic disposal to landfills, an increased recovery rate at all sites, that could by mutual agreement be improved year by year and the permanent engagement of local community members in the protection of their local environment.

Case Study:

Scrapmart Buy-back Shop (Cooma)

The initial set up and construction cost for the project was **$83,500**, however over the past 4 years additional investment of between **$10,000** and **$15,000** per annum was made as part of expansion of the shop space and continuous improvements.

This initiative resulted in creation of 3 part-time staff positions, with the operational and labour expenditure costing **$152,250** since the conception of the facility.

The shop stocks everything from household items, electrical items (tagged & tested), construction material, playground equipment, indoor and outdoor furniture, gardening tools and equipment and many more interesting articles, all diverted from the tipping face at Cooma Landfill (exact volumes/tonnages of materials diverted cannot be accurately provided for this report).

7 Economic Analysis

This section provides a “top down” view on the overall size of the economic opportunity in the region, updating and applying an earlier analysis [17] *Regional economic development implications of waste for the SEROC region, by Prof Steve Garlick, 2012* to each opportunity type in the previous section, but using the harmonized data set collated in the first phase instead of the inferred data of the original study. This provides the overall quantum of potential opportunity, and economic benefit, of each opportunity type in terms of employment and output value across the region.

7.1 Methodology

Table 12 in this report provides the basis for the analysis in this section. It lists the quantities of available waste for processing in the Greater Capital Region in various key resource areas. This section takes this data and also uses available economic impact data from the same ‘typical’ waste processing industries in a region of comparable structure to ascertain the wider regional economic implications for employment and output for the region. In this case we have used relevant data from the US state of Iowa by RW Beck and the Iowa Department of Natural Resources (2007).

Utilising an economic model from a comparable location is not the ideal approach, however given the data, time and budget constraints for this project it is not unreasonable. Ideally we could use a partial equilibrium regional input-output type model for the whole of the study area, but this was not available to us.

In the report [17] it was emphasised that the regional economic impacts from considering an endogenous transformative approach to the treatment of the regional waste stream as a new resource came more from the regional connectedness of the industry as opposed to the simple quantum size and value of its output. Whatever the end focus of new resource business enterprise generation there should be effort within the region to ensure these regional connections are strengthened through greater regional purchases, processing and sales and in the creation of export-competing downstream enterprises.

The Iowa economy (2007) can be used as a useful modelling framework for this project given a comparison of regional and national parameters for economic, demographic and employment activity. We have used pricing information derived from this study converted to tonnes and Australian dollars and then converted to 2007 prices.

In this section we have calculated the employment and output values for each of the waste processing sectors and for the SEROC economy as a whole. In this sense, the analysis here takes a different approach to that in section 6 which is concerned with processing cost. Here we have taken the region-wide output value as the measure of total outcome. Output value comprises the cost of purchases (materials and other costs of production) together with the value added to the original material input that comprises wages and salaries and gross operating surplus (i.e. net operating surplus together with taxes less subsidies) at the industry level. When assessing regional economic impact this is important for two reasons:

- Firstly, it enables the calculation of the induced economic effects resulting from household consumption expenditure, through the generation of wages and salaries and net profit.

- Secondly, it enables the effects of capital expenditure on the regional economy through profit-driven investment decisions.

7.2 Assumptions

It should be stressed that this analysis provides an assessment of the total economic potential for materials transformation opportunities in the region, rather than specific business cases for investment. In addition:

1. It is assumed that for this economic analysis all waste collected in the region is processed and transformed within the region with none being exported and none being imported. While this is an unrealistic assumption, it nevertheless enables one to obtain a baseline situation.
2. It is assumed, again unrealistically in a region such as SEROC, the regional economy is currently running at full capacity so that the full multiplier impact will occur in practice.
3. While we have indicated the types of downstream transformative industries that could be generated (through re-manufacturing / re-engineering) from the in-region's processing of waste, the region-wide impacts calculated are a summary and we have not indicated any specific business enterprise detail on any of these possible in-region downstream industries.
4. While we have measured the possible employment impacts of within-region processing of waste, we have not in this report been specific on the types of job skills that will flow from these processing activities.
5. It is assumed that produced output is consumed in the region and exported according to the structure of the same industries as exemplified in the Iowa model of the economy.

7.3 Glass

To fully process 30,174 tonnes of glass waste, of various shapes, sizes and colours, across the whole of the Greater Capital Region based on the Iowa model, would correspond to the employment of around 70 FTE (Full-Time Equivalent) employees to undertake a number of storage, sorting, washing, crushing and other downstream tasks. Generally, the glass will be crushed and used for sandblasting, road bed construction, drainage filter media, and other uses. While in this report we have assumed the total product will be used within the region, in reality there is likely to be a reasonable component of this product that will be exported. We have estimated that the total output value resulting from processed waste glass within the region will be around $1.8m at 2007 prices.

In this we have used an output value figure of $59 tonne of processed glass, which is noted to be $24 tonne greater than the processing cost for glass (at $35 tonne) shown in Table 13. This is the difference between the cost of processing and the value of the output actually produced. This conceptual difference in the analysis is repeated for all the waste commodities that have been examined in this section.

The region-wide economic impacts from this processing industry will generate around $2.8m in output value through its connections with other regional industries and a total of 117 jobs, including 70 directly in the glass processing, 35 in other regional industries where there are purchasing and sales linkages, and a further 12 resulting from household consumption and investment expenditure from the income of those employed in the glass processing business.

In arriving at these regional economic impacts we have used a labour productivity rate of 436 tonnes of crushed glass per employed FTE, with every $1 million dollars of output value supporting 38.9 jobs directly. The employment multiplier we have used is 1.69, while the output multiplier for the region for this industry we have used is 1.59.

7.4 Metals

Metals recovery includes the processing of aluminium and other metal products, steel and aluminium cans, ferrous non-container scrap, non-ferrous non-container scrap. Unless there is downstream manufacturing opportunities in the use of aluminium, steel and ferrous and non-ferrous metals in the region, we would have to conclude that regional supply will exceed demand and most of the processed metal will be exported. We have estimated the total value of the processed metal in the region is $11.9m (2007 prices).

To process 18,186 tonnes of metal waste across the whole of the Greater Capital Region we have estimated that it will require the direct employment of an estimated 30 FTEs.

While in this report we have assumed the total product will be used within the region in reality there is likely to be a reasonable component of this product that will be exported in the early years until there is a full downstream industry base created. In the early years therefore our figures of 72 region-wide jobs and $16.7m in output value will be overstated.

In arriving at these regional economic impacts we have used a labour productivity rate of 616 tonnes of scrap metal per employed FTE. Every million dollars of output value generated in the region via this relatively capital intensive industry will support 2.5 jobs directly. The employment multiplier we have used is 2.4, while the output multiplier for the region for this industry we have used is 1.4

7.5 Cardboard and Paper

This includes the processing of newspapers, cardboard containers and other kinds of paper and packaging materials. With a total regional supply of cardboard and paper of 95,837 tonnes for regional processing we estimate it will employ some 210 FTE and have an output value in the region of around $10.01m (2007 prices). In the absence of a fully developed paper products industry in the region it is likely there will be downstream processing industry opportunities or high exports resulting from local processing of these materials.

Through this industry’s connections with other parts of the region’s economy we estimate the total number of jobs in the region that would result would be in the order of 350 with an output value across the region of $12m.

In arriving at these region-wide economic impacts we have used a labour productivity rate of 462 tonnes of paper per employed FTE. Every million dollars of output value generated in the region via this relatively capital intensive industry will support 18 jobs directly. The employment multiplier we have used is 1.7, while the output multiplier for the region for this industry we have used is 1.2.

7.6 Organic Material

Organic waste material includes food, grass and brush trimmings, and other organic by-products. A regional processing industry could handle around 98,465 tonnes of organic waste and we estimate such an industry could employ around 100 people and have an output value of $7.08m (2007 prices). Much of the product of this processing industry can be sold within the region.

Through its region-wide purchases and sales connections the total multiplied employment resulting from the establishment of this industry could be of the order of 180 FTE with 60 of this occurring in other regional industries due to industry connections (15) and through employee expenditure of household income earnings on final consumption (45). Total regional output value across the region resulting from this waste processing activity will be of the order of $12.6m (2007 prices).

In arriving at these region-wide economic impacts we have used a labour productivity rate of 985 tonnes of processed organic material per employed FTE. Every million dollars of output value generated in the region via this industry will support 14.6 jobs directly. The employment multiplier we have used is 1.6, while the output multiplier for the region for this industry we have used is 1.8.

7.7 Plastics and Polystyrene

This industry involves the processing of polyethylene terephthalate, high-density polyethylene, polyvinyl chloride, low-density polyethylene, polypropylene, polystyrene, and other mixed plastics. Total regional supply for processing of these materials is estimated 14,704 tonnes. We estimate such an industry could employ around 26 people FTE and have an output value of $9.7m (2007 prices). Supply in this industry is likely to exceed demand in the absence of a downstream plastics industry that could take the processed output meaning that a processing industry of this kind will have a relatively high export element to its output.

Through its region-wide purchases and sales connections the total multiplied employment resulting from the establishment of this industry could be of the order of 65 FTE with 40 of this occurring in other regional industries due to industry connections (18) and through employee expenditure of household income earnings on final consumption (22). Total regional output value will be of the order of $14.5m.

These region-wide economic impacts are based on a labour productivity rate of 574 tonnes of processed plastic material per employed FTE. Every million dollars of output value generated in the region via this industry will support 2.7 jobs directly. The employment multiplier we have used is 2.5, while the output multiplier for the region for this industry we have used is 1.5.

7.8 Tyres

This industry involves the processing of around 7,900 tonnes of old rubber tyres primarily from the ACT. We estimate such an industry could employ around 9 people FTE and have an output value of $0.840m (2007 prices). The output from the industry could generate downstream business opportunities within the region in areas such as playground equipment, outdoor furniture, flooring, etc., ensuring a higher multiplier impact.

Through its region-wide purchases and sales connections the total multiplied employment resulting from the establishment of this industry could be of the order of 16 FTE with 7 of this occurring in other regional industries due to industry connections (3) and through employee expenditure of household income earnings on final consumption (4). The total output value that could be generated across the region through this activity might be of the order of $1.3m.

We have relied on a labour productivity rate of 878 tonnes of processed rubber material per employed FTE. Every million dollars of output value generated in the region via this industry will support 10.7 jobs directly. The employment multiplier we have used is 1.8, while the output multiplier for the region for this industry we have used is 1.6.

7.9 Construction Materials

This industry involves the processing of around 253,400 tonnes of building and construction waste and will include masonry, concrete, bricks, tiles, and plasterboard primarily from the ACT. We estimate such an industry could employ around 92 people FTE and have an output value of $21.5m (2007 prices). The output from the industry could generate downstream business opportunities within the region in areas such as playground equipment, outdoor furniture, flooring, etc., ensuring a higher multiplier impact.

Through its region-wide purchases and sales connections the total multiplied employment resulting from the establishment of this industry could be of the order of 183 FTE with 91 of this occurring in other regional industries due to industry connections (37) and through employee expenditure of household income earnings on final consumption (54). The total output value that could be generated across the region through this activity might be of the order of $27.9m.

We have relied on a labour productivity rate of 2,754 tonnes of processed material per employed FTE. Every million dollars of output value generated in the region via this industry will support 4.3 jobs directly. The employment multiplier we have used is 2.0, while the output multiplier for the region for this industry we have used is 1.3.

7.10 Mattresses

This industry involves the processing of around 15,000 units of used mattresses whereupon they are deconstructed and rebuilt into refurbished mattresses. The report by Australian Institute of Sustainable Communities at the University of Canberra in 2006 reports that in NSW an estimated 142,000 mattresses going to land fill each year, will comprise 251 tonnes of foam, 856 tonnes of fibre and 1,325 tonnes of metal in the form of springs and wood. This translates into 58.4 mattresses generating 1 tonne of foam, fibre, metal and wood.

For the Greater Capital Region there will be 25.68 tonnes of these materials available for further processing. Based on data from St Vincent de Paul in Oregon, reported on in University of Canberra (2006), we might expect only around 0.7 FTE employment for the region from this relatively small activity. Due its relative economic insignificance in the context of the region as a whole, we have not calculated wider impacts.

7.11 Conclusion

The regional economic analysis carried out in this section reveals that a focus on developing processing industries in key new resource (waste stream) sectors could make a substantial contribution to the economy of the Greater Capital Region. It is possible that around 500 new direct jobs could be generated if all new waste stream processing was carried out to full capacity. This would equate to a collective industry output value of around $63m. When the purchases and sales connections of these industries with other regional industries are taken into account along with the impact on other industries of income expenditure by employees in these new waste processing industries, then the multiplied impacts on employment for the region grows to around 990 jobs and $88m in regional output value.

Most significant in terms of regional employment impact is the processing of cardboard, paper and organic materials. While metal is less significant in employment terms it is equally as significant to organic waste processing areas in terms of output value generated, while cardboard and paper processing is less significant in output value terms.

The other two areas of interest are building and construction material processing and glass processing. Both of these activities have a reasonably high employment impact, however processing of building and construction material has a much greater impact on regional output value than glass does. Processing plastics also has a relatively good impact in terms of employment and output, while the economic impact of tyres is relatively insignificant.

Table 22 - Overview of the regional economic impact

Waste industry	Quantity processed (tonnes)	Direct employment (FTE)	Output value $'m (2007 prices)	Total regional employment impact		Total regional output value impact	
				FTE	Multiplier	$'m (2007 prices)	Multiplier
Glass	30,174	70.0	1.8	119.0	1.7	2.8	1.6
Metal	18,186	29.9	11.9	71.7	2.4	16.7	1.4
Cardboard & paper	95,837	209.8	10.0	356.6	1.7	12.0	1.2
Plastics	14,704	25.9	9.7	64.9	2.5	14.6	1.5
Organics	98,466	99.4	7.0	179.0	1.8	12.6	1.6
Tyres	7,900	9.0	0.8	16.2	1.8	1.3	1.6
Construction materials	253,400	92.0	21.5	184.0	2.0	27.9	1.3
Mattresses	26	0.7	Na	Na	Na	Na	Na
Total	522,558.3	536.7	62.7	991.4	-	87.8	-

This data demonstrates the importance of taking a regional economic development perspective to pursuing a within-region waste stream strategy. Such a strategy views 'waste' as a new resource and it views the regional economy as a place where there are opportunities to turn these resources into wider regional economic benefit rather than simply see waste as something to be disposed of because it represents a problem or an immediate cost for landfill.

8 The True Cost of Landfill

The approach taken in this project is to explore materials transformation opportunities that can be locally undertaken as an alternative to disposing waste into landfill. In many cases, a key factor in determining the economic feasibility of an opportunity is the avoided landfill costs associated with diverting part of the waste stream away from landfill. There are two fundamental challenges that such an analysis raises:

1. What is the true cost of landfill in the first place?
2. What proportion of the true landfill cost can reasonably be regarded as a realisable cost saving per tonne of waste diverted for the purposes of economic analysis or business cases?

It is important to consider the total waste stream management costs from a Life Cycle Assessment (LCA) point of view, and not just on economics in isolation. The full cost of disposing waste to landfill includes both private costs incurred for landfill establishment, operation and end of life management, as well as the impacts that landfills have on the environment, human health or social amenity – the costs that are not captured in private costs and market transactions – so called ‘externalities’.

The report undertaken on behalf of the Department of Environment, Water, Heritage and the Arts (DEWHA) in 2009 by BDA Group has done a comprehensive study into true cost of landfills in Australia. The figure below was taken from the report and highlights the full cost of disposing of putrescible waste to landfills in rural areas:

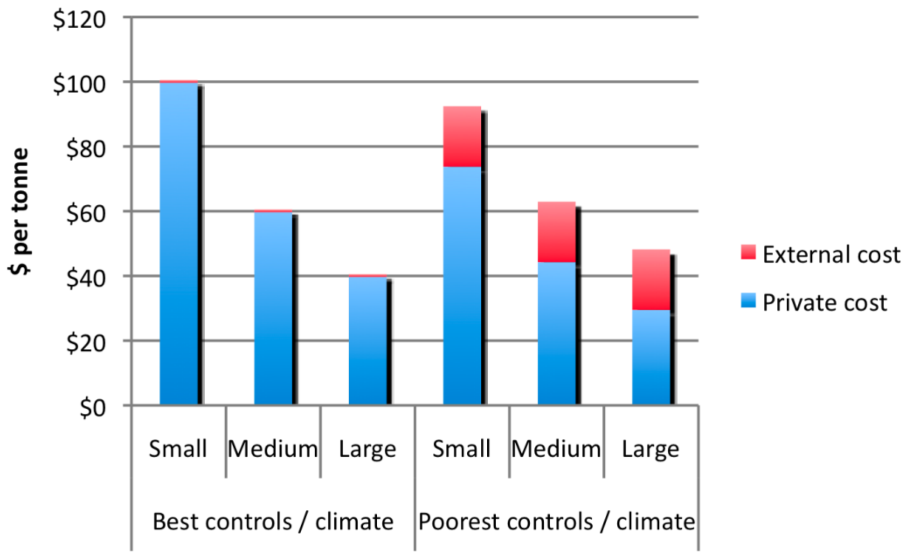


Figure 11 - True cost of landfills in rural areas, BDA Group, 2009

The report finds that the total cost of landfilling in rural areas ranges between $41 and $101 per tonne, depending on the level of management controls and prevailing climate. It also finds that external costs are significant for landfills with the poorest controls, making up 20%-40% of total costs for landfills in rural areas. The greenhouse and amenity impacts dominate the external costs for landfills with poorer management. For landfills with liners, landfill gas collection, energy recovery and best practice amenity management the greatest impacts in rural areas are dominated by disamenity.

8.1 External costs

Disposal of waste to landfill can result in externalities including the impact of releasing methane and other greenhouse gases from the decomposition of organic wastes. There is also the potential for impacts from leaching of toxic metals and compounds into the surrounding soil structure. Other externalities include the impact of noise and odours on local amenity, as well as the impact of air emissions. There are also longer term risks to human health and the environment associated with land that was formerly a landfill.

In the literature on non-market costs of waste disposal, these impacts are categorised as follows:

- Emissions of greenhouse gases – landfill gases such as methane caused by anaerobic degradation of organic material. This may be captured for larger operators by the carbon price.
- Emissions of other air pollutants – landfill gases include trace quantities of various other gases including hydrogen sulphide and volatile organic compounds.
- Leachate emissions – a range of pollutants are found in leachates that have the potential to be discharged to groundwater or sometimes surface water.
- Amenity impacts (also referred as *disamenity*) – includes impacts on local communities arising from the operation of the landfill and may cover noise, dust, litter, odour and pests.
- Transport impacts – including emissions from the collection and transfer of wastes.
- Pollution displacement - some studies estimate 'gross' externalities referring to impacts measured at landfill. Others are 'net' externalities that take into account the displacement of pollution elsewhere. For example, although landfill gas has a negative impact at the landfill, it can also have a positive impact if the gas is used to produce energy. This is because it reduces the need for energy generation from other sources such as coal fired power stations.

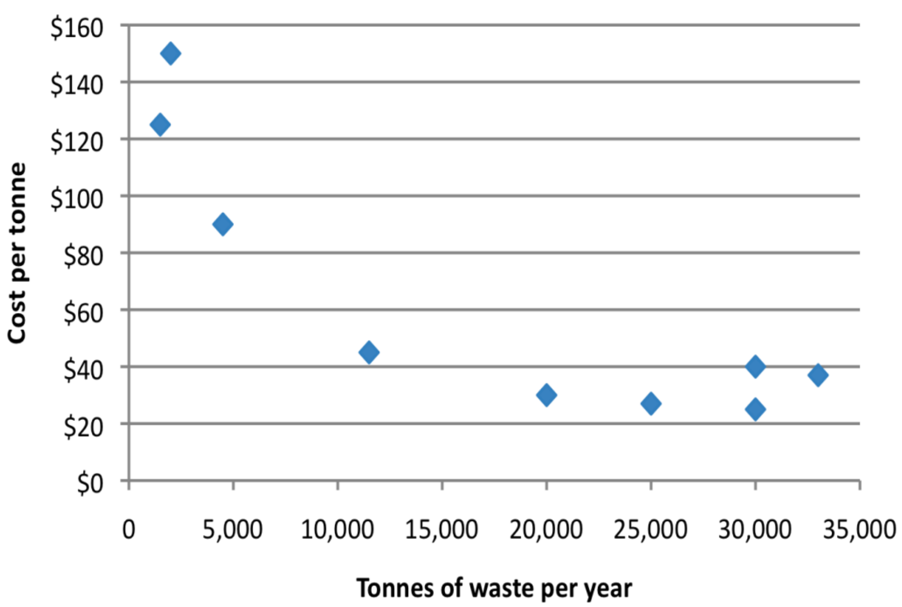


Figure 12 - Examples of current private costs for small Australian landfills, BDA Report, 2009

The BDA report also finds that for smaller landfills the private costs are significantly greater than for larger ones.

A large number of landfills in the Greater Capital Region can be considered of smaller scale and poorer management controls, as they are mostly unlined and many of them historically were unregulated. Based on that, and taking into account BDA report's assessment, it is reasonable to conclude that the landfill cost for the Greater Capital Region range between $60 and $100 per tonne, hence we have adopted $70 per tonne for the economic assessment, which is quite conservative as it does not factor in 'externalities' (which would add between 20% and 40% to the cost, arriving at a true cost between $85 and $140 per tonne).

Even for large landfills, implementing best practice environmental controls and measures comes at a significant additional cost. For instance, it is estimated that the full private costs of a large best practice landfill for ACT NOWaste is around $50 per tonne[15], taking 200,000 tonnes of waste per year.

For smaller landfills (which are quite common in the Greater Capital Region), the study suggests an increase per tonne between 50% and 100% depending on the amount of waste accepted, if those landfills were to meet future environmental standards (Figure 13).

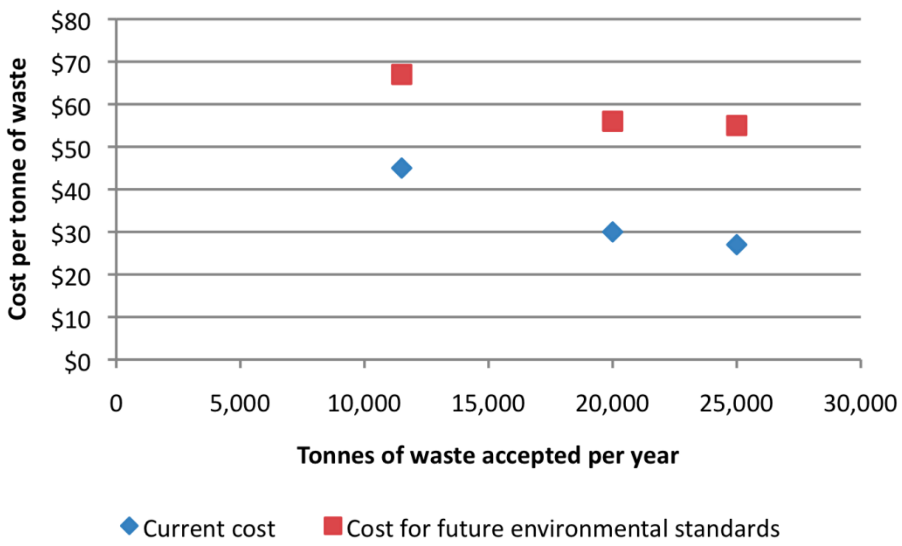


Figure 13 – Estimated increase in costs to meet environmental standards

15 These estimates were developed by Wright Corporate Strategy in the ACT context and include management costs (BDA Report, 2009).

8.2 Observations on existing regulations

In 2006 the Productivity Commission examined the external costs of landfill as part of its *Inquiry into Waste Generation and Resource Efficiency in Australia*. The Productivity Commission examined a range of estimates including the value of avoided air and water emission benefits at landfills.

While it is conceded that the objective of increasing recycling and reducing landfill in the regulated areas was stated as the reason for the introduction of levies in 1989 in NSW, the Greater Capital Region is still part of the non-regulated area, and none of the landfill prices in the region includes levies, with the exception of the ACT. All the prices quoted represent the “private” operational cost of labour, machinery and management. It is understood that the situation with landfill levies for the currently non-regulated areas (or a lack thereof) is currently under consideration by the state government and a consultation on the extension of a waste levy across the state is to take place. Notably, the present levy for what is called the ‘regional regulated area’ is $53.70 per tonne of waste disposed.

It should also be noted that with respect to landfill levies currently collected by the state governments, the majority of funds raised goes into internal revenue, and not into recycling programs.

As such, as a general observation of the regional situation, there could be an argument made for having a ‘special’ regional landfill levy established prior to the state government changing the levy arrangements and including the region into the scope of a state-wide levy - if such ‘levy’ were introduced by the state, then funds raised would most likely go to internal revenue, however if the region were to instigate its own special levy it would have full control of the funds raised.

For instance, if the ‘special levy’ was $20 per tonne, it would raise at least $2 million per year based on the current total volumes of waste disposed into landfill for the region[16] (excluding the ACT). Half of the funds raised (i.e. $1 million) could be distributed by the SEROC group to councils as an incentive for every tonne diverted from landfill, while the other half could go to the proposed Business Development Office to facilitate the development of new businesses. If such a model were to work, then over time the total volume of waste landfilled would decrease – and so would the total amount of funds collected by the levy – but at the same time new recycling businesses could appear.

Whilst it was outside of the scope of this project to recommend any policy changes, for completeness of the picture this observation on the existing regulations was included.

[16] Based on the total volume of kerbside municipal waste, C&I waste and C&D waste that was not recycled.

8.3 Observations on landfill management

As part of this project, we have attempted to estimate the variable cost of waste disposal in the region (see section 8.4). However, what we have uncovered highlights the lack of understanding of the true costs of landfill, as well as the true economic potential of landfill diversion.

At present, councils that manage their own landfills account for the value of the land taken by the landfill site, but do not track or account for the total (diminishing) volume of free landfill space available at each site. There is generally no value assigned to the free landfill space itself, even though this is a finite resource that is consumed, and has a significant cost of replacement. Therefore the true present value of the landfill asset cannot be determined.

Various studies point to the fact that free landfill space is not abundant or cheap, and as landfills are being filled up, new landfill sites with more rigorous environmental controls would need to be established. As a result, the cost per unit of free landfill space goes up in value over time, and – as with any appreciating asset – there can be an argument made that by knowing the true valuation of an asset and its appreciation in value over time, there will be a stronger economic incentive for the councils to ‘hold onto’ their assets (i.e. free landfill space) and as such reduce the rate at which the landfills are being filled now as the value of that free space will be higher in the future.

Waste is sometimes transported large distances in search of cheaper landfill space. Around 400,000 tonnes of waste per year is sent by rail from Sydney to Veolia’s Woodlawn landfill, some 250km from the city. Waste is trucked from Perth to Dardanup, a round trip exceeding 300 km[17]. This is because of the low cost per tonne kilometre of transferring compacted waste in large trucks — an increase in the transport distance of 50km would add only around $10 per tonne to the disposal cost.

As pointed in the report *Australian landfill capacities into the future, Hyder, 2009*, state and territory jurisdictions generally do not hold aggregated data on landfill capacities, which is surprising given firstly that operators are typically already required to report annually to the regulator, and secondly that the supply of landfill capacity is an essential service that jurisdictions must ensure is provided. Collection and collation of capacities data by jurisdictional authorities would be a simple way to improve landfill planning as well as asset management.

The analysis in the report by Hyder indicates the potential for waste reduction and recycling to extend the lifespan of existing landfill capacity by many years. Industry sources suggest that landfill space typically costs around $15/m^3 to buy, $10/m^3 to develop and $15/m^3 to operate and close. Establishment of a one million cubic metre facility would typically cost around $25 million so delaying this expenditure for a year produces an economic return of around $1.5 million per year.

[17] Source: *Australian landfill capacities into the future, Hyder, 2009*.

A key observation from this project is that a practice of understanding and accounting for landfill capacity as an asset with an ongoing valuation using current landfill space prices would encourage more landfill diversion, as it would quantify the value of extending the expected life of a landfill site (through diversion of waste to other forms of material transformation), as the landfill capacity will be consumed at a lower rate.

8.4 Variable disposal costs

Whilst the true cost of landfill is an important point of reference for further considerations, the original principle of this project (see section 2.3 Project Principles) was not to recommend policy changes (e.g. suggesting a new levy). A regional levy can certainly play a role, and make the economics of the opportunities listed in this report even more attractive, however the idea was to identify business opportunities that could be actioned on the short term, under the existing parameters.

In this report we have made certain assumptions on the savings from waste diversion per tonne of waste diverted. These assumptions were based on the analysis of the BDA report findings, as well as based on the actual costs of running landfills, which we have collected through a process of interviewing SEROC stakeholders.

The net benefit from diversion of waste in this report is based on the premise that there is a cost saving from waste diversion, which can be invested in the development of new economic opportunities. We have estimated these cost savings in the near term in the mix of waste flows through the solid waste management system by looking at variable disposal costs (as opposed to the fixed disposal costs for running the landfills):

- When a council pays a per-ton tipping fee for land disposal at a landfill owned by another entity (e.g., a private waste management firm), then land disposal can be an entirely <u>variable</u> cost because disposal costs to the local government vary directly with waste disposal tonnage (subject to appropriate contractual and commercial arrangements);
- However, if a council own their landfill, then only a <u>portion</u> of land disposal costs actually will be reduced when waste is diverted (e.g., through recycling), because variable costs account for only a portion of total land disposal costs. The remainder is fixed costs to maintain the landfill, pay for the equipment, wages, environmental controls, waste collection and transportation costs, etc.

The key figure is the variable component of the true cost of landfill, that is, the actual savings that can be made (in an annual budget for example) for reduced tonnage going to landfill. For example, if half the true cost of landfill can be treated as a variable component in this manner, then the <u>realisable</u> cost saving per tonne of landfill avoided for our adopted true cost of $70 would be $35. If a council were to explore a business case based on shifting operational budgets to fund a new opportunity, then the lower figure would need to be used. Note that in the opportunities explored in Section 6, many still appear worthy of consideration even with this reduced cost of disposal per tonne.

To better understand the variable disposal costs, we investigated the landfill arrangements in the region, so as to understand the proportion of the waste disposal costs per tonne that are variable when the tonnage of the disposed waste varies. Some of the councils were interviewed in regards to their landfill arrangements, whilst the other data was taken from the existing reports:

Table 23 - Summary of landfill infrastructure for the Greater Capital Region [18] (excl. the ACT)

<table>
<tr><th>Council Name</th><th>Annual volume (kerbside), tonnes</th><th>Percentage (from regional total[19])</th><th>Comments</th></tr>
<tr><td>Bega Valley</td><td>12,195</td><td>19%</td><td>Operate own landfills:
• Bermagui Waste Depot
• Eden Waste Depot
• Merimbula Waste Depot</td></tr>
<tr><td>Bombala</td><td>610</td><td>1%</td><td>Operate own landfill (Bombala Waste Depot)</td></tr>
<tr><td>Cooma-Monaro</td><td>2,160</td><td>3%</td><td>Operate own landfill (Cooma Landfill)</td></tr>
<tr><td>Goulburn Mulwaree</td><td>8,864</td><td>14%</td><td>Operate own landfills:
• Goulburn Mulwaree Landfill
• Minda Landfill
• Marulan Waste Management Centre
• Tarago Waste Management Centre
There is also a privately operated Woodlawn Landfill, operated by Veolia Environmental Services jointly with Goulburn-Mulwaree council.</td></tr>
<tr><td>Palerang</td><td>2,016</td><td>3%</td><td>Operate own landfills: Araluen Tip, Braidwood Tip, Bungendore Tip, Macs Reef Road Tip, Majors Creek Tip, Nerriga Tip</td></tr>
<tr><td>Upper Lachlan</td><td>2,300</td><td>4%</td><td>Operate own landfills: Bigga Waste and Recycling Centre, Crookwell Landfill Facility, Gunning Waste and Recycling Centre, Taralga Waste and Recycling Centre, Tuena Waste and Recycling Centre.</td></tr>
<tr><td>Eurobodalla</td><td>13,663</td><td>21%</td><td>Operate own landfills:
• Brou Landfill Facility
• Surf Beach Waste Depot</td></tr>
<tr><td>Snowy River</td><td>1,658</td><td>3%</td><td>Operate own landfills: Adaminaby Landfill, Dalgety Landfill and Jindabyne Landfill.</td></tr>
<tr><td>Boorowa</td><td>532</td><td rowspan="4">12%</td><td rowspan="4">Harden operates own landfills:
• Benangaroo And North Ridge Quarries
• Galang Landfill
• Harden Murrumburrah Garbage Tip

Yass and Young also operate own landfills.

There is also a privately leased landfill arrangement serving 4 councils via:
• Jugiong Landfill
• Ecofill Regional Landfill (Bald Hill Quarry Pty Ltd)</td></tr>
<tr><td>Harden</td><td>1,114</td></tr>
<tr><td>Yass</td><td>2,858</td></tr>
<tr><td>Young</td><td>3,106</td></tr>
<tr><td>Queanbeyan</td><td>14,064</td><td>22%</td><td>Private landfill arrangements, served by the ACT landfill.</td></tr>
</table>

With exception of the ACT, the situation regarding landfill management in the region is quite diverse and complicated:

[18] From *Resource Recovery Infrastructure Needs Analysis - Background Report 2011, GHD, 2011.* Due to the time constraints this project did not verify if all landfill arrangements are up-to-date, so some of the data in this table may be not be up to date.
[19] In this analysis, the regional total excludes ACT volumes, given the size of the ACT.

- Councils that own and manage their own individual landfills are Bega, Bombala, Boorowa, Cooma, Eurobodalla, Goulburn-Mulwaree, Palerang[20], Snowy River, Upper Lachlan;
- The Jugiong/Bald Hill Landfill arrangements are such that it is a privately leased landfill from Harden Council, servicing 4 SEROC councils – Yass, Young, Harden and Boorowa – plus another 4 councils in an adjoining region;
- Queanbeyan Council sends its waste to the ACT.

To investigate the variable component in the cost structure for landfills, we interviewed a number of stakeholders from various LGAs. Since this issue was not intended to be the main objective of this report, time constraints dictated that an exhaustive study on this issue was not possible, but enough data was gathered to give an indicative insight into the issue.

Our investigation has identified the following aspects of landfill pricing by way of specific examples:

- For one council that operates their own landfill, the running costs can be estimated at around $90 per tonne (we determined this by collecting the total annual running costs[21] of landfills within the LGA divided by the total tonnage of waste processed at the gate). Due to commercial confidentiality it is not possible to disclose which council's actual budgetary data was used, however the sampled data covers more than 20% of the region's tonnage outside the ACT and at least 30% of all council-owned landfills by tonnage.
- The gate fee that councils with their own landfill sites charge per tonne of waste ranges between $128 and $150 per tonne. For landfills with smaller annual intake the gate fee is higher (and so would be the fixed cost of running the landfill).
- For councils that operate their own landfill sites, there is generally a fund that is established to run the landfill as well as to pay for remediation and rehabilitation of land post-closure. In an example of the Jugiong landfill arrangements, shared between 4 SEROC councils, those councils contribute a certain amount into that fund each year, and that amount can vary based on the tonnage of waste disposed (i.e. if they dispose less they will pay less).
- For one council that does not have its own landfill arrangements in place and instead sends its waste to a privately owned landfill, they are charged around $130 per tonne at the gate. There are no minimum volume limitations in the contractual arrangements, thus there is no obligation for the council to dispose of a fixed volume of annual waste. There are however annual maximums set in the contracts, but actual annual tonnages are generally well below the set limits.

Based on the above, we have made the following assumptions towards determining the proportion of the landfill costs that can be deemed variable:

[20] At the time of preparing this document it was understood that this situation was changing.

[21] Including costs to manage domestic collection and overheads such as salaries for waste manager, waste minimisation officer, attribution to other council sections (finance, IT, HR, stores etc.).

- In the case of the private landfill arrangements, it is safe to assume that all costs ($130 per tonne on average) can be deemed variable, as the direct reduction in tonnage would result in direct reduction of the disposal costs to the council, such as would be the case for Queanbeyan.
- Where a council operates their own landfill sites, there is generally a gate fee of about $130 per tonne for the waste disposed of by waste contractors, and this is built into the waste contractor business models. If the internal running cost is around $90 per tonne, it is more likely than not that not all of these costs are fixed, i.e. if the tonnage of waste per year was reduced, it will generally require less machinery and labour to manage it (this was confirmed during the interviews with the councils that operate their landfill sites). So some proportion of the running costs will be reduced if the rate of disposal to landfill is reduced. If the same tonnage is diverted to another site, it is reasonable to still charge the $130 per tonne for disposal, and even if we assume the worst case that all $90 costs are fixed, then the $90 can still be paid back to the landfill operations leaving $40 available for exploiting an alternative opportunity. The greater the proportion of landfill operating costs are variable, the greater the available savings will be.

Therefore, a conclusion can be made that between $40 and $60 or at least 30%-50% of the average gate fee charge – and, in some instances (where there is a private arrangement in place, such as Queanbeyan) up to $130 per tonne – can be directly attributed to the variable cost in the region.

So, at the lower end of our estimates, the councils with their own landfills would be able to free up about $40 per tonne of waste diverted from landfill, while at the higher spectrum it would be up to $130 per tonne. On this basis we have used an average figure of $70 per tonne in estimating the net diversion costs and net benefits for the opportunities listed in section 6, although this can be expected to vary widely between councils.

For those councils that may have a smaller variable component in their landfill operations cost, the difference may be that the break-even point for an opportunity in some of the cases may take longer to occur, whereas for councils with private landfill contracts the break-even point may occur sooner than stated.

Given the complexity of the landfill arrangements and lack of data on the true actual costs of running various landfills in each council, we recommend a detailed analysis and understanding of the actual running cost in each council and the break-down of those costs into fixed and variable components, so as to determine the return on investment from diversion of waste for each opportunity listed in this report. A general observation is that those factors should be reflected as part of the accounting practices in each council (see section 8.5).

It should also be noted that although there is generally no way to avoid fixed costs in the short term, in the long-term, a permanent and predictable extension in the expected life of a landfill (through increased diversion of waste) can produce both accounting and economic benefits, by extending the lifetime of the landfill site, as the landfill capacity will be filled at a lower rate (see section 8.3 *Observations on landfill management* for more details).

8.5 Recommendation

Given the importance of understanding, and maximising, the realisable component of the true cost of landfill, it is recommended that:

1. Commercial arrangements with private landfill operators are negotiated to enable reduced landfill disposal to have a corresponding reduction in fees (in other words, landfill costs are variable via “gate fees” or similar); and
2. Where councils use internal landfill operations, that these facilities adopt variable operational cost structures and accounting practices internally so that reduced landfill volumes can be reflected in reduced costs.

9 Further Recommendations

9.1 Rationale

With respect to so-called ‘waste’ streams, indicators suggest that with an increase in population, and a continuous increase in consumption, and where consumption products are not noticeably more sustainable, there will be an increase in discarded products – known as ‘waste’. This is a growing problem that the Greater Capital Region will be facing, a problem that needs addressing. The SEROC/SERRG Regional Waste Stream Management Strategy highlights the growth in so-called ‘waste’ generation.

To address this problem of increased quantities of discarded products - or ‘waste’ - there are perhaps two major ways in which to view the matter with potentially quite different outcomes. One can address the problem from the perspective of a so-called discard management problem or the challenge can be addressed as a regional development economic opportunity. These two approaches might align, but not of necessity.

The two approaches align when the discarded products are actually used as a basis for local wealth and employment creation. This happens when all recycled products are transformed in a locally sited processing plant and there are input and output connections with other regional industries.

When a ‘problem - discard’ approach to waste is adopted, residents pay twice. Firstly, they pay for any ‘waste’ that is embedded as a generalised feature of the product purchased and secondly, they pay for the management of the discards being sent to landfill or a lost resource exported for recycling to places like Sydney and Melbourne. This scenario can be changed with an economic benefit to the region firstly by strong representation and a requirement for Product Stewardship and secondly by product transformation industry taking place locally within the region. The regional benefits are achieved through a waste stream management approach, but one which is very different from the past.

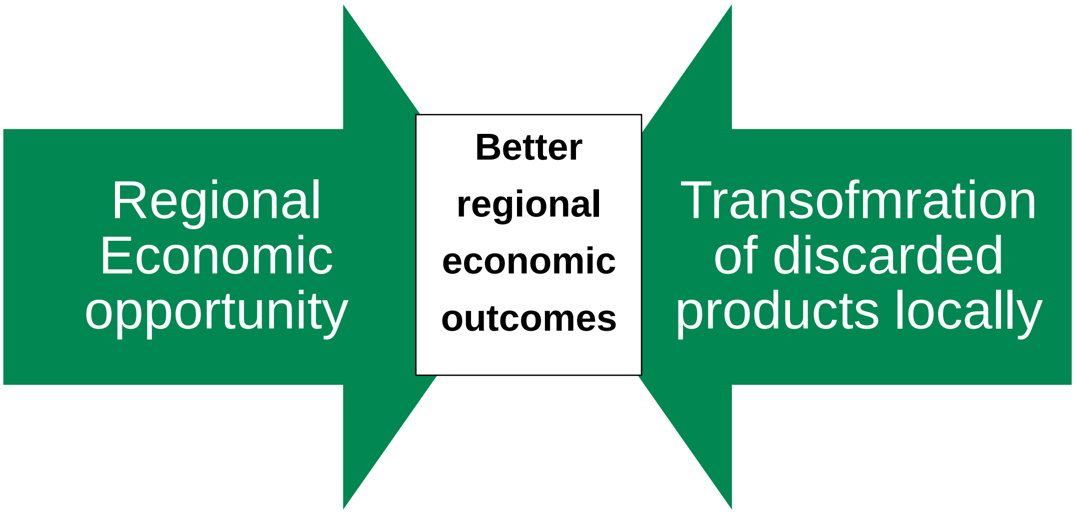
These two approaches do not align, or align poorly, when little consideration is given to local value-adding through materials transformation. The economic benefits to the region are severely reduced by exporting the separated and recycled discarded products.

SERRG has a policy direction to support the regional economic development route rather than the passive waste stream management route – and it now has the evidence to suggest this is justified - but in order for this approach to apply on a national scale there has to be a significant change in the production and distribution systems of our national economy. In the short term such a radical change is unlikely but nevertheless change is slowly happening via such influences as government policy directions, including the product stewardship approach, increased business management challenges to reduce costs and responding to increased consumer sentiment (e.g. “the challenge to landfill textiles”), plus better and available technology. In the meantime, this report highlights immediate actions that councils within the regions can take, with immediate economic benefits and on a cost neutral basis, to move in this direction.

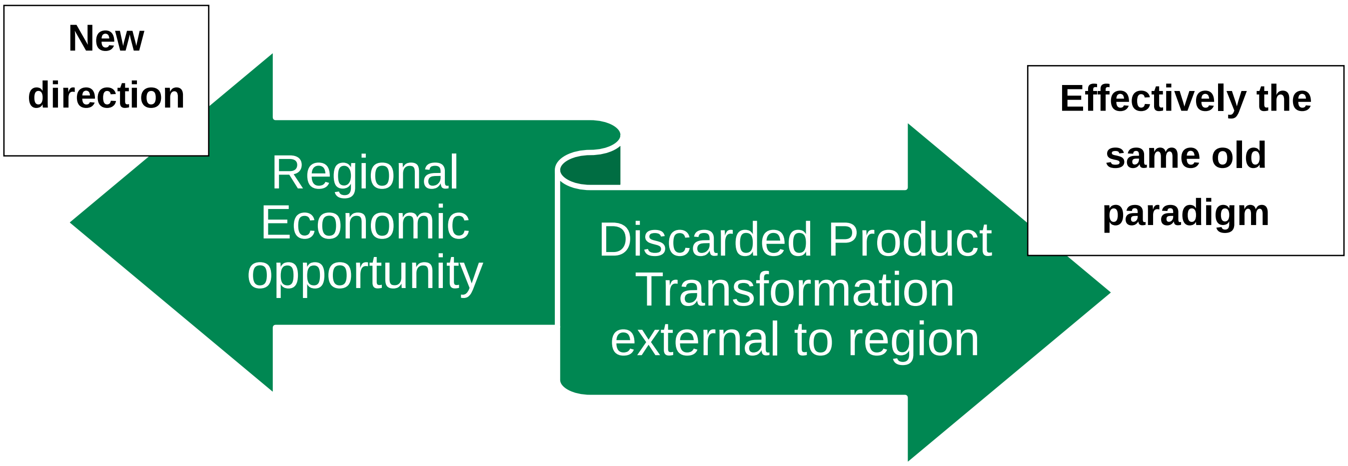
The SERRG paper produced by Prof Steve Garlick entitled ‘*Regional economic development implications of waste for the SEROC region*’ was a first for Australia and is based on the economic approach to addressing waste stream management. It shows clearly the potential for regional economic benefit, but where the diversion from landfill activity lies upstream in the supply chain from the present end-of-pipe waste disposal processes.

This Greater Capital Region Waste Stream mapping project begins from the waste stream management starting point. However, although starting from this end-of-supply chain perspective, its aim is to identify what might be potential product transformation opportunities to be developed in the SEROC region, thereby generating increased economic return for the regional community. That is, this project aims to reduce the discard problem by identifying where local regional processing is a possibility.

These views might be represented diagrammatically as per the diagram below where both the Regional Economic approaches and the Local Discarded Transformation of recycled products approach are facilitating a better return for the regional community.



Alternatively these two approaches will work in different directions for the regional economy if the discarded products strategy is a traditional waste process model where landfill and taking recyclables out of the region are the norm.



To work with the existing paradigm and attempt to move it toward the new paradigm requires a set of conditions to be in place. These might be summarised as:

1. The true cost to landfill is in place so that the price differential makes business sense;
2. The technology must be available and suitable for use in smaller communities;
3. There has to be an entrepreneurial culture supported by the appropriate skills development infrastructure;
4. The regional communities must have a business support culture addressing – finances, transport, local demand.

There is already data available which can be used to help support the existing paradigm of increased recycling, but the issue is whether there is enough data and / or whether this data is adequate to support a move toward a regionalised discard product transformation approach

In addition to the above, the 'term' recycling gives a sense of something that is ostensibly the same product that has been used by others at least once before for household consumption (e.g. Revolve-type operations), or it is transformed into another product predominantly made from the same material for final demand (consumption and export). So, for example, recycled rubber tyres become rubber products of various kinds (playground mats, rubber door mats, etc.) for final demand (consumption and export). Glass bottles and other glass products are crushed and become glass, scrap metal is recycled into sheet metal and then sent elsewhere and that's where the economic impact ends.

With a few iterations in the economy the 'recycled' material quickly becomes a consumption good while it has the possibility of being an input into other higher value added industry (including rural, mining and services) within the regional economy before becoming a final demand (consumption or export) good. Because there are more iterations resulting inside the regional economy, the multiplier impact within the region for the latter approach will be greater and as a result the impact on regional jobs and income will also be greater.

Second, but related, is that the recycling industry is always portrayed as being distinct and separate to the rest of the regional economy, rather than being an interdependent part of it. So as a result, assistance is provided for a recycling activity that has a certain multiplier impact for jobs and income rather than for an economic activity that makes use of discarded materials as its chief function which will have a greater multiplier impact because it results from more iterations, because the inputs from discarded materials are just one from a number, and because it may be import replacement.

So, the approach of just identifying several key recycled product industries like rubber tyres, glass, plastic, will only take us part the way along the opportunity spectrum. In addition, we should be asking how we can make existing industry (whatever they might be) in the local region more competitive (with more jobs and income) by seeing where discarded materials can be used to substitute for existing (predominantly import replacement) purchased inputs.

9.2 Aggregating Market Forces across the Region

Many of the opportunities identified in this report warrant more detailed business case analysis and the brokering/introduction of commercial and community operators to take on local materials transformation responsibilities as an alternative to disposal to landfill. However, even where none of the opportunities identified in this report are adopted, the data produced highlights the potential for the Greater Capital Region and other regional council groups to cooperate to identify and aggregate their recycling streams so that they can present more of a "market force" when negotiating prices and services with existing and future recycling providers, particularly in internationally competitive markets like metals, paper, glass and plastics.

It is therefore recommended that the data is provided to each of the Greater Capital Region councils, and a group is formed to explore the potential for cooperative procurement of waste services across the region.

9.3 Business Development Officer

Based on the results obtained in this report it is suggested a number of facilitation initiatives be considered for implementation within the region to ensure the notion of waste as a new resource can evolve and have a momentum meet the dual objectives of environmental integrity and regional economic stimulus in good time. In this regard we see there are short and long term region-specific initiatives that could be implemented that don't impact on the current broad-based regulatory regime put in place by government.

In the short term we suggest two broad initiatives:

- A role of a business development officer who will carry out a number of on-the-ground facilitative functions;
- Financial incentives.

We see the role of a business development officer having the following tasks:

1. Liaise with targeted waste stream producers to assess their preparedness to explore the business opportunities identified in this report for the downstream processing of waste to other re-manufactured product for local use or export.
2. Liaise with waste stream managers to encourage their focus on further waste processing practices so as to reduce the impact on current landfill and to endogenise current recycling exports.
3. Liaise with regional development agencies with a view to having waste as a new resource incorporated in their strategic planning regional development stimulation programs and to explore the availability and targeting of financial incentives.
4. Construct new recycling data sets related to the processing and end-use of targeted waste streams that have been identified as gaps in our knowledge in this report, as well as have the overall responsibility for surveys to fill these data needs and develop an ongoing monitoring program to assess performance over time.
5. Develop an informational campaign for business and the community focussing on the regional economic development and environmental benefits of viewing 'waste' as a new low-cost resource to influence attitude and behaviour toward waste.
6. Identify skill enhancement requirements through training, foster entrepreneurism and technology transfer, particularly targeting industry opportunities identified in this report.
7. Network building between regulators, regional waste stream managers, business entrepreneurs, and regional development agencies.

We are not intending to suggest in this document a creation of a new position, but rather that a new role may be useful and that such new role may be fulfilled by an existing position on a part-time basis.

Whilst it may be argued that such business development role is unnecessary as the commercial businesses should be able to identify opportunities if those existed, we note that as part of this project we had to go to considerable effort to collect the data presented in this report – something a commercial operator might not discover at face value. We have also discovered that linking potential operators (especially if none exist yet in relation to a particular raw material type) to the right data and business opportunities is a non-trivial exercise, requiring insider knowledge of how the region is governed.

We see value in financial initiatives including enhancing access to existing business, regional development and environment program grants and subsidies to processors and end-users seeking to generate downstream processing of targeted waste areas built around the opportunities identified in the report.

The facilitative role of the Business Development Officer could evolve to the development of a broader Sustainability Hub in the region, as previous studies have highlighted. Such a facility could go beyond the proposal outlined in the draft business case prepared for SERRG by Zero Waste Australia (2012) (see Section 3).

A regional sustainability hub would provide a knowledge platform facility enabling business incubation in areas of waste transformation that focus on new products and markets. It could provide R&D facilitation and support, marketing intelligence and business training to aspiring and new businesses through network links to universities, technology parks and other expertise within Australia and overseas where work is occurring to convert waste into marketable products. Through links to learning institutions, the Hub could be a platform for new business incubation, facilitate skill building, entrepreneurship and good practice demonstration. Generally, a hub of this kind could be a facilitator for a business cluster and innovation platform for diverting waste into purchasable products to ensure the downstream economic benefits from waste processing are retained within the region.

Such a Sustainability Hub can be established as a social enterprise with the dual purpose of enhancing environmental and regional development outcomes for the Greater Capital Region through the diversion of waste stream output to more productive purposes within the region. The resulting benefits that flow broadly throughout the community will have a multiplied impact on generating employment and income throughout the regional economy, fostering enterprising behaviour by segments of the region's human capital, encouraging research and knowledge generation to further explore avenues and solutions for even greater waste diversion to recycled and re-engineered products of market value, and will encourage greater environmental awareness by material and service purchasers to consider alternative uses for what otherwise might have been considered 'waste'. In doing so the Sustainability Hub will aim to address a number of current regional shortcomings that together reflect a region operating at under capacity. In particular these include relatively low levels of employment and high levels of under employment, relatively low levels of enterprise generation, and low levels of R&D application for regional business solutions and high levels of waste to landfill. The collective benefits for the region of making progress against these regional under performance measures need to be factored into any assessment of net benefits and costs and overall viability of the Sustainability Hub concept.

A centre of excellence in the form of a Sustainability Hub could also be the vehicle to attract 'green capital' through an internationally marketed prospectus.

It is outside of the scope of this report to provide a detailed business case for such a Sustainability Hub, given that work of that nature has already been undertaken by others. However, the general principle is that such a Hub could be a non-for-profit operation, with all surplus finances re-invested into new business opportunities.

9.4 Data Collection

This project as part of data mapping activity has identified that accurate and timely data is not readily available or not consistently available from all the LGAs in the region. Where some data is available, it is very rarely an actual current data set but rather ballpark estimates which do not adhere to a common data structure. As a result, mapping of all the various data elements from all streams into one common data model for the region proved to be a challenge. Whilst this activity is feasible as a one-off task, it is not practical to undertake such activity on yearly basis to see if there were improvements.

Data, its collection, veracity and use, is a key issue for regional waste management, as the notion “you cannot control what you can’t measure” also applies here. In March 2010, SEROC engaged consultants Strategic Economic Solutions Pty Ltd (SES) to research and report on how to assist SEROC councils more effectively and strategically use collected waste data sets over the next 5-10 years.

The report titled ‘*SERRROC Regional Resource Recovery strategy options – including waste prevention*’ was released in July 2010. It sought to look ‘over the horizon’ in order that waste stream management strategies might be developed in light of emerging trends and changes occurring in our wider community. By extrapolation of population trends, and including increased consumption, the report concluded there will be significantly increased quantities of so-called waste materials in the region. The report also concluded that more could be done by Councils around waste stream transformation and recycling.

Currently data is collected primarily for statutory reasons. Councils who operate landfills need to collect more data, for licensing requirements, than councils who do not operate landfills.

Many of the observations in this project mirror those in the 2010 report:

1. Data collection is ad-hoc and not consistent across councils
2. Data accuracy, and the way it is measured and collected, varies considerably
3. Improved data accuracy and availability would assist in planning and waste management
4. There is a lack of benchmarking of data against best practice

From our findings it is also evident that while the MWS is covered by the EPA survey and collected data is mostly consistent and adherent to a common data model, there is a big data gap related to C&I and C&D streams. This data is either patchy or non-existent, and the recovery rate is hard to estimate.

This can be one of the reasons why very little has been done in the region in regards to reducing food waste from commercial sources.

The current state of data collection (“as is”) is shown on the diagram below.

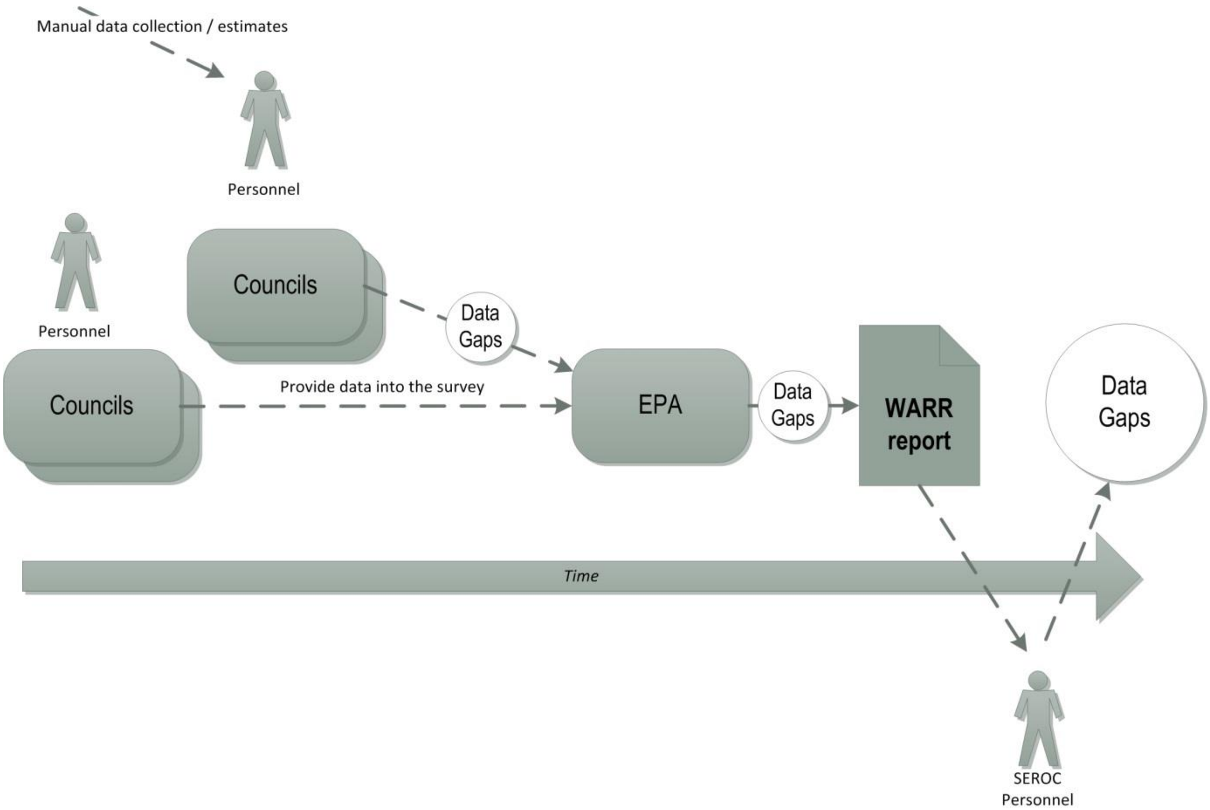


Figure 14 - "As Is" Data Collection Business Process

What has emerged out of this project, and supported by the findings of the previous reports, is that what is needed is a consistent data monitoring system/process for data collection, development of indicators, benchmarking & continuous improvement. Such a system could be used to collect data consistently from all the councils and so provide a timely snapshot of the regional waste profile. The collection of data can be facilitated in the short term via online forms and hand-held mobile devices used by waste managers in each council, or, in the longer term, an automated data collection can be implemented where waste data is collected directly from the trucks. Systems such as bin tracking software can facilitate real-time data collection, whilst removing overheads and improving accuracy, timeliness and consistency of the collected data sets. A simple trial is being undertaken at Cooma-Monaro on the implementation of real-time data collection via low cost mobile devices to explore the potential of this approach.

The diagram below schematically illustrates one of the possible re-modelled “to be” business processes:

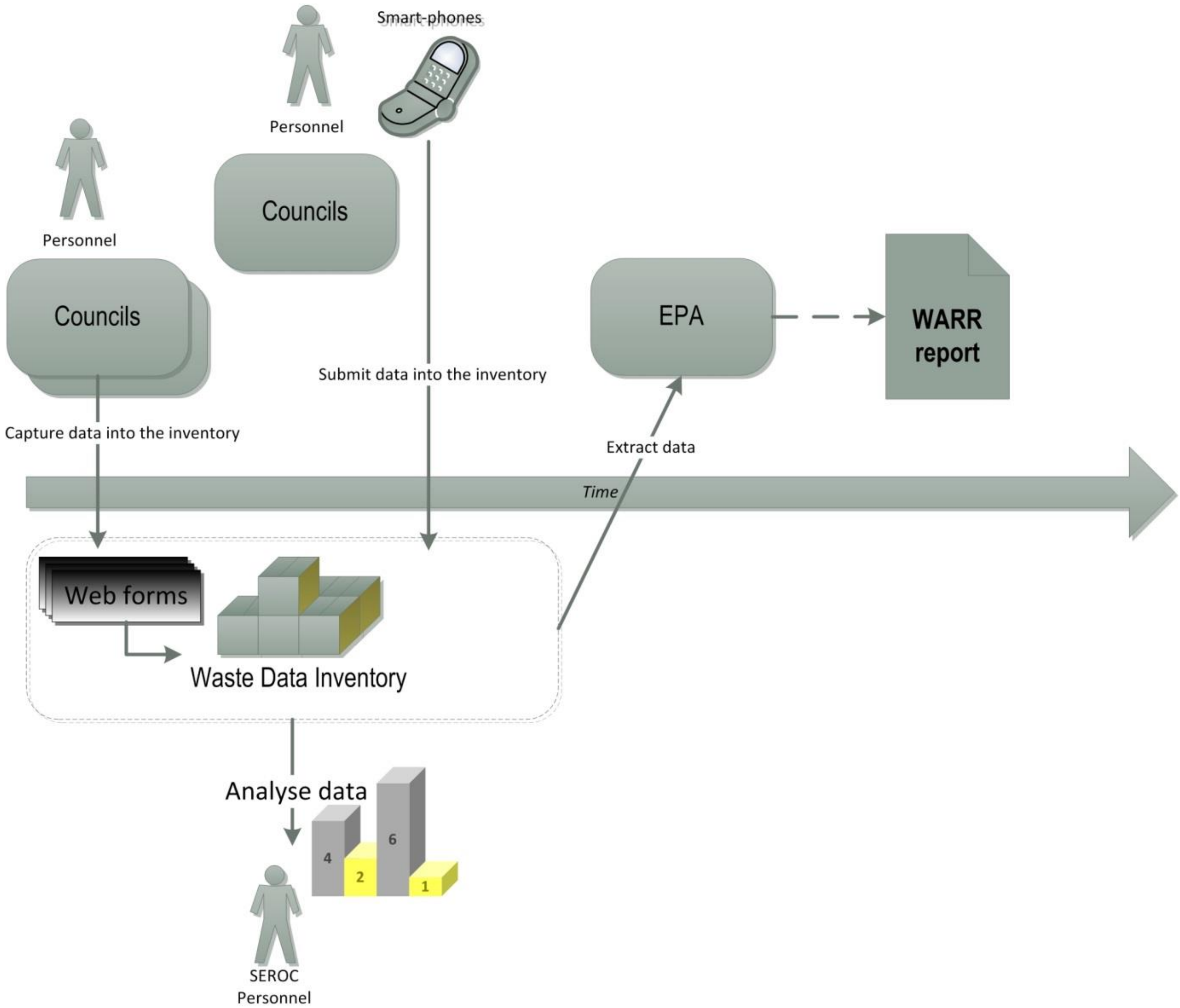


Figure 15 - Possible "to be" data collection business process

In this possible future process, there is a centralised waste inventory to which all councils have access to enter their data at the point of capture. This inventory has normalised common data sets that are consistent, so that every council captures the same data sets. Such facilities are now very easy to set up using cloud-based software such as is being trialled at Cooma-Monaro. Data can be entered either via a web interface or using a mobile device.

Such Waste Data Inventory will ensure that the data will always be current, and that analysts can have access to historical data to identify trends and define benchmarks. For instance, SEROC personnel will always have the most recent data sets at their fingertips without the need to wait for the release of the annual WARR report. A business development officer envisaged in the previous section would always have data at their fingertips to undertake cost benefit analysis or to evaluate ongoing projects. As such, there could be a rationale that a regional group such as SEROC collects its own data, makes recommendations, defines benchmarks, and measure the outcomes of actions and measures.

The EPA will also significantly benefit from such a repository as all data will be current and consistent from all the councils.

Based on our experience with improving data collection processes, we believe that capturing data immediately and at the point of occurrence of an event (“in the field”) may offer an easy means of improving the flow and accuracy of data for some data types, given the geographically distributed nature of waste activities across the region. This has been made easier with the widespread availability of low-cost mobile devices (such as smart-phones and tablets) which are able to run custom “apps”. Such mobile capture technology in conjunction with robust data management practices has potential to improve data collection and management in the field.

9.5 Other considerations

Materials which have a high calorific value (such as currently unrecyclable plastics), contain carbon (such as wood waste) or are problematic because of their environmental impact and/or because they difficult to process locally (such as metals, household hazardous material and e-waste) may not have much value now, but looking over the horizon, will have a market. Whilst some councils in the region may not have enough supply of such materials, what they do have is plenty of space for stockpiling. Therefore source separation and stockpiling of these materials for future processing or collection may be a feasible medium-term option.

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11 Appendix A – Raw Data Sets

11.1 Municipal Residual Waste Breakdown

Household Residual Waste 2011-12		Average Waste Bin Composition (SEROC, excl. ACT)																
		35%	11%	7%	20%	4%	10%	2%	1%	1%	3%	1%	4%					
Council Name	Total **Residual Waste** Collected from **Kerbside**	Organic compostable (food)	Organic compostable (non-food)	Organic Other	Total paper	Total glass	Total plastic	Total ferrous	Total non-ferrous	Total Hazardous	Total earth based	Total E-waste	Total Other	Film/ Plastic bags	Textile / Clothing / Carpet	Nappies	Ceramics	Total Compostable
Bega Valley	5,958	2,102.65	656.47	446.57	1,168.53	217.81	622.68	130.93	38.23	54.04	180.02	79.96	260.31		178.75			3,205.68
Bombala	462	163.21	50.96	34.66	90.70	16.91	48.33	10.16	2.97	4.19	13.97	6.21	20.21		13.87			248.83
Boorowa	500	176.45	55.09	37.48	98.06	18.28	52.25	10.99	3.21	4.54	15.11	6.71	21.84		15.00			269.01
Cooma-Monaro	1,562	551.23	172.10	117.07	306.34	57.10	163.24	34.33	10.02	14.17	47.19	20.96	68.24		46.86			840.40
Eurobodalla	6,106	2,154.83	672.76	457.65	1,197.53	223.21	638.14	134.18	39.18	55.38	184.49	81.95	266.77		183.18			3,285.25
Goulburn Mulwarree	3,560	1,256.49	392.29	266.86	698.28	130.16	372.10	78.24	22.85	32.29	107.58	47.79	155.55		106.81			1,915.64
Harden	589	208.02	64.95	44.18	115.60	21.55	61.60	12.95	3.78	5.35	17.81	7.91	25.75		17.68			317.14
Palerang	1,049	370.05	115.53	78.59	205.65	38.33	109.59	23.04	6.73	9.51	31.68	14.07	45.81		31.46			564.18
Queanbeyan	8,032	2,834.55	884.98	602.02	1,575.28	293.62	839.43	176.51	51.54	72.85	242.68	107.80	350.92		240.97			4,321.55
Snowy River	1,188	419.09	130.84	89.01	232.90	43.41	124.11	26.10	7.62	10.77	35.88	15.94	51.88		35.63			638.94
Upper Lachlan	1,700	599.93	187.30	127.42	333.41	62.14	177.66	37.36	10.91	15.42	51.36	22.82	74.27		51.00			914.65
Yass	1,976	697.33	217.71	148.10	387.53	72.23	206.51	43.42	12.68	17.92	59.70	26.52	86.33		59.28			1,063.15
Young	1,512	533.43	166.54	113.29	296.45	55.26	157.97	33.22	9.70	13.71	45.67	20.29	66.04		45.35			813.26
ACT	64,271	25,065.87	4,241.92	-	7,005.59	1,992.42	1,221.16	706.99	-	-	1,606.79	-	11,247.51	3,792.02	3,599.20	3,149.30	642.71	29,307.79
		39%	7%		11%	3%	2%	1%			3%		18%	6%	6%	5%	1%	
		Average Waste Bin Composition (ACT)																

11.2 Municipal Dry Recycling Breakdown

Recyclables 2011-12		Average Recyclables Bin Composition (SEROC, excl. ACT)							
		54%	29%	7%	2%	1%	NA	7%	
Council Name	Total **Dry Recyclables Collected** from **Kerbside**	Recyclable paper	Recyclable glass	Recyclable plastic	Recyclable ferrous	Recyclable non-ferrous	Polystyrene	Residual waste	Comments
Bega Valley	3,972	2,136.80	1,158.16	270.89	87.80	28.01	No data	290.63	
Bombala	148	79.61	43.15	10.09	3.27	1.04	No data	10.83	
Boorowa	32	17.40	9.43	2.21	0.72	0.23	No data	2.37	
Cooma-Monaro	591	317.90	172.31	40.30	13.06	4.17	No data	43.24	
Eurobodalla	4,954	2,664.85	1,444.37	337.84	109.50	34.93	No data	362.46	
Goulburn Mulwarree	3,655	1,966.16	1,065.67	249.26	80.79	25.78	No data	267.42	
Harden	260	140.01	75.89	17.75	5.75	1.84	No data	19.04	
Palerang	967	520.17	281.94	65.95	21.37	6.82	No data	70.75	
Queanbeyan	4,148	2,231.39	1,209.43	282.89	91.69	29.25	No data	303.50	
Snowy River	470	252.90	137.07	32.06	10.39	3.32	No data	34.40	
Upper Lachlan	600	322.76	174.94	40.92	13.26	4.23	No data	43.90	
Yass	882	474.45	257.16	60.15	19.49	6.22	No data	64.53	
Young	1,594	857.45	464.75	108.70	35.23	11.24	No data	116.63	
ACT	49,937	29,312.77	13,632.68	2,347.02	1,098.60	249.68	149.81	3,146.00	
		59%	27%	5%	2%	1%	0%	6%	From APC report Domestic Waste Audit 2009 (Table 8, Chart 4)
		Average Recyclables Bin Composition (ACT)							

11.3 C&I Breakdown

Annual C&I Quantities (2011-12)			Average C&I Composition																		
			Landfilled			Operational Materials		Separated Materials									Special Wastes		Other		
Council Name	Interviewed	Annual Quantities Tonnes	Putrescible Waste	Non-Putrescible Waste	Offensive Waste	Glass Fines	VENM Soils	Mixed Masonry	Clean Bricks / Concrete	Stumps / Logs	Palms	Vegetation	Metals	Untreated Timber	Dirty Timber	Buy-back	Asbestos	Glass	Plastics	Paper & cardboard	Textiles & leather
			L	L	L	O	VENM	O	O	O	O	R	R	O	O	R	L	O	L	R	L
Bega Valley	N	11,656.53	3,151.04	2,024.74	-	-	-	428.85	-	-	-	-	993.75	-	-	-	-	201.92	769.70	3,962.42	124.11
Bombala	Y	31.50	8.52	5.47	-	-	-	1.16	-	-	-	-	2.69	-	-	-	-	0.55	2.08	10.71	0.34
Boorowa	N	850.05	229.79	147.65	-	-	-	31.27	-	-	-	-	72.47	-	-	-	-	14.72	56.13	288.96	9.05
Cooma-Monaro	Y	2,184.00	590.39	379.36	-	-	-	80.35	-	-	-	-	186.19	-	-	-	-	37.83	144.21	742.41	23.25
Eurobodalla	Y	10,504.96	6,668.58	1,219.38	40.08	1,522.11	80.70	17.99	81.00	22.19	27.46	652.60	154.96	32.99	42.35	0.46	22.68	-	-	-	111.85
Goulburn Mulwarree	Y	9,906.08	718.10	8,104.18	22.02	-	-	-	-	-	-	-	-	-	-	-	1,061.78	-	-	-	105.48
Harden	N	583.83	157.82	101.41	-	-	-	21.48	-	-	-	-	49.77	-	-	-	-	10.11	38.55	198.46	6.22
Palerang	Y	2,600.00	702.84	451.62	-	-	-	95.65	-	-	-	-	221.66	-	-	-	-	45.04	171.68	883.82	27.68
Queanbeyan	N	14,276.89	3,859.39	2,479.90	-	-	-	525.25	-	-	-	-	1,217.15	-	-	-	-	247.31	942.72	4,853.16	152.02
Snowy River	N	1,310.00	354.12	227.55	-	-	-	48.19	-	-	-	-	111.68	-	-	-	-	22.69	86.50	445.31	13.95
Upper Lachlan	Y	1,204.78	325.68	209.27	-	-	-	44.32	-	-	-	-	102.71	-	-	-	-	20.87	79.55	409.54	12.83
Yass	N	2,707.97	732.03	470.37	-	-	-	99.63	-	-	-	-	230.86	-	-	-	-	46.91	178.81	920.52	28.83
Young	Y	2,084.41	563.47	362.06	-	-	-	76.69	-	-	-	-	177.70	-	-	-	-	36.11	137.64	708.56	22.19
ACT	N	120,960.07	32,698.41	21,010.79	-	-	-	4,450.14	-	-	-	-	10,312.20	-	-	-	-	2,095.31	7,987.18	41,118.10	1,287.94

L = landfilled, R = recycled, O = Operational

11.4 Arrangement

The following table contains additional information about waste collection arrangements captured during the interviews with various stakeholders.

Council Name	Mattresses	Metals	Polystyrene	Glass	Bio-solids	C&I	C&D
Bega Valley							
Bombala	No mattresses collected or no data	Local contractor is collecting metals	No polysterene collection / no data	Local contractor used for glass colelction. Collected glass gets recycled.	No bio-solids data.	C&I makeup is generally from hospitals, schools and shops	Generally building waste
Boorowa							
Cooma-Monaro		Self haul to Cooma Landfill & three transfer stations, One Steel collect from each site		Co-mingled glass,plastic,aluminium.	Waste from Cooma sewage tretment plant, made into grade B compost for land remediation at Cooma Landfill. Cost neutral.	Makeup: Commercial waste, waste outside shire, VENM	Makeup: Bulk mixed demo, bricks & concrete, Contaminated soil, asbestos, carpet, demo waste outside shire
Eurobodalla	Incoming count of mattresses used, and as some additional mattresses are also recovered from mixed loads, the count is understated.	The steel is regularly collected, so have used the outgoing tonnage for this as the incoming is less.	Only commenced receiving and processing polystyrene late last year as part of EPA grant. This is the source separated amount only, more would be coming in in mixed loads. A polystyrene machine is at surfbeach – data is from about October 2012 only.	Domestic collection and self haul to community recycling points, includes some C&I. This material was coming to landfill as glass fines and used as cover - SITA in process of installing EPA. We were using our glass fines and Bega valley shire's fines (1500 t) as alternate daily cover. Once glass crusher is installed SITA will be supplying to local concrete company free of charge.	STPs are being upgraded and the biosolid generation is unknown at this time.		
Goulburn Mulwarree	568 mattresses have been removed from landfill for recycling in the period 24/8/12 to 30/5/13. Extrapolation to the whole year is needed.	No metal was sold to recyclers for the FY12/13 – please note that the current piles will go to quotation mid July 2013 (a true estimate can be made available then). Goulburn Mulwaree Council provides a white good collection every September up to 2m3 per household, this is undertaken by the local recycling contractor.	Council do not keep records on polysterene collected.		Response provided from the Water Services section of Council: 'We dewater approx 2000 dry ton / year. Currently this is not going to landfill. However, as part of the upgrade, Sydney Catchment Authority have specified that all biosolid are to go to landfill.'		
Harden							
Palerang	Unknown		Unknown	Unknown. COMMINGLED KERBSIDE RECYCLING AND DROP OFF SITE AT WASTE TRANSFER STATIONS. Colelcted by a contractor.	Various existing processes. Sewage and water treatment plant bio-solids, bio-solids to landfill.	Makeup unknown	Makeup unknown
Queanbeyan							
Snowy River							
Upper Lachlan				Glass goes to Remondis in ACT with co-mingled recycling		No data available	No data available
Yass							
Young	Not recorded	Unknown to Council metal is under scavenging rights to contractor. Estimate 600-800 tonnes.	Not recorded	Contractor collected, crush and on sell	Do not take bio-solids at this stage	Makeup: Mixed load /recyclable /industrial waste /cardboard/ rags/ containers gass bottles/ steel / paint/ chemical drums/ deceased animals/ oil/ road sweepings/ storm debris	Makeup: Concrete/bricks/timber/ dry wall lining/ roofing tiles/ copper pipe/ electrical cable/glass/Clean fill / contaminate fill with concrete and bricks/ asbestos type materials

12 Appendix B – Costing Modelling

12.1 Zero Waste System

In relation to the composting of organic materials, for consistency we have used the following terminology in this report:

- The term *City to Soil collection process* refers to the source separation process of organic waste material modelled on the source separation process of organic waste for households, which has been implemented in Armidale and Queanbeyan.
- The term *Zero Waste composting process* refers to the composting process of organic material using the composting methodology developed by Zero Waste Australia in the Groundswell project as described in the [13] The Economics of Groundswell [M & M Management, 2011].
- The term *Zero Waste System* refers to a combination of *City to Soil collection process* and *Zero Waste composting process*.

As part of this project, we have reviewed in detail the costing of the existing implementations of the Zero Waste System undertaken by Zero Waste Australia and published in the report [13] The Economics of Groundswell [M & M Management, 2011] by Michael Reynolds. We have identified that the costs published in the report [13] were specific to the Groundswell project budget, which in turn was also specific to the length of that particular project. This means that there are variations and economies of scale which would occur in any ongoing implementation of Zero Waste System that is established over a longer term. This section provides an expansion of the costing model published in the original report, taking into account factors such as economies of scale.

It is acknowledged that the Zero Waste System is the result of one of the author's work (Gerry Gillespie, President of Zero Waste Australia) on both the City to Soil and Groundswell projects. While there is a conflict of interest in recommending this approach specifically, any similar approach could also be used and the specific case of the Zero Waste System is used here as an illustration of what can be achieved, rather than a prescription for a preferred solution.

All calculations in this costing model were made based on the following set of assumptions:

1. Organic material in the Zero Waste composting process is composted in windrows of about 50 metres in length, about 2 meters high and about 5 metres wide at the base. As such, the total volume of one standard windrow is calculated at 250 cubic metres, or 5 cubic meters for every linear metre of length. This is the base unit to calculate the volume of compost in a windrow of any length.
2. A standard 50-metres long windrow with a total volume of 250 cubic metres will hold 125 tonnes of organic material. Similar, there will be 2.5 tonnes of organic material for every linear metre of a windrow's length.
3. To cover the organic material the Zero Waste composting process requires compost tarps (or tarpaulins) – a cover which has average dimensions of 18m x 12m. A good quality tarp of such dimensions costs about $450 and can last up to three or four years of ongoing operations.

4. Based on the standard sizes of windrows and tarpaulins, it will require 3 standard tarps to cover a standard 50-metres long windrow with a small overlap.
5. The processing period for a newly established windrow is around 18 weeks (including curing), meaning that after 18 weeks the tarps can be rotated onto a new windrow. So the total number of tarps required for establishing the composting process is calculated based on the rotation period and the total volume of organic waste being composted. For example, if a composting facility expects 3,200 tonnes of organic waste per year (or 123 tonnes per fortnight), this will result in a full new standard windrow created every fortnight and covered by 3 tarps. However, since the tarps can be rotated after 18 weeks (or 9 fortnights), the total number of traps required will be 9x3. To be conservative, it is reasonable to allow for a 9+1 cycle (an additional "spare" set of tarps), therefore in total the process will require 30 tarps to manage the given volume of organic material.
6. The process requires 2 litres of liquid inoculants for every 10 cubic metres of material. The inoculant cost is around $6 per litre including freight, or $12 for every 10 cubic metres of material.
7. After the 18-weeks period, mature windrows can be either used by the council as top soil, or compost testing and certification can be undertaken prior to sale. Alternatively for small-scale implementation to reduce testing costs the project may choose to stockpile mature compost into a single pile which will require additional tarps for cover. The project may use existing covered storage or build new facilities for storing mature compost.
8. Compost testing and certification is usually done in batches. It does not require testing every week, but instead composted material can be stockpiled and tested once every two or four months prior to sale. This could mean only testing in batches of 500 tonnes at a cost of $400 per test. For example, if the total annually collected organic material reduces to 1500 tonnes, 3 tests will be required during the year at a total cost of $1200 on testing annually.
9. The original communication strategy for City to Soil collection process only requires minor modification for use by new councils. The graphic design for brochures, stickers and other collateral has already been produced. The cost per household covers the notification of introduction of the process by council and does not require any additional promotional cost. In our modelling we estimate the initial cost to cover the printing and postage of the notifications for each household ($1.60 per household), as well as cost of an annual letter (printing and postage, $0.80 per household) updating on the results of the Zero Waste System implementation.
10. Equipment hire cost for managing the Zero Waste composting process is estimated at $80/hr. For Zero Waste Systems with fortnightly collection frequency, the medium-scale implementation will be using the equipment for about 8 hours every fortnight; a small-scale implementation will be using the equipment for about 4 hours every fortnight. For an implementation to process the entire ACT volume, we assumed a full-time equipment hire (40 hours per week).
11. Labour costs for managing the Zero Waste composting process are estimated at $35/hr. For facilities with fortnightly collection frequency, we estimate the workload of 2 man-days (16 hours) per fortnight (0.2 FTE, 8 hours per week) for a medium-scale implementation. For small-scale implementations the workload may me smaller, but to be conservative we estimated it to be the same as for the medium scale. For an implementation to process the entire ACT volume, we assumed a full-time position (40 hours per week).

12. For amortisation costs of Max Air bins as well as 240L bins, we assume 2% annual contingency for wear-and-tear (incl. theft and fire), which is a conservative estimate meaning that for every 100 bins in stock 2 bins need replacement each year, or that 10% of the total bin stock will be replaced within 5 years of the project operation.
13. We assumed that the total composition of organic waste within the MWS is 50%, which is what collected data has shown on average. This means that in terms of collection cost, we can assume that Zero Waste System does not change the total number of collections as it does not change the total volume of waste collected. As a result, the cost of collection of waste will be same under the business-as-usual scenario and with an implemented Zero Waste System. For example, if the current arrangement is to collect the kerbside waste weekly, then when organic waste is source separated into a separate bin its volume will be half of the total volume (the other half will be regular waste in the regular bin). Therefore a fortnightly collection can be arranged for City to Soil collection process, and the regular collection frequency can also be reduced to fortnightly, meaning no change to the total number of collections per household.

It should also be noted that the cost for inoculants can be reduced dramatically by councils making their own inoculants – this is what Cooma and Armidale LGAs are doing now. The cost of these self-made inoculants is estimated at $0.1 per litre. In our modelling we have not taken this into account, and used the conservative cost estimate for the VRM inoculants. This can however be taken into account when producing individual business cases for projects.