DEPARTMENT OF SUSTAINABILITY, ENVIRONMENT, WATER, POPULATION AND COMMUNITIES

WASTE AND RECYCLING IN AUSTRALIA 2011

INCORPORATING A REVISED METHOD FOR COMPILING WASTE AND RECYCLING DATA

FINAL REPORT

Hyder Consulting Pty Ltd
ABN 76 104 485 289
Level 5, 141 Walker Street
Locked Bag 6503
North Sydney NSW 2060
Australia
Tel: +61 2 8907 9000
Fax: +61 2 8907 9001
www.hyderconsulting.com

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Authors Katherine Smith, Kyle O'Farrell, Fraser Brindley

Checker Paul Randell, Garth Lamb, Ylva Engqvist

Approver Victoria Bond

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EXECUTIVE SUMMARY

The primary purpose of this report is to compile solid waste and recycling data published by the states, territories and industry. This is the fourth *Waste and Recycling in Australia* report, and now provides data covering the 2008–09 financial year. The report again endeavours to provide the most up-to-date and comprehensive picture of solid waste and recycling activity in Australia.

Previous *Waste and Recycling in Australia* reports have noted differences in the datasets published by the states and territories which resulted in some incidence of 'apples to oranges' data comparisons across different jurisdictions (see Section 1 for further detail). In response to this, Hyder Consulting was commissioned by the Department of Sustainability, Environment, Water, Population and Communities (the Department) to produce a report in 2010 titled *National waste and recycling reporting – A more uniform approach to data* (the method report) which contained recommendations for a more consistent compilation of state and territory datasets. This method report is attached as Appendix 2.

The central components of the method report are reproduced in this report, namely the definitions of key terms (Section 2) and the recommendations (Section 3). In addition, this report includes a discussion regarding the testing of the method report and any refinements made as a result of the testing.

The focus of the method report, and this report, is the presentation of data on the recycling of solid waste, energy recovery from solid waste, and the disposal of solid waste to landfill (Section 4). This report also endeavours to present data, to the extent that is possible, by material categories and material type (Recommendation 18), and in terms of the three major solid waste streams (Recommendation 7), which are:

- Municipal solid waste (municipal or MSW)
- Commercial and industrial (C&I)
- Construction and demolition (C&D).

Previous *Waste and Recycling in Australia* reports sourced data from publicly available reports, or directly from state and territory departments or agencies that were able to provide unpublished data that was more up-to-date. Data for this report was gathered in the same manner and from the same principal sources. Section 4 includes summary tables of the sources used to compile data for each of the jurisdictions and also notes any assumptions that have been made in the application of the method report.

A key difference in this version of *Waste and Recycling in Australia*, from previous versions, is that datasets from states and territories have been grouped into the waste material categories (for example metals) and types (for example aluminium) outlined in the method report. This includes a number of waste material categories and types that were not reported previously.

This report also contains an overview of:

- Environmental impacts of waste management in Australia (Section 5)
- Solid waste management strategies and policies (Section 6)
- Barriers to resource recovery of solid waste (Section 7).

Important

Data from previous *Waste and Recycling in Australia* reports has not been grouped into the waste material categories and types outlined in the method report. This should be taken into consideration when comparing data reported in this report and that reported in previous years.

The method report and this version of *Waste and Recycling in Australia* are not intended to set out the framework for the National Waste Data System under Strategy 16 of the *National Waste Policy: Less Waste, More Resources*.

The method report and this version of *Waste and Recycling in Australia* are not intended to set out the framework which the states and territories need to adopt in their reporting of waste and recycling. As stated above, the main aim of these reports is to develop and test an improved method of data collation to enable national reporting.

Key findings

For the most part, the recommendations contained in the method report were found to be appropriate for the compilation of the jurisdictions' data. Any further refinements are described in Section 3 of this report. The key data for 2008–09 is summarised in Table E-1 and Table E-2 below, with further detail provided in the body of the report.

Table E-1 Australian rates of waste generation, recycling and recovery, by jurisdiction, 2008–09

Jurisdiction	Population[1]	Waste generation[2]	Disposal	Recycling	Recycling rate[3]	Energy recovery	Recovery rate[4]
		kg per capita				kg per capita	
NSW	7,099,714	2,290	940	1,350	59%	10	59%
Vic	5,427,681	1,900	870	1,010	54%	10	54%
Qld	4,406,823	2,100	1,160	930	45%	10	45%
SA	1,622,712	2,050	650	1,340	67%	60	68%
WA	2,236,901	2,670	1,830	830	31%	10	32%
TAS	502,627	1,060	890	150	15%	20	16%
ACT	351,182	2,260	580	1,650	74%	30	74%
NT	224,848	1,690	1,610	70	4%	10	5%
National	21,872,488	2,140	1,030	1,090	51%	20	52%

1. Population as at 30 June 2009, sourced from: *ABS Release 3101-04 - Estimated Resident Population, States and Territories* (Number) (June 2009), Australia.

2. Assume waste generation = waste disposal(t) + waste recycling (t)+waste energy recovery(t).

3. Recycling rate = Recycling / waste generation.

4. Recovery rate = (Recycling + Energy Recovery) / Waste generation.

Notes:

- These national averages present jurisdiction 'sub-totals' and hence do not include fly ash.
- All figures have been rounded. Minor discrepancies may occur between the stated totals and the sums of the component items, as totals are calculated using the component item values prior to rounding.

Table E-2 Estimated net landfill emissions and total gross embodied energy to landfill, 2008–09[1]

Environmental impact	NSW	Vic	Qld	SA	WA	Tas	ACT	NT	Total
Net[2] landfill emissions (net Mt CO_2-e)	3.2	2.3	2.5	0.5	2.0	0.2	0.1	0.2	11.0
Gross embodied energy to landfill (Mt CO_2-e)	3.1	2.4	2.0	0.4	1.4	0.2	0.1	0.2	9.8

Notes:

- The gross embodied energy value estimates do not include the energy that is required to recycle the materials for use.
- Gross embodied energy estimates present 'sub-totals' and hence do not include flyash.

[1] Estimates generated by applying the proportion of jurisdictional solid waste disposal that is biodegradable waste to the national emissions total as per the *Australian National Greenhouse Gas Inventory*. See Section 5.1.2.

[2] Methane generated at landfills less the amount of methane recovered for energy or flared at landfills.

1 INTRODUCTION

In February 2006, Hyder Consulting (Hyder) produced a report titled *Waste and Recycling in Australia*. This report informed the then Department of Environment and Heritage's submission to the Productivity Commission's inquiry into waste generation and resource efficiency in Australia.

Hyder produced a report with the same title in 2008 for the (then) Department of the Environment, Water, Heritage and the Arts collating data for the financial year of 2006–07. The 2008 report updated and supplemented information contained in the 2006 report, and endeavoured to "provide the most up-to-date and comprehensive picture of waste and recycling activity in Australia".

An amended version of the 2008 report was produced by Hyder in 2009 to incorporate 2006–07 data from states and territories that was not available at the time of writing the original 2008 report. The amended version also included the latest data for some organic materials that had become available after the publication of the original report in 2008. The 2009 report provided the core data for the first *National Waste Report*, published in May 2010. It also informed and was developed alongside the *National Waste Policy: Less Waste, More Resources* during 2009.

The Hyder (2009) report noted that:

> The data contained within the report should be used with caution as it has been drawn from a range of sources with varying data quality and methodologies.

In particular, the Hyder (2009) report stated that:

> There is a lack of consistency between the material inclusions and definitions used for disposal and recycling in reports produced by different states/territories.

This is reflective of the different approaches of states and territories to collecting and reporting waste and recycling data. It is also reflective of the difficulty in defining what should be considered within the scope of waste and recycling reporting.

The 2009 report listed a number of 'data gaps' identified in available data. The method report (2010) further assessed the consistency of waste and recycling datasets nationally, and made specific recommendations for a "more uniform approach" to the compilation of state and territory datasets. These recommendations deal with fundamental principles of the scope of waste and recycling reporting, known issues of difference, and issues regarding the measurement and recording of waste and recycling. These recommendations were informed by an appraisal of the definitions of key terms used in waste and recycling reporting, and an assessment of waste and recycling datasets produced nationally.

These recommendations align with the 'Providing the evidence' key direction of the *National Waste Policy*. The objective of this direction is to:

> Develop capacity to effectively collect consistent, accurate and meaningful national waste and resource recovery data to inform policy and decisions.

The direction also states that:

> Any improvements and streamlining that can be easily made in the short term will be identified and improvements undertaken where feasible.

Data for this current *Waste and Recycling in Australia* report was sourced through publicly available reports except where states, territories, or industry bodies were able to provide unpublished data that was more up-to-date or more detailed. Data sources are provided at the relevant points throughout Section 3 and Section 4. Section 4 includes summary tables of the sources used to compile data for each of the jurisdictions and also notes any assumptions that have been made in the application of the method report.

Where possible, potential discrepancies or uncertainties have been identified during the examination of published definitions within each of the data sources used. Some data sources did not include a definition for the reported waste streams and as such, discrepancies within the data that cannot be identified are likely. The allocation of material to source sectors, and material categories and material types should therefore be considered a 'best estimate' and the data should be used with caution.

Significant consultation was undertaken with state and territory governments during the development of the method report and for the draft version of this report (the testing of the method). Further, Blue Environment Pty Ltd was commissioned by the Department to conduct an audit of the method report and the consultation draft of this report. Hyder has considered both the consultation with states and territories, and the findings of the audit by Blue Environment, during the production of this (final) report.

As part of the quality assurance process associated with this project, the Department commissioned Randell Environmental Consulting to review this (final) report, and the detailed workbook of underlying data and calculations.

Please note that the participation of state and territory governments in the consultation process undertaken by Hyder does not indicate the endorsement or otherwise of state and territory governments of this report or the recommendations contained within it.

2 DEFINITIONS

This section contains a discussion of the definitions of key terms used in waste and recycling reporting. The majority of the discussion relating to the definition of key terms was originally presented in *National waste and recycling reporting: A more uniform approach to data* (the method report).

The discussion of key terms is then followed by a glossary of terms in Table 2-3, which outlines the definition of these terms *for the purposes of this report*, and Figure 2-1 which illustrates the key terms and how they relate. A number of other key terms, including those for material categories and types, are defined during the discussion of the method report in Section 3.

There are likely to be differences in the definitions provided in this report and those used in the reports produced by states, territories, and industry bodies. Definitions across different reports need to be reconciled before data comparisons can be made.

Consumption

According to the Australian Standard *Waste management – Glossary of terms* (AS/NZS 3831:1998) a consumer is "any organisation or person purchasing or using materials, goods or services."

The definition of consumption provided in the Plastics and Chemicals Industries Association (PACIA) *National Plastics Recycling Survey* (Hyder, 2008a) is:

> Consumption - Total use of product by... industry and consumers. Includes locally made and used product, imported product and locally utilised recyclate. Does not include locally made product that is exported for use.

The key aspects of these definitions are that consumption of products and materials occurs at the point of purchase or use, and is distinct from the production of products and materials.

Waste

There is no widely accepted scope for waste and recycling reporting. What is defined as 'waste' is often subjective; however, most jurisdictions have a legal definition. The *National Waste Policy Regulatory Impact Statement* (RIS) states that:

> Defining waste is not simple and there is no single domestic or international definition. This is due to the complex nature of waste, and the fact that the nature of waste is changing rapidly, involving more diverse materials and products as well as new processing and management technologies.

Nevertheless, the *National Waste Report 2010* includes the following definition of waste:

> Any discarded, rejected, unwanted, surplus or abandoned matter; discarded, rejected, unwanted, surplus or abandoned matter intended for recycling, reprocessing, recovery, re-use or purification by a separate operation from that which produced the matter, or for sale, whether of any value or not.

Waste re-use

The definition of re-use is captured in Zero Waste SA's *Recycling Activity in South Australia* (Hyder, 2008b), where:

> Re-use involves recovering value from a discarded resource in its original state without reprocessing or remanufacture.

The Australian Standard (AS/NZS 3831:1998) definition is essentially the same, though it does explicitly mention the exclusion of reprocessing from the definition of re-use.

The Australian Standard defines re-use as using a product again for the same or a different purpose, which is the equivalent to recovering value. It is important to note that within the Australian Standard (AS/NZS 3831:1998) the terms re-use and recycle are clearly stated to **not** be synonyms.

End-of-life

The *Metropolitan Waste and Resource Recovery Strategic Plan* (Victorian Government, 2009) defines end-of-life waste as:

> Products such as cars that have reached the end of their useful life and become waste. This term is often used in the context of the product stewardship responsibilities of manufacturers and brand-owners for wastes discarded by consumers.

The use of the term "useful life" implies a product has passed through its intended application, reached the end of its serviceability, and has no further re-use value and enters the waste stream. Products and materials are often disposed of into the waste stream when they have not reached their 'end of life' and such materials are often recovered at the landfill transfer station or tipping face. Where these materials are recycled (see definition) they are then reintroduced back into consumption. Where the materials are re-used, however, they are reintroduced into the use and re-use cycle (see definition).

Recovery

Recovery is used to refer to both material resource recovery (such as through recycling) and energy recovery. The Australian Standard (AS/NZS 3831:1998) defines resource recovery as a "process that extracts material or energy from the waste stream." The *National Waste Report 2010* expands the definition of resource recovery to be:

> The process of extracting materials or energy from a waste stream through re-use (using the product for the same or a different purpose without further production), recycling or recovering energy from waste.

In some cases, the amount of products or materials 'recovered' is the gross amount collected, and does not exclude contamination or unwanted components.

Recycling

The definitions given in the Australian Standard (AS/NZS 3831:1998) and the *National Waste Report 2010* provide a clear definition of recycling. The Australian Standard definition of recycling is:

> [A] Set of processes (including biological) for converting recovered materials that would otherwise be disposed of as waste, into useful materials and or products. The following definitions apply: a) *Closed loop recycling* - recycling process in which the reclaimed output is used as an input to the same product system. b) *Open loop recycling* - recycling process in which the reclaimed output is used as an input into another product system.

The Australian Standard defines something as recyclable if it is:

> ...able to be recovered, processed and used as a raw material for the manufacture of a useful new product through a commercial process.

The *National Waste Report 2010* definition is simpler, and places recycling as a subset of resource recovery. Recycling is:

> A resource recovery method involving the collection and processing of waste for use as a raw material in the manufacture of the same or similar non-waste product.

The *National Waste Report 2010* defines recyclate as:

> Material able to be processed for recycling in a facility. Sometimes only to refer to materials actually recovered from recycling, excluding residual wastes.

Recycling Activities in South Australia (Hyder, 2008c) was careful to exclude:

> ...waste materials that are reclaimed and reutilised within the same manufacturing processes that generated it as a matter of course to the efficient operation of the site...

It is important to note the inclusion of biological process in the Australian Standard definition of recycling. In some cases, composting is seen as being distinct from the definition of recycling. For example, the Victorian *Metropolitan Waste and Resource Recovery Strategic Plan* (2009) in defining "recyclables" states that:

> While this term strictly applies to all materials that may be recycled, in this document the term is generally used to refer to the recyclable containers and paper/cardboard component of kerbside waste, i.e. it excludes garden organics.

Energy recovery

The *National Waste Report 2010* defines energy recovery as:

> Processes or opportunities to recover energy from waste materials, usually through thermal processes.

Most other definitions of energy recovery have a similar meaning, although the WA Waste Authority *Draft Waste Strategy 2009* added reprocessing to the list of means of extracting materials or energy.

Landfill

The Australian Standard (AS/NZS 3831:1998) definition for landfill is:

> Waste disposal site used for the controlled deposit of solid waste onto or into land.

This is much more formal than other definitions of landfills. The Victorian *Metropolitan Waste and Resource Recovery Strategic Plan* (2009) defines landfill as "a site for the disposal of waste to land". The ACT's *No Waste by 2010* strategy defines landfill as "a site where waste materials are buried."

Disposal

The Australian Standard (AS/NZS 3831:1998) defines disposal as the "final stage in the management of the waste stream". In this sense, disposal can be used to describe any end-of-life product or material that is discarded regardless of whether it is recycling, energy recovery or landfill.

However, waste reported as having been "disposed" usually refers specifically to material that is disposed of to landfill.

Yet, incineration and other controlled destruction of solid waste that does not include energy recovery can similarly be considered to be a final disposal. Incineration is often coupled with landfill in the definition of "disposal" at the bottom rung of the waste hierarchy.

Similarly, litter, illegal landfilling and dumping, where the waste remains unrecovered and it is discarded directly into the environment, can be considered to be a form of illegal disposal.

Waste generation

The Victorian *Metropolitan Waste and Resource Recovery Strategic Plan* (2009) defines waste generation as:

> Generation of unwanted materials, including recyclables as well as garbage, i.e. waste generation = materials recycled + waste to landfill.

Similarly, the Western Australian Waste Authority *Draft Waste Strategy 2009* defines waste generation as:

> ... the sum of waste disposed to landfill and resource recovery.

Recycling rate and recovery rate

There is a degree of inconsistency in the use of the terms recycling rate and recovery rate.

The United States Environment Protection Agency cites the municipal recycling rate as being waste recycled as a percentage of waste generated. Although not providing a definition of the recycling rate, the *National Waste Report 2010* also uses material recycled as a percentage of material disposed to generate reported recycling rates.

However, the Australian Standard (AS/NZS 3831:1998) states that:

> The term recycling rate has been omitted from this Standard because it is ambiguous.

The Australian Standard does define the recovery rate, being:

> The amount of material recovered from a product group as a percentage of overall consumption.

This is different to the definition in *Victorian Recycling Industry Annual Survey* (Sustainability Victoria, 2008), which states:

> The recovery rate is the percentage of materials recovered for reprocessing from the total quantity of waste generated.

The major difference in the definitions of the recycling rate or the recovery rate is the use of consumption or waste generation as the denominator. Consumption tends to be used as the denominator in instances where consumption figures are more readily attainable and/or where a product has a short life span (for example, newspapers). In such cases there is no significant difference between the use of consumption or waste generation as the denominator.

However, where a product or material has a longer life span, or where the consumption rate of a product or material has changed significantly over time, the use of consumption as the denominator can lead to implausible results. For example, given that the number of cathode ray tubes (CRTs) currently recycled is greater than the number of CRTs currently consumed, using consumption as the denominator to calculate the recycling rate of CRTs would generate a rate greater than 100%.

Solid waste

There is no standard definition of ‘solid waste’. For example, materials such as sludge and slurries can equally be defined as a liquid or solid waste. A practical definition often adopted is to define a solid waste as anything that is ‘spadeable’, i.e. can be picked up with a spade. Wastes that have a relatively high liquid content, such as sludges, being accounted for as solid wastes, will result in some liquid waste being counted as solid wastes. Whilst most jurisdictions

do not report on liquid waste volumes (outside of what is disposed to the sewerage system), this may not be a significant issue. However, to enable reporting of solid and liquid waste volumes, the issue of waste such as sludges and their appropriate allocation will need further consideration.

In the ACT, solid waste is defined as municipal waste and biosolids, while in Victoria the *Metropolitan Waste and Resource Recovery Strategic Plan* (2009) defines solid waste as composed of "non-hazardous, non-prescribed, solid waste materials ranging from municipal garbage to industrial waste."

Table 2-3 Glossary of terms

Consumption	Total use of products and materials.
Waste	Any discarded, rejected, unwanted, surplus or abandoned matter; discarded, rejected, unwanted, surplus or abandoned matter intended for recycling, reprocessing, recovery, re-use or purification by a separate operation from that which produced the matter, or for sale, whether of any value or not.
Waste re-use	Re-use involves recovering value from a discarded resource in its original state without reprocessing or remanufacture
End-of-life	Products and materials that have become a waste.
Recovery; resource recovery	Solid waste recycled and recovered for energy, net of contaminants/residuals disposed of to landfill.
Recycling	A set of processes (including biological) that converts solid waste into useful materials or products, net of contaminants/residuals disposed.
Energy recovery; waste to energy	The combustion of solid waste or the combustion of methane collected from landfill as a fuel for an industrial process and/or electricity generation.
Landfill	A site used for the controlled and legal deposit of solid waste onto or into land.
Disposal	Solid waste that is disposed of to landfill, incinerated or destroyed without energy recovery, or is unrecovered litter.
Waste generation	The total of products and materials that are recycled, recovered for energy or disposed.
Recycling rate	Solid waste recycled (net of contaminants/residuals) as a proportion of waste generation.
Recovery rate	Solid waste recycled and recovered for energy (net of contaminants/residuals) as a proportion of waste generation.
Solid waste	Waste products and materials that are 'spadeable'.

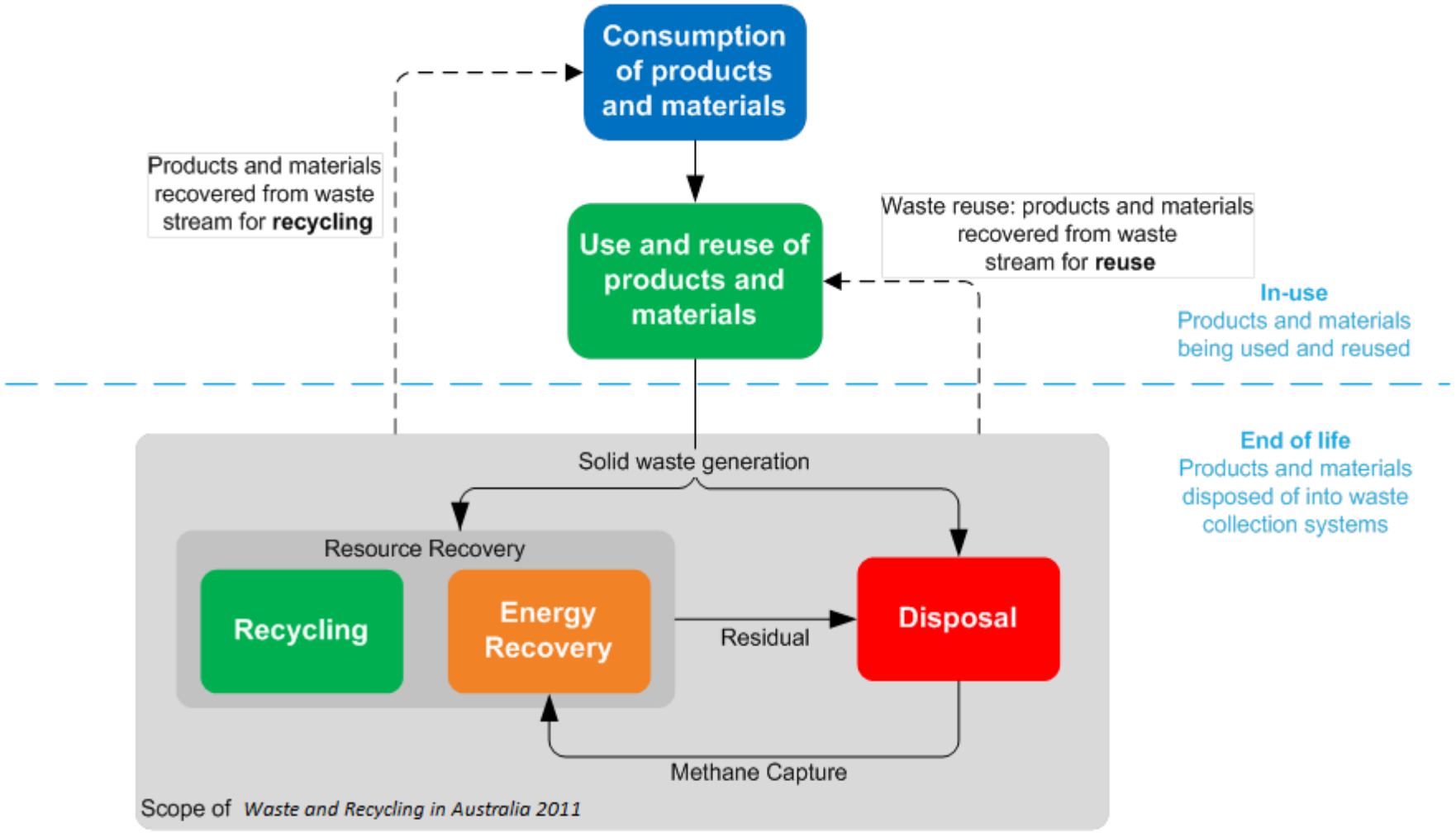

Figure 2-1: Key terms in waste and recycling reporting

3 METHOD REPORT RECOMMENDATIONS - TESTING FINDINGS

This section contains the recommendations and relevant discussions from the method report. It also contains the analysis of the testing of these recommendations during the collection of data for this report.

The recommendations and discussions are grouped as they were in the method report, as follows:

- General considerations of scope for waste and recycling reporting
- Specific waste categories and types that were difficult to allocate in the scope of waste and recycling reporting
- Issues related to the measurement, compilation and allocation of data.

The majority of the discussion in this section, and all of the recommendations relating to the data scope and method, were originally presented in *National waste and recycling reporting: A more uniform approach to data* (the method report), which is attached as Appendix 2.

Where necessary, the discussion providing the rationale for the recommendations has been expanded or amended within this current report. Changes to the recommendations have also been noted, along with the commentary on their implementation.

Note:

The intent of these recommendations is to aid the collation of the national data for this report only. This report and the recommendations contained within it are not part of the process of development of the National Waste Data System, and recommendations should not be read as suggestions to states and territories as to how they should collect, manage or report data.

The recommended exclusion or separate treatment of any particular waste type, in waste and recycling reporting, should not be seen as a suggestion that these wastes should be exempt, or eligible for discounts, on fees or charges relating to the disposal of waste.

3.1 General considerations

Recommendation 1 (from the method report): the scope should be limited to waste material that is recycled, recovered for energy and disposed. Re-use is excluded from the scope.

Re-use usually provides more favourable environmental outcomes than recycling, energy recovery or disposal. The waste hierarchy, shown in Figure 3.2, is discussed below.

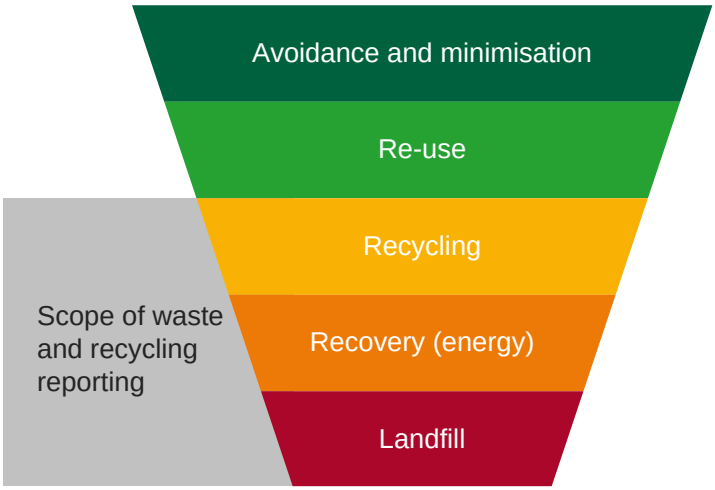

Figure 3-2: Waste hierarchy[3] and scope of waste and recycling reporting

Re-use prolongs the life of the energy and water that is embodied in a product or material. Re-use also prolongs the life of a material in its current physical state. In doing so, re-use offsets the use of further energy, water or materials to produce new products.

Recycling does not fully recover the embodied energy and water in a product or material. Recycling also often reduces the physical performance of a material. For example, polymers, both synthetic and natural, often deteriorate in strength due to the process of recycling.

Energy recovery only captures the energy value of the raw material, and destroys the physical value of a material. Energy recovery does not recover the embodied energy and water required to refine a material or to make a product.

Landfill of a product or material usually represents a complete loss of a resource, and the embodied energy and water within it, with the notable exception of methane gas capture and combustion for electricity generation.

The consideration of re-use is often a cause of uncertainty as to what constitutes a waste. While a somewhat grey area, re-use is usually seen as evidence that a product has not reached end-of-life, and that it is therefore not a waste. The vast majority of re-use occurs before the material or product enters the waste stream (for example the sale and reuse of a car) as illustrated in Figure 2-1 and is difficult to quantify and not within the scope of this report.

The exception to this is waste reuse, which is the recovery of materials or products from the waste streams (i.e. they have been thrown away) for re-use in their original applications. For example items recovered from local council hard-waste collections and then sold through second-hand goods organisations.

[3] As shown in: Department of the Environment, Water, Heritage and the Arts, *National Waste Report 2010*.

Previous national waste and recycling reports have compiled figures for wastes recycled and wastes disposed, with some accommodation of energy recovery from waste; but have not included broad data on re-use.

The exclusion of re-use from the scope of this study **does not suggest** that re-use should not be pursued and valued by states and territories. It is widely recognised within state and territory policy frameworks that re-use is an important component of waste minimisation policy (see Section 7.5 for further discussion).

There are occurrences where the re-use of products and materials has been accounted for within recycling. For example, a number of jurisdictions count as recycling products and materials that are extracted from waste loads at transfer stations and sold on-site through second-hand goods shops. Given that data on this practice is not currently disaggregated, this re-use cannot be reported separately from recycling data. In the future, if disaggregated data for products that are recovered from the waste stream is available from the states and territories, it should be reported and Recommendation 1 amended to enable reporting on the amounts of waste re-use.

In regard to energy recovery, data on waste that was incinerated without energy recovery has not been collected. The *Australian National Greenhouse Gas Inventory* in May 2009 reported that estimated emissions from waste incineration in Australia are 0.03 Mt CO_2-e, mainly from the incineration of solvents and clinical wastes. Public data on the exact splits between waste incinerated without energy generation and waste incinerated with some energy recovery was not readily available, but should be included in any future reports if it becomes available.

Recommendation 2: Waste generation and waste disposal quantities should be reported, as well as recycling and recovery rates.

A change in the amount of re-use impacts on waste generation and waste disposal quantities. All else being equal, an increase in re-use will lead to a decrease in waste generation and/or waste disposal. As such, waste generation and waste disposal quantities have some use as indicators of the total amount of re-use occurring. Therefore Recommendation 2 has been modified from the method report to include waste generation and waste disposal.

Note

There are a number of occurrences where some materials that are recommended for inclusion by the method report may be absent from this report because of the difficulty in obtaining data. The most notable of these are:

- Self-managed or on-site disposal (e.g. home composted organics, or discarded farm and mining equipment)
- Council managed recycling of organics
- Litter (included in the definition of disposal; see Section 2).

Recommendation 3: Liquid and gaseous wastes should be excluded from the scope at this stage.

The scope of the Hyder (2009) report was:

> ... the three major solid waste streams: municipal solid waste (municipal or MSW), commercial and industrial (C&I), and construction and demolition (C&D).

This is narrower than the scope of the *National Waste Policy*, which:

> ...encompasses wastes, including hazardous wastes and substances, in the municipal, commercial and industrial, construction and demolition waste streams, and covers gaseous, liquid and solid wastes. Radioactive waste is excluded.

However, the focus of the key directions and strategies, and the implementation plan of the *National Waste Policy*, is on solid waste. *The National Waste Policy Regulatory Impact Statement* (RIS), while acknowledging the scope defined above, also restricts its analysis to the three major solid waste streams.

State and territory government reporting of waste is generally constrained to solid waste. Queensland does include liquid wastes within its *State of Waste and Recycling* reports, but lists these separately.

Liquid wastes cannot be disposed directly to landfill in any jurisdiction. Liquid wastes that are not readily re-used or recycled are often solidified (stabilised) to enable their disposal to landfill, usually as a hazardous solid waste. As a result, it is important to note that the reported amount of waste disposed to landfill usually includes solidified liquid wastes. Solidified liquid wastes may be a significant proportion of hazardous wastes, but are a small percentage of total solid waste.

The exclusion of liquid and gaseous waste is not intended to imply that waste minimisation and resource recovery of materials in these states of matter (liquid and gas) should not be pursued and valued by states and territories any less than for materials in a solid state of matter.

There are occurrences where high viscosity liquids are being counted as solid waste. For example, in Victoria, liquids that are blended with plastics to create a high viscosity cement kiln fuel have been accounted for as energy recovery from solid waste. However, these quantities are relatively minor with respect to total waste generation.

Where data is available, solidified liquid wastes are included in the reporting scope, for example, with solidified hazardous wastes.

The Department recently commissioned a project to collate and assess data and information on liquid waste. Among other things, this project will document the different definitions and classifications of liquid waste and will assist in distinguishing between liquid waste and solid waste data.

Recommendation 4: Report waste generation data, disposal, energy recovery and recycling on a per capita basis using population figures that correspond to the end of the reporting period.

Variation in overall waste generation data for each state is expected given the population size of the different states/territories. This can be corrected for by including data on waste on a per capita basis. When presenting data on a per capita basis, the population of the relevant time period (as reported by the Australian Bureau of Statistics) needs to be used to ensure that population growth does not lead to a misstatement in the per capita generation rates of the time.

The recommendation has been adjusted from preliminary versions of the method to include disposal, energy recovery, and recycling.

In addition to reporting on a per capita basis, data has been included in this report on a per domestic product (dollar) basis for each jurisdiction, using economic activity figures that correspond to the reporting period.

Recommendation 5: Waste and recycling should be reported by weight.

The approach of previous reports, and that of most states and territories, is to report waste and recycling by weight.

It should be noted that mass alone does not provide a complete representation of the relative benefits of recycling or disposing to landfill of products and materials. For example, from the perspective of resource recovery, in particular embodied energy, the diversion from landfill of a tonne of aluminium is more important than the diversion of a tonne of timber. Aggregating the disposal of materials by mass does not provide detail on this important environmental aspect of material disposal.

The full life cycle impacts of the disposal of materials requires a more detailed analysis of the embodied resources of a product or material, and the impacts associated with the recovery (or not) of these resources.

However, the weight of end-of-life products and materials that are disposed is important for understanding the impacts of waste and recycling, and is a useful first step towards better management and use of materials and resources. It is also the most practical and universal way to measure waste and recycling.

Recommendation 6: Waste converted to energy should be reported as a separate disposal pathway to recycling and disposal.

Energy recovery from solid waste can occur through the conversion of material with a useful energy value directly into a combustible fuel, or through the collection and combustion of methane generated through the anaerobic decomposition of organic material.

Previous national waste and recycling reporting has not reported upon energy recovery. This reflects the approach of most states and territories. However, given that waste to energy (WtE) is recognised as a distinct tier in the waste hierarchy, and there has been increase in the prevalence of WtE in Australia—particularly methane capture—energy recovery is now reported separately from disposal and recycling.

Energy recovery from solid waste combustion data:

Data on the weight of solid waste combusted for energy recovery was obtained directly from industry sources. Note that the data provided is not net of any residual material following combustion (e.g. bottom ash).

Where jurisdictions were known to aggregate such energy recovery with overall recycling figures, these volumes were then subtracted from recycling figures.

The material classification of energy recovery from combustion was made on a case-by-case basis according to the source material used. The source sector classification was also made on a case-by-case basis, with all material classified as coming from either C&I or C&D sources.

Energy recovery from methane capture at landfills and AWTs data:

The mass of methane that was captured and combusted for the generation of electricity at landfills and (much less significantly) advanced waste treatment facilities (AWTs) was calculated. This mass was then accounted for as energy recovery, and subtracted from disposal.

Benchmarks of the annual generation of electricity, based on the installed capacity at landfill sites, were generated for each state and territory for the 2008 calendar year[4]. These benchmarks were then applied to more recent data on the installed capacity at landfill sites in each state and territory[5].

The amount and composition of landfill gas generated by solid waste disposal to landfill, and the amount of electricity generated from landfill gas, was taken from a report on the Woodlawn bioreactor in NSW[6]. The effective weight of solid waste recovered as energy through landfill gas capture was then calculated assuming a landfill gas ratio of 1:1 for methane and carbon dioxide[7]. This estimate was then subtracted from the quantity of organics to landfill to ensure that this mass was not 'double counted' within waste generation tonnages (i.e. counted within the organic waste mass and then counted again within the landfill gas tonnage estimates).

This method is consistent with that used for National Greenhouse and Energy Reporting (NGER). In future years, it is possible that disaggregated figures on the amount of methane generated and capture at landfills for each state and territory will be able to be extracted directly from the NGER related reporting, or from carbon accounting undertaken by the Federal Government.

The mass estimates relating to energy recovery through methane capture at landfills and AWTs were all classed as organic material, and apportioned to sector streams on the basis of the amount of total organic material arising from those streams in each state and territory. This is a significant approximation for a number of reasons, including:

- Methane recovered would mostly be generated by organic waste deposited before the reference year period
- The organic material make-up of the waste streams will be different, and different organic material types, for example food as compared to timber, generate different levels of methane per unit mass
- Methane generation in landfills is somewhat dependent on regionally variable climatic conditions, as well as management of the landfill.

The flaring of methane at landfills was excluded from the calculation of energy recovery. There is a greenhouse gas benefit in reducing the emissions of methane, however this is a separate issue to the recovery of energy from solid waste.

4 Green Energy Markets for Energy Developments Ltd and LMS Generation Pty Ltd, *Base-load renewable energy form organics – Innovation in Australia's green electricity industry*, 2008.

5 Clean Energy Council, *Power Plant Report* <www.cleanenergyaustraliareport.com.au> 31 August 2010.

6 Golder Associates for Veolia Environmental Services, *Recycling organics for energy at Woodlawn bioreactor – Desk study*, 1 May 2009. The ratio of CH_4 to CO_2 was assumed to be 1:1 for all landfill.

7 For the purposes of this report, it has also been assumed that methane and carbon dioxide are the only gases present in landfill gas. Typically, methane and carbon dioxide account for over 90% of the mass of landfill gas.

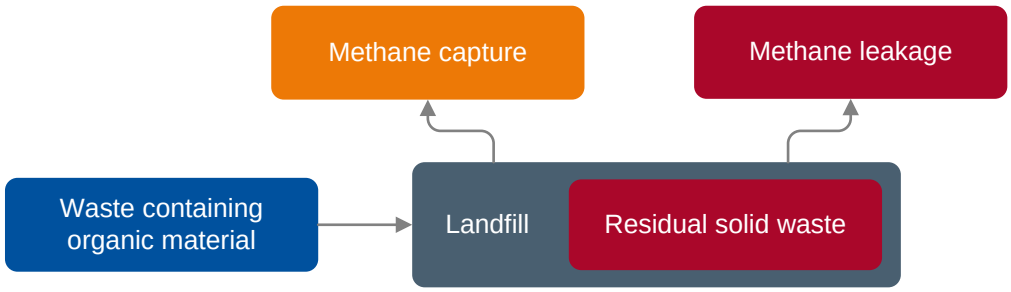

Figure 3-3: Mass flow of organic material in landfill

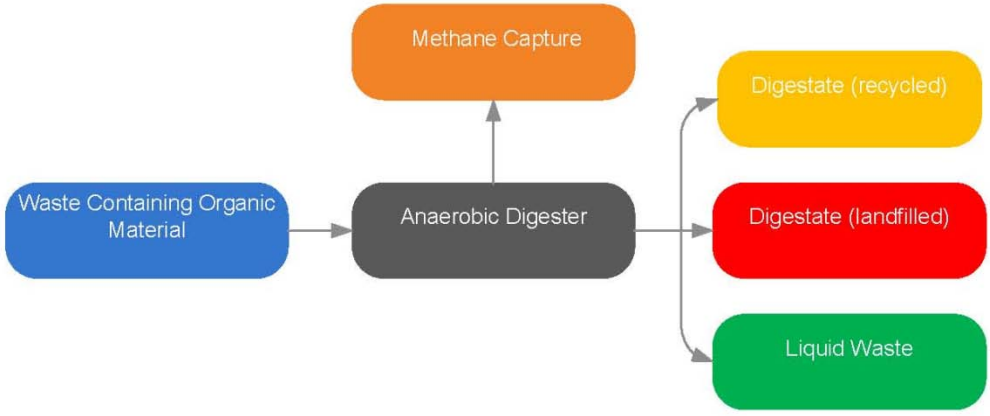

Figure 3-4: Mass flow of organic material in an AWT anaerobic digester

3.2 Waste streams

Recommendation 7: The definitions in the *National Waste Report 2010* for the three major solid waste streams should be used.

Waste streams (also known as source sectors when referring more directly to the sector origin) indicate the general source of waste material, usually in terms of MSW, C&I and C&D.

Taking account of waste by streams is an important first step in establishing the composition of waste. Information on waste and recycling by waste stream also helps inform investment and infrastructure decisions made by industry and state, territory and local governments regarding collection and treatment facilities.

However, from the perspective of trying to understand the environmental and resource consumption impact of waste and recycling, making a distinction between the points of generation of waste is less important than understanding the composition of waste.

The *National Waste Report 2010* provides the following definitions as a guide for the three major solid waste streams:

- Municipal solid waste (MSW) - waste produced primarily by households and council facilities, including biodegradable material, recyclable materials such as bottles, paper, cardboard and aluminium cans, and a wide range of non-degradable material including paint, appliances, old furniture and household lighting.
- Commercial and industrial (C&I) waste - waste that is produced by institutions and businesses; includes waste from schools, restaurants, offices, retail and wholesale businesses, and industries including manufacturing.
- Construction and demolition (C&D) waste - refers to waste produced by demolition and building activities, including road and rail construction and maintenance and excavation of land associated with construction activities. The C&D waste stream usually covers only some of the generation, disposal and recycling of C&D wastes, as these materials can also be found in the MSW and C&I streams, or as hazardous wastes.

The terms waste stream and source sector are used throughout this report to refer to the three solid waste streams, being MSW, C&I and C&D.

For states and territories where little or incomplete waste stream data was available for waste sent to landfill, typically linked with a lack of compositional data, it was necessary to estimate the types of waste, and therefore the likely source sector generating the waste.

This was done using either reference landfill audits that have been conducted in various states, or subsequent jurisdiction wide extrapolations (based on actual audits) on waste compositions. These reference audits and analyses are listed in Table 3-4.

For states and territories where only overall disposal to landfill was known, estimated national average source sector splits (and waste stream compositions) were calculated using the available audit data, and applied to the overall disposal figure to estimate the respective waste stream quantities, and compositions. These average waste stream and compositional estimates (or national default values) for Australia were calculated by aggregating the available audit results, with the state audit data firstly weighted against the population of the state/territory within which the audit occurred.

For states and territories for which waste stream data was unavailable but audit (compositional) data was available, the audit data was used to derive a waste to landfill composition for those jurisdictions. However, the estimated national average source sector splits were used to estimate the respective waste stream quantities.

In calculating the average waste stream splits and composition of waste to landfill, waste recorded as 'other' in audits was excluded from calculations.

It was necessary to decide the degree of representativeness of each of the reference audits. The following factors were considered:

- *Scale* - All audits were considered to be of a similar order of magnitude. Therefore, no audits were discounted on the basis of the quantity of waste audited.
- *Seasonality* - The results were assessed for seasonal variation, especially with respect to the quantity of garden and park waste. However, no obvious correlation was apparent. The results are therefore considered to be representative of annual waste received at landfills.
- *Location* – The reference audits were conducted across five jurisdictions. Results from the two regional and metropolitan sites were compared, and no obvious correlation between location and waste composition was found. The results for metropolitan sites are therefore considered representative of both metropolitan and regional sites.

Estimated national averages (default values) were also calculated for recycling, both in terms of source sector splits and composition. This was done in part by calculating municipal waste generation from the average generation recorded for other jurisdictions. Municipal waste to landfill was then subtracted from this figure to provide an estimate of municipal recycling.

A reporting impact of this estimation approach, where used, is that the difference between the estimated municipal recycling and total recycling is reported as an aggregated C&I and C&D recycling figure, as it was not feasible to assume an average split for these two variable sectors.

Extensive detail on the sources of data, data collation assumptions and calculation methods for each state, is provided in tables in Section 4 of this report.

Table 3-4 Audit data sources

Source sector	Report
Municipal, C&I, C&D	Waste Audit and Consultancy Services and Golder Associates (2005) *Disposal based waste survey*, prepared for Sustainability Victoria
Municipal & C&I	Department of Environment and Conservation NSW (2005) *Garbage bag compositional analysis*.
Municipal	APC Environmental Management (2007) *Domestic waste audit*, prepared for Thiess Services and ACT NoWaste
Municipal	Department of Environment and Climate Change NSW (2004) *Getting more from our recycling systems: assessment of domestic waste and recycling systems*, prepared by Nolan ITU
Municipal	Hyder Consulting (2008) *Kerbside waste audit data analysis and audit template*, prepared for Sustainability Victoria
Municipal	Murdoch University (1999) *Domestic waste analysis*, prepared for the City of Stirling
Municipal	Waste Audit and Consultancy Services and Nolan ITU (2002) *Survey and Audit of Kerbside Waste and Recycling Practices and Recommended Kerbside Service Standards*, prepared for the Environment Protection Authority (South Australia)
C&I, C&D	Golder Associates Pty Ltd & Waste Audit & Consultancy Services (Aust) Pty Ltd (2007) *Disposal based audits of the C&I and C&D waste streams*, prepared for the Department of Environment and Conservation (WA)
C&I, C&D	Zero Waste SA (2007) *Disposal based survey*, prepared by Waste Audit and Consultancy Services (Aust) Pty Ltd
C&I	Department of Environment, Climate Change and Water NSW (2008) *Disposal based survey of the commercial and industrial waste stream in Sydney*
C&D	Department of Environment and Climate Change NSW (2007) *Report into the construction and demolition waste stream audit 2000-2005*

Recommendation 8: Wastes generated by the core processes of primary production should be excluded from the scope.

Primary production is defined here as the conversion of natural resources into primary products, usually for use as raw materials by other industries. Although primary production is considered an industrial activity, the C&I waste stream includes only wastes from the secondary, tertiary and quaternary industrial sectors; wastes from the primary sector do not usually fall within the definition of C&I waste.

Furthermore, the 'disposal' pathway of primary production waste is often analogous to, or chemically indistinguishable from, natural processes. For example, sawdust created during the felling of trees is difficult to distinguish from the natural decomposition of trees and tree limbs in a forest. As a result, primary production waste is often disposed of on-site, and often does not follow the same disposal routes for the three major solid waste streams.

The approach to wastes from primary production is also important from the perspective of trying to achieve a more consistent set of data for states and territories. The amount of primary production and primary production waste varies markedly between different jurisdictions, principally because of the different natural resource conditions in states and territories.

Primary production wastes generated by core processes refers to wastes from the primary production process itself, rather than wastes ancillary to primary production. For example, end-of-life mining equipment should be considered to be C&I waste and not be considered primary production waste.

Primary production wastes reported as being recycled by Compost Australia[8] were excluded from organics reprocessing calculation. See Table 3-6 for specific inclusions and exclusions of organic materials.

However, primary production wastes (particularly organic materials) that are disposed of to landfill are not usually disaggregated from landfill figures. As such there are likely to be primary production wastes included in many jurisdictions' disposal to landfill figures. For example large quantities of broiler chickens are sometimes disposed to landfill when an incident causes a large number of chicken deaths. The significance of this waste tonnage from primary production is not known.

Recommendation 9: Pre-consumer wastes that are recycled on-site as part of the manufacturing process should be excluded from the scope.

Pre-consumer waste typically refers to the scrap from manufacturing inefficiencies or malfunctions. Pre-consumer wastes are part of the industrial process and could be considered within the definition of C&I waste. However, pre-consumer wastes are usually only considered in waste and recycling reporting when they are disposed of offsite.

Where pre-consumer wastes are fed back into the manufacturing process this is what is referred to in the Australian Standard (AS/NZS 3831:1998) as "closed loop recycling". Mill broke generated during the production of paper that is fed back into the manufacturing process is an example of closed loop recycling.

Closed loop recycling is usually excluded from waste and recycling reporting, and is sometimes excluded from the definition of recycling. Closed loop recycling can be considered to be something that is done as a matter of course in the efficient operation of the site.

Conversely, the generation of waste during an industrial process can be considered to be the result of inefficient operation of the site, either by design or by malfunction. If closed loop recycling was to be included in waste and recycling reporting, then an increase in the inefficiencies of the industrial processes would be represented as an increase in recycling.

By contrast, post-consumer wastes are clearly within the scope of waste and recycling reporting. Most products and materials that enter the municipal waste stream are clearly post-consumer wastes and are relatively easy to define within this stream.

Most products and materials in the C&D waste stream are also clearly post-consumer wastes, although there are a number of raw materials in the C&D stream, most notably earthen materials clean fill (see Recommendation 12).

The scope of waste and recycling reporting can also be approximately defined by the point of waste disposal. Products and materials included within the scope of waste and recycling reporting are usually those disposed of offsite, from non-primary production sources. Conversely, materials excluded from the scope are usually primary production or pre-consumer wastes that are close to their raw form and that are disposed of on-site.

8 Recycled Organics Unit, *Organics Recycling in Australia: Industry Statistics 2009*, revised edition December 2009.

No state or territory data-sets include any significant quantities of pre-consumer wastes. These are routinely either excluded from the scope of national waste and recycling primary (direct) data collection exercises or the data is collected, but reported separately.

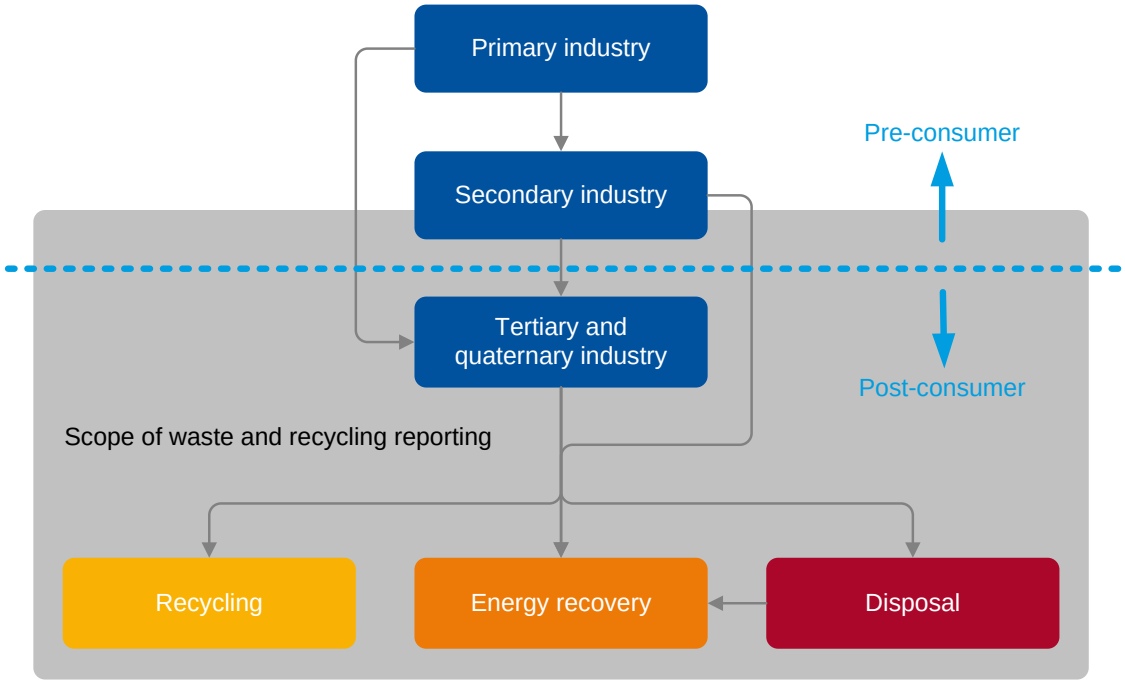

Figure 3-5: Scope of waste and recycling reporting by production stage

3.3 Specific wastes

Recommendation 10: Bark and sawdust from forestry operations, and mining and mineral processing wastes should be excluded from the scope.

Bark and sawdust from forestry operations, and mining wastes, are all primary production wastes. Bark and sawdust generated from forestry operations is distinct from those generated in secondary industrial processes, such as timber mills.

Bark and sawdust from forestry operations reported by Compost Australia[9] were excluded from organics reprocessing calculations. See Table 3-6 for specific inclusions and exclusions of organic materials.

No states or territories treat the disposal of bark and sawdust to landfill any differently to other landfilled material. However, many do account for the recycling of bark and sawdust from forestry separately. A number of these jurisdictions use *Organics Recycling in Australia – Industry Statistics*, compiled by Compost Australia, to generate the breakdown of organic material. This report lists sawdust and barks from forestry residuals as a separate item.

New South Wales reports bark and sawdust from forestry residuals as distinct items in reporting on recycled organic material.

Victoria reports sawdust and other forestry residuals, but does not distinguish the origin of the material. Bark and sawdust is reported separately from other materials regardless of where it originates.

9 Recycled Organics Unit, *Organics Recycling in Australia: Industry Statistics 2009*, revised edition December 2009.

Western Australia records and reports on forestry waste collected for reprocessing but does not include it in its reported organic materials collected for reprocessing.

South Australia reporting excludes barks and sawdust from forestry residuals.

Mining and mineral processing wastes, such as tailings and red mud (generated through alumina production), are defined as primary production related wastes and are excluded from the data scope.

Recommendation 11: Organic agricultural wastes are excluded from the scope.

Agricultural wastes are generated through primary production activities. However, defining the point at which agricultural wastes shift from being primary production wastes to secondary industry wastes is particularly difficult, and especially so for food. For example, the distinction between fruit that falls on the ground in an orchard, fruit that is dropped on the packing room floor and fruit that becomes a waste at a cannery is not easily made within the framework of primary and secondary industry.

Agricultural wastes are also likely to be sent to different destinations depending on where the industry is located. Agricultural wastes generated in more remote areas are likely to be disposed of on-site and are unlikely to be recorded. Conversely, agricultural waste generated adjacent to more highly populated areas are more likely to be disposed of at specific organic waste treatment facilities and are more likely to be recorded in recycling activity.

For the purposes of this report, agricultural wastes do not include waste material ancillary to the core primary production. For example, fencing wire should be considered C&I waste, and not agricultural waste.

Organic agricultural wastes reported by Compost Australia[10] were excluded from organics reprocessing calculations. See Table 3-6 for specific inclusions and exclusions of organic materials. However, post-consumer wastes generated by the sector are included in the scope. This includes products such as drums and other packaging, general farm consumables, and end-of-life farm equipment.

There are a number of jurisdictions that include reprocessed agricultural wastes in recycling data. NSW reports agricultural waste received for reprocessing as a component of its organic stream. Queensland reports manure and other agricultural wastes recovered. Western Australia reports agricultural waste, excluding manures, collected for reprocessing. South Australia includes waste from agricultural processes collected for reprocessing in the 'other organics' category.

However, in all states and territories, agricultural waste that is disposed of to landfill is not usually distinguished from other organic material or other solid waste. As such, there is likely to be some agricultural waste included in many jurisdictions' disposal to landfill figures.

Recommendation 12: Clean fill should be excluded from the scope.

Clean fill – earthen material in a raw or unrefined state – can be considered a primary product. By this account, it should be considered for exclusion from the scope of waste and recycling reporting.

However, clean fill is an anomaly in an interesting respect. Putting clean fill in landfill can be (and sometimes is) considered a re-use of materials. As such, clean fill can either be included or

10 Recycled Organics Unit, *Organics Recycling in Australia: Industry Statistics 2009*, revised edition December 2009.

excluded from the landfill ledger, but cannot be included in the recycling ledger; when earthen materials are used as fill it is a re-use of material, not recycling.

This recommendation has been changed significantly from preliminary versions of the method that recommended clean fill be included in the scope, but "reported separately to the total of all other materials included within the scope".

This recommendation also differs from preliminary versions in that 'soil, sand and rock' has been renamed as 'clean fill'. This enables a better distinction between earthen materials in a raw or unrefined state and loads of mixed rubble (which are counted under masonry materials and rubble and unclean fill).

In most cases, clean fill is not disposed to landfill, and only a small portion of total clean fill handled would ever be disposed to landfill.

In addition, any clean fill that is used for cell construction, capping or rehabilitation should also be excluded from the data scope.

Recommendation 13: Daily cover (that is clean fill) should be excluded from the scope.

Daily and intermediate landfill cover refers to soil or other inert material used to temporarily cover waste in landfills. Where landfills use daily cover, clean fill that is disposed of at the landfill is likely to be used for this purpose.

The inclusion of daily cover in landfill figures is an anomaly for the same reasons that the inclusion of clean fill is an anomaly. The consistent approach would be to treat daily cover as a component of clean fill.

Most states and territories list soil or daily cover as a separate material, though the way it is accounted for varies greatly between jurisdictions. Daily cover practices also differ between jurisdictions, at different landfill types and under different conditions.

This recommendation has been changed from preliminary versions of the method by specifically referring to daily cover that is clean fill. Any other material (e.g. mixed rubble or chipped organics) that is used for daily cover and that is included in the scope should be included.

In some jurisdictions, the amount of material disposed to landfill is adjusted downward to account for daily cover, irrespective of whether that daily cover is generated on-site. Accounting for daily cover in the recommended way would better account for the disposal of daily cover generated on-site.

NSW counts soil, including daily cover, as waste disposed to landfill. Earth based material is reported as a particular material in the domestic waste stream. Soil is not reported separately from other C&D waste.

In Victoria, landfill operators are granted a fixed rebate equal to 15% of all "waste deposited onto land at the premises" to allow for daily cover. As a result, some data reported for Victoria regarding waste disposed to landfill is 15% less than the actual amount disposed to landfill. This report has reported the total wastes to landfill (i.e. the 15% cover allowance has not been subtracted).

Queensland reports clean fill disposed to landfill as a discrete item. Queensland previously made allowances for daily cover, but no longer does so.

Western Australia provides separate data on "sand, soil, clean fill and rubble" in its materials recovery reporting. In calculating the landfill levy, some landfill sites are able to make an allowance for daily cover of up to 8% of the waste received.

South Australia reports soil in combination with brick, tile and rubble. Clean fill is exempt from the landfill levy and is reported separately in the landfill levy accounts. No special accounting is made for daily cover.

Tasmania excludes clean fill from landfill reporting and does not make any allowance for daily cover.

Recommendation 14: Fly ash should be included in the scope, but is reported separately to the total of all other materials included in the scope.

Fly ash is a pre-consumer waste generated during the combustion of material, most usually coal for electricity generation (a secondary industry). It is also sometimes classified as a hazardous or regulated waste.

Fly ash is unusual in that where it is not recycled, it is usually disposed of into 'ash dams' located adjacent to mines and power stations. In this respect, fly ash can be considered to be disposed of on-site. Where fly ash is recycled, it is commonly used in the cement manufacturing process, or as a soil conditioner.

However, unlike primary production and pre-consumer wastes disposed of on-site, fly ash is clearly a solid industrial waste (when it is disposed) that should be disposed of in a controlled way. The on-site disposal of fly ash is more by virtue of the fact that it is generated adjacent to a site which is available for disposal. But for this, it is likely that fly ash would be subject to stringent requirements for disposal through routes for conventional or hazardous wastes.

Most states and territories do not record fly ash separately as part of solid waste data.

Queensland lists fly ash as a separate item in the reporting of waste from industrial facilities.

South Australia also reports on fly ash separately to other materials, and records it as a specific waste type in the composition of recycled materials.

Data on aggregated national generation, re-use and storage of fly ash was obtained from the Ash Development Association of Australia. For the purposes of this report, re-use of fly ash was considered to be recycling, and that which was put into storage (annually) was considered to be disposed.

Data on the size and location of coal fired power stations was then used to estimate data on the amount of fly ash produced in each state and territory. Data on the amount of fly ash recycled was obtained from government reports for South Australia and Queensland. For all other states and territories, generation, recycling and disposal figures were then estimated according to the distribution of coal fired power stations. This did not take into account variations in the generation of fly ash as a result of difference in the feed stock and the type of coal fired power stations.

Fly ash was recorded as having been sourced from the C&I sector.

Although fly ash is recorded separately to other materials in this report, its inclusion has a significant effect of the total volumes of solid waste recorded. This can be observed in the difference in volumes between the subtotal and totals for most states in Section 4.1.

Recommendation 15: Biosolids should be included in the scope.

Biosolids are the residual material from sewage treatment plants and industrial wastewater treatment. Biosolids are a residual waste from the treatment of a post-consumer waste.

Biosolids are usually dewatered and recycled or sent to landfill. The water content of fresh biosolids is variable and often very high. However, from the perspective of national and state/territory levels of data aggregation, it is believed likely that the biosolids produced in any

year are likely to have similar average moisture levels. Assuming this is the case, and that no other significant changes to data collection have occurred, then year-on-year comparisons of available data on biosolids generation, landfill and recycling, are useful.

NSW reports biosolids, grit and screenings as a distinct material type in the composition of organic material received for reprocessing.

Victoria measures biosolids separately from other wastes, and reports on it separately to all other recycling and landfilling activity.

Queensland reports biosolids separately both in terms of material landfilled and material recovered. In recording biosolids, an attempt is made to measure the dry weight of the material, where possible.

Western Australia records biosolids that are collected for reprocessing, but reports them separately to other organic wastes.

South Australia excludes biosolids from its reported recycling.

Data on the disposal to landfill of biosolids was obtained from the Australian and New Zealand Biosolids Partnership[11] on production and disposal routes of biosolids in Australia. The tonnages reported are dry biosolids reported as disposed by the partnership. Data on the stockpiling of biosolids was excluded as information on the age of the stockpiles was unavailable. Data on the recycling of biosolids was taken from Compost Australia[12].

Biosolids are classed being an organic material and attributed to the municipal sector as the majority of biosolids are generated from the treatment of domestic sewage. Many industrial wastes sent to sewer also contribute to biosolids, however many facilities will also have on-site treatment to remove dissolved and suspended solids. The respective contributions of MSW and C&I sources to final biosolids quantities is not known, and the current agreed approach is to allocate all biosolids to the municipal waste stream.

Recommendation 16: Hazardous, prescribed or clinical wastes should be included in the scope.

Hazardous, prescribed or clinical wastes have been excluded from previous national waste and recycling reports, which reflects the reporting approach of most states and territories. However, this exclusion raises a number of issues.

Firstly, hazardous wastes are usually defined through regulation, based on consideration of the chemical or biological state of a particular product or material, rather than any relationship to a distinct product or material type. For example, contaminated steel and plastic containers may be excluded from solid waste data, but clean containers are included in both recycling and landfilling figures.

Secondly, different jurisdictions have different classifications for hazardous, prescribed or clinical wastes. Instances may arise where materials are included in solid waste data in one jurisdiction but excluded in another on the basis of different classification methods for hazardous wastes.

Most jurisdictions keep separate databases for hazardous, prescribed or clinical wastes, or are in the process of developing them. The National Pollutant Inventory also provides a point of consolidated information on particular pollutants and their transportation.

11 Personal communication, Australian and New Zealand Biosolids Partnership, 20 January 2011.

12 Recycled Organics Unit, *Organics Recycling in Australia: Industry Statistics 2009*, revised edition December 2009.

NSW reports a hazardous waste component of domestic waste from the Household Chemical Cleanout Program.

Victoria has accurate data for prescribed industrial waste disposed of to landfill, but data on this waste is reported separately to data on municipal and industrial waste.

Queensland reports regulated wastes separately. This data is generated from the movement of hazardous waste, not disposal, which may result in some double counting.

In Tasmania, data is gathered for hazardous waste. However, most hazardous waste is reported to be pre-treated for use as clean fill. Any remaining hazardous waste that does go to landfill is not distinguished from all other material going to landfill.

Hazardous waste from the ACT goes to NSW, and is not counted in that territory's data.

The recommendation of the method report was that hazardous materials be reported in combination with non-hazardous materials of the same category and type. However, the application of this method proved impractical during the production of this report.

Data sets on hazardous wastes received from states and territories are variable in approach and categorisations. This made it difficult to accurately partition hazardous waste to particular material categories. For this reason hazardous wastes are reported in separate material categories. The four hazardous waste types reported throughout this report are: quarantine; contaminated soil (both chemical and biological); hazardous industrial waste; and asbestos.

Hazardous (industrial) waste is generally allocated to the C&I source sector, however the default waste audit data applied to some jurisdictional data sets did allocate a very minor proportion of hazardous waste as being in the MSW stream, and in these cases this was allocated to MSW. Contaminated soil and asbestos are allocated by default to the C&D source sector. Quarantine waste is allocated by default to the C&I source sector.

Hazardous wastes fallling into any category that is recommended for exclusion from the scope elsewhere in this report, in particular liquid wastes, have been excluded.

Recommendation 17: Quarantine wastes should be included in the scope.

Quarantine waste can be considered similarly to hazardous waste; it is the regulatory state of the waste that is its defining characteristic, more than the material type.

Non-quarantine products or materials that enter the country by ship or by air are not usually distinguished from other products or materials if they end up in the waste stream. For example, non-quarantine waste collected at international airports is not considered differently to other C&I waste.

Therefore, it follows that quarantine (solid) waste should be considered similarly to non-quarantine waste from ships.

This recommendation has been broadened from the preliminary version that referred specifically to 'quarantine wastes from ships'.

Quarantine wastes were included, but grouped under the broader material category of hazardous waste. Tasmania was the only jurisdiction to report quarantine wastes (from ships), most of which are generated by the Australian Antarctic Division.

Quarantine wastes from ships and from airports in other jurisdictions are assumed to be counted amongst other hazardous or non-hazardous wastes.

NSW and Queensland are aware that quarantine waste from ships is included in recorded waste figures.

3.4 Measurement

Recommendation 18: A consistent set of materials should be used to report the composition of waste streams.

As noted above, establishing the composition of waste streams is important in gaining a more detailed understanding of the environmental and resource consumption impacts of waste generation, recycling, energy recovery and disposal. Establishing the composition of waste streams also helps inform government and industry of products and materials that might be targeted for greater resource recovery, or where investment might be needed.

The reporting of data by material has been presented at two levels of detail:

- Material category, e.g. metals, organics – for most states, data has been provided or been able to be generated to the material category level
- Material type, e.g. aluminium, timber – reporting to the material type has been limited to the level of detail provided by states and territories.

A number of changes have been made to the material categories and material types contained in the consultation draft of this report. An amended list of material categories and material types is shown in Table 3-5. The material types used by Compost Australia in relation to the organics category are displayed in Table 3-6, with explanation provided for their inclusion or exclusion from this report.

'Clay, fines, sand and rubble' have been renamed as 'rubble' to better distinguish it from 'clean fill'. For the purposes of this report, rubble refers to broken stone and masonry material, including any soil and sand that is mixed in with it.

'Foundry sands' were removed as a separate material type. With the exception of South Australia, states or territories do not document foundry sands as a distinct material type. Anecdotal evidence suggests that the landfilling of foundry sands is not distinguished from the disposal of other 'rubble'. The exception is foundry sands that are contaminated which are usually managed as a hazardous industrial waste.

'Newsprint and magazines' have been consolidated into one category, including phonebooks. 'Printing and writing papers' have been renamed 'office paper'. 'Cardboard and waxed cardboard' has been shortened to 'cardboard'.

'Glass' has been moved from being a material type under the subset 'other', to being a material category.

Some states and territories report on the composition of waste, though the practice is not widespread or consistent. Those jurisdictions that do report on the composition of waste use a similar set of materials. Where there are differences, they are usually with respect to:

- the grouping or separation of plastic polymer types
- the grouping or separation of organic materials, particularly whether food is identified separately
- the grouping or separation of C&D materials, particularly whether soil is reported separately.

Those jurisdictions that do report on waste composition usually use the breakdown of waste streams, in combination with audits, to refine the overall product and material composition of waste and recycling.

More detail on the individual state approaches to material breakdowns is provided in the state datasets in Section 4.

Table 3-5 Material categories and material types

Material category	Material type
Masonry materials	Asphalt
	Bricks
	Concrete
	Rubble
	Plasterboard & cement sheeting (ex. asbestos reinforced)
Metals	Steel
	Aluminium
	Non-ferrous metals (ex. aluminium)
Organics	Food organics
	Garden organics
	Timber
	Other organics
	Biosolids
Paper & cardboard	Cardboard
	Liquid paperboard (LPB)
	Newsprint and magazines
	Office paper
Plastics	Polyethylene terephthalate (PET)
	High density polyethylene (HDPE)
	Polyvinyl chloride (PVC)
	Low density polyethylene (LDPE)
	Polypropylene (PP)
	Polystyrene (PS)
	Other plastics
Glass	Glass
Other	Leather & textiles
	Tyres & other rubber
Hazardous	Quarantine
	Contaminated soil
	Industrial waste
	Asbestos
Reported separately	Fly ash

Table 3-6 Material types used by Compost Australia[13] with explanation for inclusion or exclusion from organics recycling calculations in this report

Material type	Status	Explanation
Garden organics (green organics / garden vegetation)	Included	Post-consumer waste
Wood/timber/sawdust (from commercial/industrial sources)	Included	Post-consumer waste
Sawdust (from forestry residues)	Excluded	Excluded under recommendation 10
Barks (from forestry residues)	Excluded	Excluded under recommendation 10
Food organics (food waste)	Included	Post-consumer waste
Biosolids/grit/screenings	Included	Post-consumer waste
Oils/grease trap/sludge	Included	Post-consumer waste
Straw	Excluded	Agricultural waste–excluded under recommendation 11
Manure	Excluded	Agricultural waste–excluded under recommendation 11
Animal bedding	Included	Ancillary to core primary production. See Section 4.2.4 of the method report.
Animal mortalities	Excluded	Agricultural waste–excluded under recommendation 11
Paunch	Included	Post-consumer C&I waste
Other–Miscellaneous agricultural wastes	Excluded	Agricultural waste–excluded under recommendation 11
Other–Paper pulp/sludge	Included	Pre-consumer waste, but not from a closed-loop recycling process. See Section 4.2.2 of the method report.
Other–MSW (organic fraction)	Included	Post-consumer waste
Other–Biowaste	Included	Post-consumer waste
Other–Miscellaneous	Included	Assumed to be post-consumer waste

Recommendation 19: Waste should be counted by the stream that it is collected in unless data is readily available.

Waste that is defined as originating from a particular source is sometimes collected, and identified, as being part of another waste stream. There are a number of instances where this happens on a regular basis.

Some councils offer a kerbside waste and/or a recycling collection service to local small businesses. Waste and recycling collected from these businesses is usually not recorded separately to that collected from households. In this case, a small proportion of waste that is recorded as municipal waste is actually C&I waste. Conversely, some municipal waste collected in mixed use buildings is counted as being C&I waste.

C&D waste from home renovations, shop fit-outs, and other minor building activities can be disposed of through council or privately sourced waste collection systems that would ordinarily

[13] Recycled Organics Unit, Organics Recycling in Australia: Industry Statistics 2009, revised edition December 2009.

be considered part of the municipal or C&I waste stream. For example, a trailer load of C&D waste taken to a transfer station or landfill by a home renovator is likely to be considered municipal waste.

In these instances, the data collected usually makes it difficult to distinguish between the source of the waste and the stream that it is collected in. Most waste and recycling reporting does not separate that component of a waste stream that is collected from another stream.

There is a quantity of waste that is counted in the stream that it is collected in but that originated from a different waste stream. The relative significance of this cross-stream material is unknown, and requires further analysis to determine its scale.

Recommendation 20: Standard conversion factors should be used except for where states or territories have justification to apply jurisdiction or site specific conversion factors.

Some landfills, particularly smaller facilities and those in rural areas, operate without weighbridges. In these instances, conversion factors are used to convert data on the volume of material collected into an estimate of the weight of material collected. Conversion factors are also often used to convert the volume of organic material collected into a weight.

The density of loads disposed to landfill or organic recyclers can vary markedly between jurisdictions, and between landfills within jurisdictions. Accordingly, conversion factors can vary between jurisdictions, and between landfills within jurisdictions.

All states and territories reported waste and recycling in tonnes, or as percentages of a total tonnage figure. Therefore, Hyder did not need to use conversion factors to convert data.

However, jurisdictions are known to use conversion factors in the following ways:

- For open truck loads, NSW applies a different conversion factor to municipal and C&I waste, to C&D waste and to “excavated natural materials”. For closed truck loads a single conversion factor is applied.
- Victoria uses a standard conversion factor for landfills that collect volumetric data. However, provision is made for landfills to establish and apply a site specific density. Victoria also uses a conversion factor to determine the weight of organic material recycled.
- Queensland uses Californian conversion factors to convert volumes to weight.

Recommendation 21: Residual material from recycling and waste to energy operations should not be counted as recovered material.

Residual material refers to the contaminants in, or unwanted components of, products and materials collected for recycling. These materials are extracted either prior to or during reprocessing operations, or the conversion of waste to energy. Residual material usually accounts for any discrepancies between the materials reported as having been recovered for recycling, and that which is actually recycled.

Difficulties in measuring the amount of residual material can arise depending on the point in the recycling process at which data collection occurs. If the amount of recycled material is measured at the point of input into a recycling process, the reported amount will include any waste material separated during reprocessing. In this case, the residual material would be counted twice: once (incorrectly) as a component of material made available for recycling, and again when it is disposed to landfill. This issue also occurs when measuring material that is collected for recycling overseas.

This recommendation has been amended from preliminary versions so as to include waste to energy as well as recycling.

No state, territory or industry recovery and recycling data-sets are known to include residual material from recycling operations. States and territories record the amount of material after reprocessing in the following ways:

- NSW reports on material received for reprocessing, and records details on contamination losses where they occur
- Victoria also records material recovered for reprocessing, and asks recyclers to provide data on the "amount of material disposed to landfill due to contamination or as processing waste"
- Queensland asks councils to provide details on "materials collected for recycling disposed to landfill due to contamination"
- Western Australia provides details of recyclable and non-recyclable reprocessing losses
- South Australia excludes reprocessing losses from the quantity of material recovered for recycling
- In the ACT, recycling is generally measured as 'out-the-gate', with the exception being green-waste, which is measured using a conversion factor.

Recommendation 22: Recycling should be counted by material input (less residual material).

Another issue in the accounting of recycling can be whether to record the weight of material inputs or material outputs, even after accounting for contamination or unwanted components. This is particularly an issue in the composting of organic wastes, where biological processes occur which reduce the mass of the compost significantly from that of the organic material coming in the gate.

Given that organic waste disposal to landfill is recorded as a waste input, it stands to reason that organic waste recycling (less residual material) should be accounted for in a similar manner.

It is understood that recycling data reported by states, territories and industry groups represents net recycling data.

Recommendation 23: Waste should be counted once at the point of generation.

The movement of waste and recyclate between states and territories sometimes leads to the double counting of material. For example, one state might record material collected for recycling within its borders, and another state that receives this material might also record this material in its recycling figures.

The accurate accounting of waste that is transported interstate can become difficult with respect to residual material. When material collected for recycling crosses state or territory borders, it is usually counted by gross weight in the state of origin. The residual material from recycling operations in the destination state is also likely to be counted as landfilled waste. In this case, care needs to be taken that the residual material from recycling is not double counted. Residual material from reprocessing that is collected in a different jurisdiction to that where it is landfilled should be attributed to the point of generation.

The double counting of material collected for landfilling is less likely. However, given that most jurisdictions record landfill data at the gate, material that is transported interstate to be landfilled is usually recorded at the point of disposal.

Significant quantities of recyclate materials (both before and after reprocessing) are exported from Australia. This occurs across many material types, including; steel, non-ferrous metals, paper and cardboard, and plastics (predominately packaging). While reasonably good data is often available on the material types of exported recyclate, the state of origin of the material can be more uncertain as materials are sometimes transported interstate prior to export.

The distinctions between materials sourced from within and outside of a state or territory are usually not made clear in the reporting of data. Due to the difficulty in determining this distinction, data in the report may contain some material sourced from outside the reporting jurisdiction. This issue also has the potential to cause some double counting of materials for recycling or landfill disposal. This is more an issue for the eastern seaboard states.

Export for reprocessing is generally quantified and incorporated into the appropriate jurisdiction's recovery estimates. An exception to this was exported waste tyres, for which data was not available for 2008–09.

NSW records data on recycling at the point of collection. That is, material imported into the state is not reported, but material that is collected and exported from the state is. However, landfill data is measured only as what comes through the gate, irrespective of origin.

Victoria provides details on material imported and exported interstate in its survey of recycling activities. However there is no tracking of the interstate movement of non-hazardous waste to landfill.

Conversely, in Queensland, landfills are asked to provide state of origin, but no tracking is undertaken for recycling.

The ACT only reports recycling originating in that territory. They receive a clearly identified quantity of material from Queanbeyan (NSW) which is excluded from the ACT's reported data. This material is included in NSW's reported data.

No waste materials are known to be imported into Australia for disposal to landfill. Small quantities of some recyclate materials (e.g. plastics) are occasionally imported into Australia for reprocessing. In relation to Australia, this material is effectively for 'consumption', and should not be considered as recycling.

Recommendation 24: Stockpiles of reprocessed product or material that has been actively recovered should be considered to be recycled.

Related to the input/output issue discussed under Recommendation 22, is the issue of stockpiling. Stockpiling is defined as an interim holding of materials, intended for recycling, that occurs across two reporting time-periods. Materials collected for recycling can be stockpiled both before and (typically) after reprocessing. This can create particular difficulties in reporting where unprocessed materials are stockpiled but the originally intended reprocessing activity does not take place as planned.

For the purposes of this report, material that has been actively recovered refers to that which has been sorted and reprocessed, is ready for use as a feed stock for a new product, and for which there is a reasonable prospect of a market demand. This is in contrast to materials that have been collected with the intention of being reprocessed, but which have not yet been reprocessed.

Recommendation 25: Waste and recycling reporting should include both the most up to date data, and data from most recent time period reported on by all jurisdictions.

The delay in publishing waste and recycling data varies between states and territories. This can sometimes make it difficult to produce a consistent set of data while also using the most up-to-date waste and recycling data. The principal datasets for all states and territories used for this report cover the period 2008–09.

4 WASTE & RECYCLING DATA

This section summarises national and state/territory data on waste disposal to landfill, recycling and energy recovery for the financial year 2008–09 (with exceptions as noted). It includes figures on:

- Weight of waste generated by material category and type on a state/territory and national basis
- Composition of waste and recycling stream by sector and by material
- Historical and projected trends.

This report collates the available data for each state and territory. Little primary research has been undertaken in producing this report, and its content is primarily based on publically reported information.

All figures reported in tables throughout this report have been rounded. Minor discrepancies may occur between the stated totals and the sums of the component items, as totals are calculated using the component item values prior to rounding.

Important Note

Data from previous *Waste and Recycling in Australia* reports has not been fully adjusted in accordance with the method report. This should be taken into consideration when evaluating data in this report and that reported in previous years (see further discussion in Section 4.1).

Comparison of previous *Waste and Recycling in Australia* reports to *Waste and Recycling in Australia 2011*

Previous *Waste and Recycling in Australia* (WRiA) reports have gathered available data through desktop research, consultation with state and territory governments, and industry bodies. The data for this report was gathered in the same manner and from the same principal sources and industry groups. The data sources and assumptions made during data compilation are provided at the relevant points throughout this section.

The key change in this version of WRiA is that the waste categories and types are grouped in line with the method report, and that a number of additional waste categories and types are reported upon in line with the recommendations in the method report. The additional waste categories and waste types being reported on in WRiA 2011 are:

- Fly ash – not reported previously; now reported as a separate waste type
- Clean fill – reported previously, but now not reported
- Hazardous waste – not reported previously; now reported as a separate waste category
- Biosolids – not reported previously; now dry biosolids are reported within the organics waste category
- Quarantine waste – not reported previously; now reported as a waste type under the hazardous waste category.

It should also be noted that the best endeavours have been made to not collate data on those wastes identified in the method report as being outside the scope of this report. The most notable of these wastes are:

- Gaseous or liquid wastes
- Primary production wastes, including mining and mineral processing wastes, agricultural and forestry operations wastes, and self-managed farm wastes.

4.1 National waste disposal and recovery

This section presents a consolidation of available data on disposal, recycling and energy recovery nationally. References are provided as footnotes and any assumptions are provided as necessary. Data presented in this report is for the 2008–09 financial year.

Data sources for each state and territory are given at the beginning of each section. These sources are largely updated versions of those used to compile the previous *Waste and Recycling in Australia* reports. The data presented in this report is similar to that presented in the previous editions, noting the changes detailed throughout Section 3. The key change between this and the previous report is the inclusion of fly ash data. Due to the large quantity of this material and its impact on recycling and recovery rates, sub-totals of waste and recycling figures are presented excluding fly ash. Separate reporting of fly ash enables more accurate comparisons with 2006–07 data, which was exclusive of fly ash for all states except SA.

Table 4-7, shows the levels of waste generation (total of disposal + recycling + energy recovery) for each jurisdiction in 2008–09.

Table 4-7 Waste generation, recycling and recovery rates by jurisdiction, 2008–09

Jurisdiction	Waste generation[2]	Destination				
		Disposal	Recycling	Recycling rate[3]	Energy recovery	Recovery rate[4]
	kg per capita[1]			(%)	kg per capita	(%)
NSW	2,290	940	1,350	59%	10	59%
Vic	1,900	870	1,010	54%	10	54%
Qld	2,100	1,160	930	45%	10	45%
SA	2,050	650	1,340	67%	60	68%
WA[7]	2,670	1,830	830	31%	10	32%
Tas	1,060	890	150	15%	20	16%
ACT	2,260	580	1,650	74%	30	74%
NT[7]	1,690	1,610	70	4%	10	5%
National average[5,6]	2,140	1,030	1,090	51%	20	52%

Notes:

1. Population as at 30 June 2009, sourced from: ABS Release 3101-04 - *Estimated Resident Population, States and Territories (Number)* (June 2009), Australia.

2. Assume waste generation = waste disposal(t) + waste recycling (t)+waste energy recovery(t).

3. Recycling rate = Recycling / waste generation.

4. Recovery rate = (Recycling + Energy Recovery) / Waste generation.

5. These national averages present jurisdiction 'sub-totals' and hence do not include fly ash.

6. All figures have been rounded. Minor discrepancies may occur between the stated totals and the sums of the component items, as totals are calculated using the component item values prior to rounding.

7. WA and NT disposal data has been extrapolated from metropolitan disposal data based on the ratio of the metropolitan to non-metropolitan.

Recovery and recycling rates (net of residuals and contaminants) have been determined as a proportion of total generation. Recovery rates vary from recycling rates as they include energy recovery (related to material recovery) as well as material recovery. Also provided in this table are national average waste generation, recycling and recovery totals, per capita rates and percentage rates (for both recycling and total recovery).

Figure 4-6 presents this information on a per capita basis, with Figure 4-7 profiling waste generation over three reporting periods being 2002–03, 2006–07 and 2008–09.

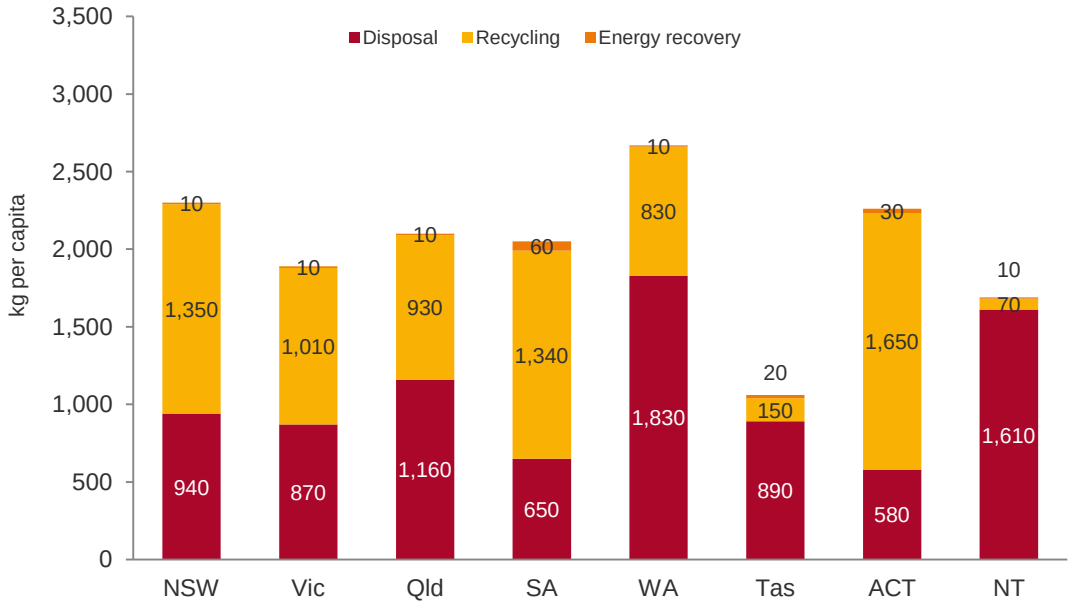

Figure 4-6 Per capita disposal, recycling and energy recovery by jurisdiction 2008–09 subtotals

Figure 4-7 presents national generation, disposal, recycling and energy recovery data for the years 2002-03, 2006–07 and 2008–09. Please note that the data for 2002–03 and 2006–07 has been taken directly from the previous *Waste and Recycling in Australia* reports and has not had the new data compilation method introduced in this report retrospectively applied.

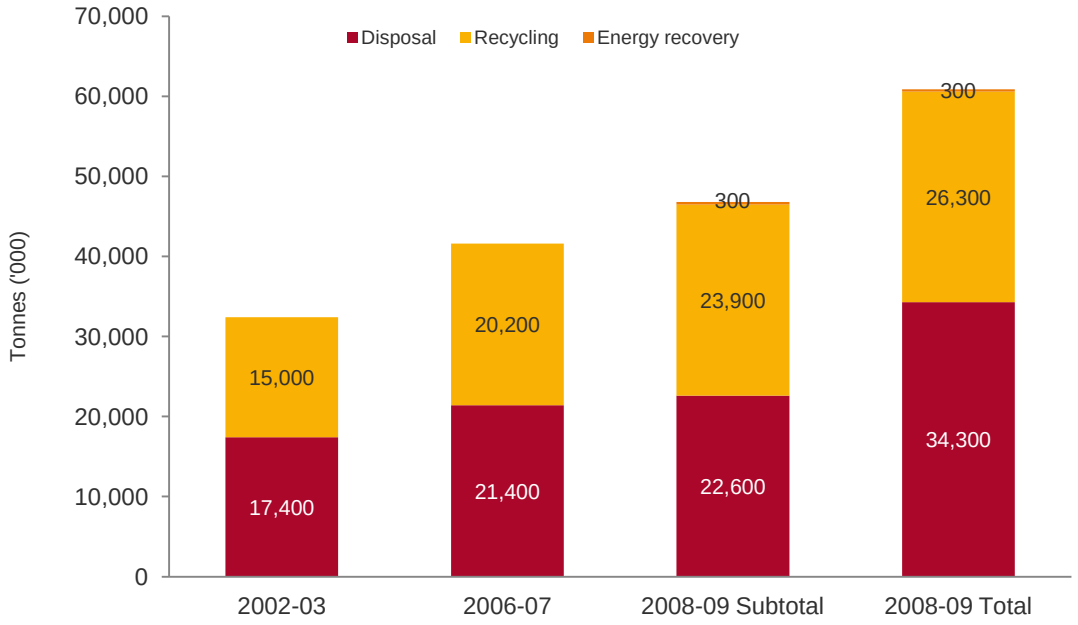

Figure 4-7 Total waste generation, disposal, recycling energy recovery, 2002–03, 2006–07 & 2008–09 subtotals

2002-03 data is as per *Waste and Recycling in Australia*, 2009, which excludes Tasmanian and NT data.

2006-07 data is as per *Waste and Recycling in Australia*, 2009.

2008-09 “Subtotal” excludes fly ash data.

2008-09 “Total” includes fly ash data.

Figure 4-8 and Figure 4-9 present waste generation and disposal to landfill for the period 2002–03 to 2008–09. Data for 2002–03 and 2006–07 has been taken directly from the previous *Waste and Recycling in Australia* reports.

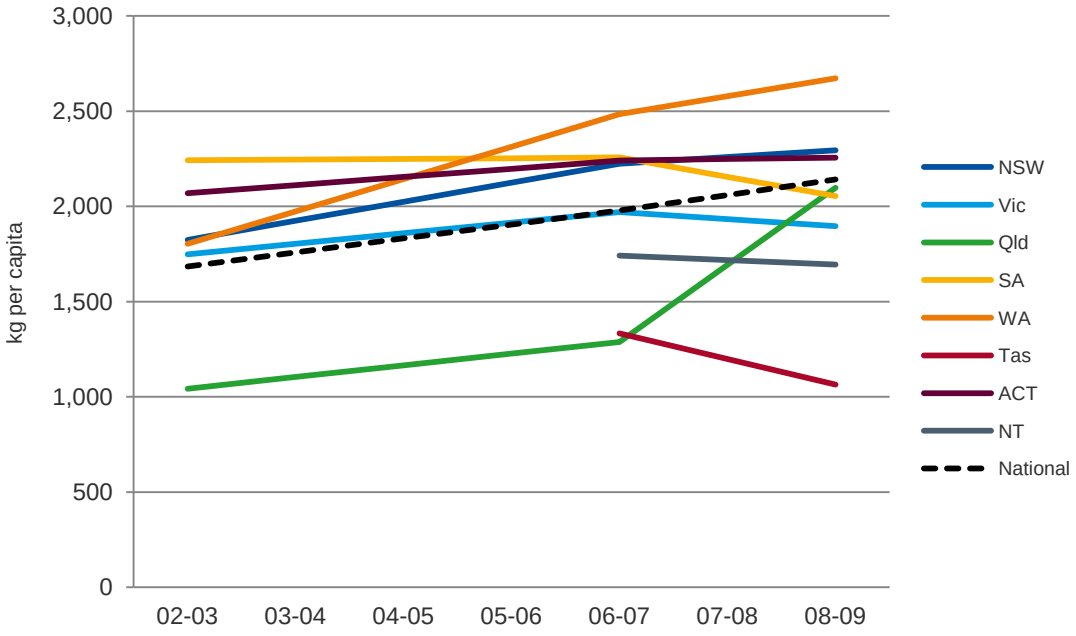

Figure 4-8 Per capita waste generation by jurisdiction, 2002–03 to 2008–09 subtotals

2002–03 data is as per *Waste and Recycling in Australia* 2009, which excludes Tas and NT data.
2006–07 data is as per *Waste and Recycling in Australia* 2009.
2008–09 data excludes fly ash.
Data for other years are estimates based on linear interpolation.

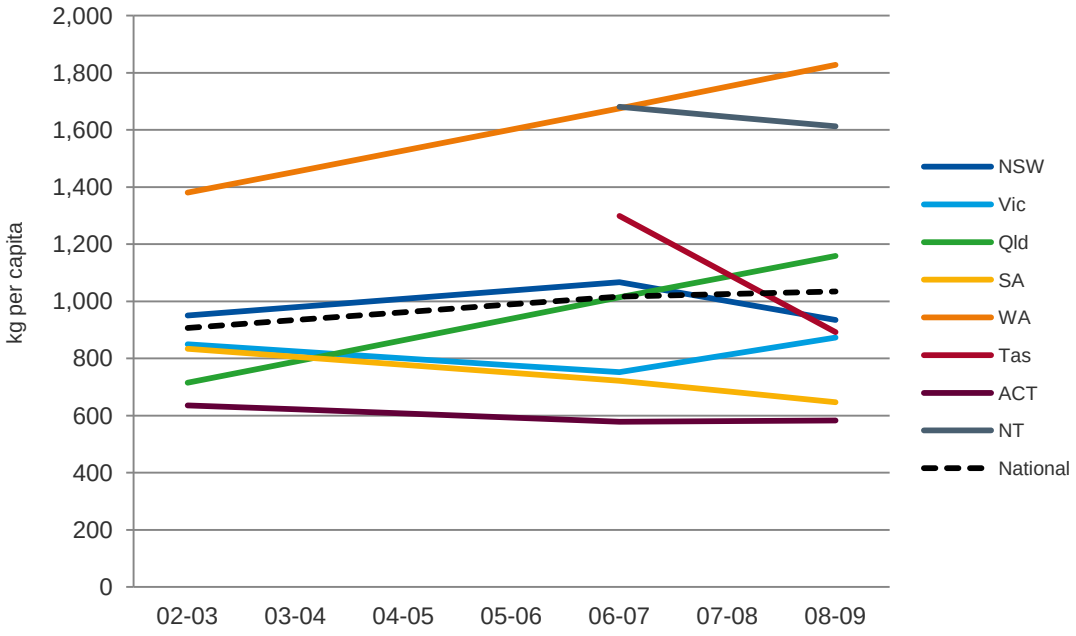

Figure 4-9 Per capita waste disposal by jurisdiction 2002–03 to 2008–09 subtotals

2002-03 data is as per *Waste and Recycling in Australia* 2009, which excludes Tas and NT data.
2006-07 data is as per *Waste and Recycling in Australia* 2009.
2008–09 data excludes fly ash.
Data for other years are estimates based on linear interpolation.

Table 4-8 and Figure 4-10 presents gross state product ($GSP) per tonne of waste generation, by jurisdiction.

Table 4-8 $GSP[14] and waste generation, by jurisdiction, 2008-09

Jurisdiction	Total $GSP	Generation	Per tonne GSP
	$million	tonnes	$GSP/tonne
NSW	395,000	16,290,000	24,200
Vic	288,000	10,293,000	27,900
Qld	251,000	9,245,000	27,100
SA	77,000	3,332,000	23,200
WA	180,000	5,977,000	30,100
Tas	22,000	535,000	41,600
ACT	26,000	792,000	32,500
NT	17,000	381,000	43,700
National	1,255,000	46,844,000	26,800

$GSP and tonnage values have been rounded. Minor discrepancies may occur between the stated totals and the sums of the component items, as totals are calculated using the component item values prior to rounding.

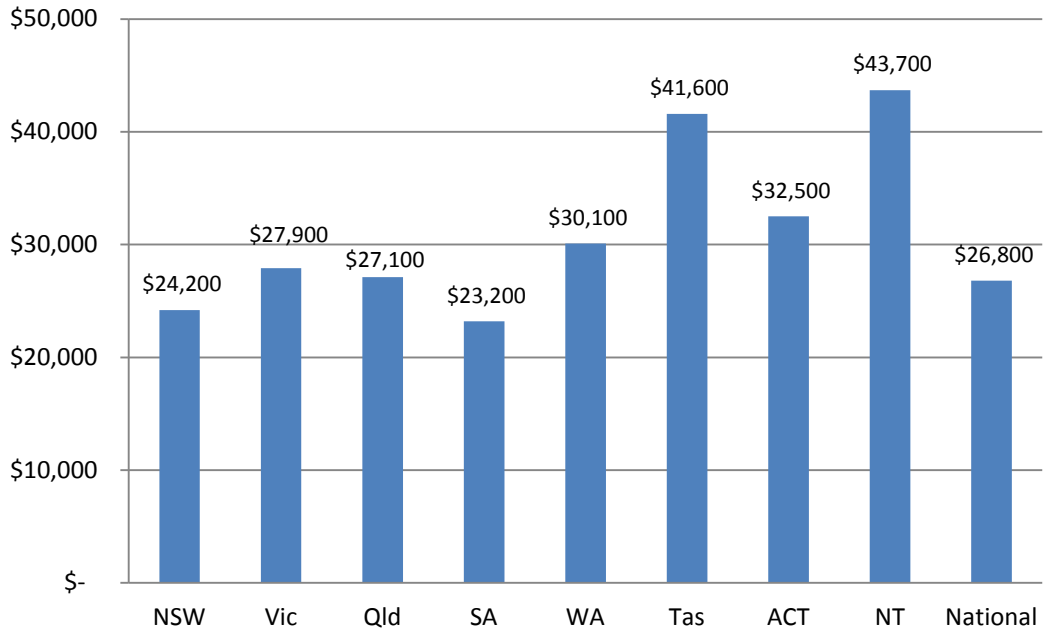

Figure 4-10 $GSP per tonne of waste generated, by jurisdiction, 2008-09

Gross State Product ($GSP) data (year ending 30 June 2009) accessed from ABS Release *5220.0 Australian National Accounts: State Accounts*.

Table 4-9, below, addresses waste generation, recycling and recovery rates by material category. Similarly to Table 4-7 recovery rates vary from the recycling rates as they include energy as well as material recovery. The recovery rate has been determined as a proportion of total generation.

[14] *Australian National Accounts: State Accounts 2008-09* (ABS Cat. no. 5220.0).

The following tables provide a summary of key information for each jurisdiction regarding generation, recovery and disposal by material type, and by source sector. The tables are:

Table 4-9 Waste generation, recycling and recovery rates by material category, 2008–09

Table 4-10 Recycling, by material category and jurisdiction, 2008–09

Table 4-11 Waste generation and disposal, by source sector and jurisdiction, 2008–09

Table 4-12 Recycling and energy recovery, by source sector and jurisdiction, 2008–09.

Table 4-9 Waste generation, recycling and recovery rates by material category, 2008–09

		Waste generation	Destination				
			Disposal	Recycling	Recycling rate	Energy recovery	Recovery rate
Material Category	Material Type	Tonnes	Tonnes	Tonnes	%	Tonnes	%
Masonry materials		16,933,900	6,834,400	10,096,500	60%	3,000	60%
Metals		4,649,100	527,000	4,122,100	89%	0	89%
Organics		11,336,900	7,263,800	3,752,700	34%	320,400	36%
Paper & cardboard		6,362,700	2,467,200	3,895,500	61%	0	61%
Plastics		2,272,600	1,746,100	520,900	23%	5,600	23%
Glass		1,427,700	468,200	959,500	67%	0	67%
Other	Leather & textiles	556,500	491,400	65,100	12%	0	12%
	Tyres & other rubber	310,900	257,800	51,200	17%	2,000	17%
Hazardous	Quarantine[15]	27,000	27,000	0	0%	0	0%
	Contaminated soil	1,418,000	1,241,600	176,400	12%	0	12%
	Industrial waste	992,700	753,900	225,300	23%	13,500	24%
	Asbestos	556,300	556,300	0	0%	0	0%
SUBTOTAL		46,844,300	22,634,600	23,865,200	51%	344,500	52%
Fly ash		14,026,500	11,629,800	2,396,700	17%	0	17%
TOTAL		60,870,900	34,264,400	26,261,900	43%	344,500	44%

All weight values have been rounded. Minor discrepancies may occur between the stated totals and the sums of the component items, as totals are calculated using the component item values prior to rounding.

[15] Tasmania was the only jurisdiction to report quarantine wastes (from ships), most of which are generated by the Australian Antarctic Division. Quarantine wastes from ships and from airports in other jurisdictions are assumed to be counted amongst other hazardous or non-hazardous wastes

Table 4-10 Recycling, by material category and jurisdiction, 2008–09

		NSW	Vic	Qld	SA	WA[1]	Tas	ACT[2]	NT[1]	Total
Material Category	**Material Type**	**tonnes**	**tonnes**	**tonnes**	**tonnes**	**tonnes**	**tonnes**	**tonnes**	**tonnes**	**tonnes**
Masonry materials		4,416,200	2,329,000	1,183,900	1,220,000	723,500	0	223,800	0	10,096,500
Metals		1,608,800	1,099,000	687,800	311,700	375,200	1,200	37,600	800	4,122,100
Organics		1,076,000	563,000	1,069,000	355,800	435,200	25,400	228,400	0	3,752,700
Paper & cardboard		1,691,000	1,132,000	529,100	204,100	231,000	40,300	56,900	11,100	3,895,500
Plastics		299,800	144,000	39,200	13,800	19,400	2,800	1,100	800	520,900
Glass		464,200	185,000	195,000	61,600	26,700	7,100	16,000	4,000	959,500
Other	Leather & textiles	0	4,000	0	3,100	51,400	0	6,700	0	65,100
	Tyres & other rubber	0	35,000	0	10,100	2,000	0	4,000	0	51,200
Hazardous	Quarantine	0	0	0	0	0	0	0	0	0
	Contaminated soil	0	0	176,400	0	0	0	0	0	176,400
	Industrial waste	0	0	221,500	0	0	0	3,800	0	225,300
	Asbestos	0	0	0	0	0	0	0	0	0
SUBTOTAL		9,556,000	5,491,000	4,101,800	2,180,000	1,864,500	76,900	578,300	16,700	23,865,200
Fly ash		705,800	399,200	929,600	223,000	139,200	0	0	0	2,396,700
TOTAL		10,261,800	5,890,100	5,031,400	2,403,000	2,003,600	76,900	578,300	16,700	26,261,900

All figures have been rounded. Minor discrepancies may occur between the stated totals and the sums of the component items, as totals are calculated using the component item values prior to rounding.

1. Full jurisdiction WA and NT data have been extrapolated from metropolitan data based on the ratio of the metropolitan to non-metropolitan populations.
2. 5063 tonnes of cooking oil & fat, and motor oil, have been excluded from the ACT total waste stream, following Recommendation 3 that liquid waste should be excluded from the scope of reporting.

Table 4-11 Waste generation and disposal, by source sector and jurisdiction, 2008–09

Jurisdiction	Population	Waste generation by source sector (tonnes)			Per capita waste generation by source sector (kg)			Disposal to landfill by source sector (tonnes)		
		Municipal	C&I	C&D	Municipal	C&I	C&D	Municipal	C&I	C&D
NSW	7,099,714	4,272,488	5,447,732	6,569,420	602	767	925	2,352,045	2,552,031	1,734,711
Vic	5,427,681	2,799,799	3,121,026	4,371,976	516	575	805	1,783,939	1,185,076	1,766,760
Qld	4,406,823	4,078,955	1,706,678	3,459,598	926	387	785	2,219,405	709,307	2,178,586
SA	1,622,712	754,093	760,899	1,816,799	465	469	1,120	358,448	277,284	414,043
WA	2,236,901	1,557,331	1,512,088	2,907,658	696	676	1,300	1,029,479	991,586	2,066,418
Tas	502,627	245,713	288,881		489	575		200,225	248,245	
ACT	351,182	204,753	587,606		583	1,673		84,458	120,127	
NT	224,848	121,910	258,938		542	1,152		104,102	258,343	
National	**21,872,488**	**14,035,042**	**32,809,301**		**642**	**1,500**		**8,132,100**	**14,502,516**	

All figures have been rounded. Minor discrepancies may occur between the stated totals and the sums of the component items, as totals are calculated using the component item values prior to rounding.

It has not been possible to distinguish between the C&I and C&D waste streams in Tasmania, the ACT and the Northern Territory. In these jurisdictions combined C&I and C&D figures are provided.

Combined C&I and C&D figures are provided for the national summary.

If the combined totals of C&I and C&D for Tasmania, ACT and NT were allocated on a half and half basis, then national C&D generation would be 19 693 163 tonnes (42% of national generation) and C&I generation would be13 116 135 tonnes (28% of national generation). MSW would be the remaining 30% of national waste generation by stream.

Table 4-12 Recycling and energy recovery, by source sector and jurisdiction, 2008–09

Jurisdiction	Population	Recycling by source sector (tonnes)			Energy recovery by source sector (tonnes)			Resource recovery by source sector (tonnes)		
		Municipal	C&I	C&D	Municipal	C&I	C&D	Municipal	C&I	C&D
NSW	7,099,714	1,863,500	2,863,500	4,829,000	56,943	32,201	5,710	1,920,443	2,895,701	4,834,710
Vic	5,427,681	985,587	1,903,194	2,602,181	30,273	32,755	3,035	1,015,860	1,935,949	2,605,216
Qld	4,406,823	1,839,145	983,687	1,278,966	20,406	13,685	2,046	1,859,550	997,372	1,281,012
SA	1,622,712	381,146	477,448	1,321,451	14,499	6,168	81,305	395,645	483,615	1,402,756
WA	2,236,901	511,374	513,493	839,589	16,479	7,010	1,652	527,853	520,503	841,241
Tas	502,627	39,468	37,471		6,020	3,165		45,488	40,636	
ACT	351,182	114,107	464,226		6,188	3,253		120,295	467,478	
NT	224,848	16,675	-		1,133	596		17,808	596	
National	**21,872,488**	**5,751,001**	**18,114,206**		**151,940**	**192,580**		**5,902,942**	**18,306,785**	

All figures have been rounded. Minor discrepancies may occur between the stated totals and the sums of the component items, as totals are calculated using the component item values prior to rounding.

It has not been possible to distinguish between the C&I and C&D waste streams in Tas, the ACT and the NT. In these jurisdictions combined C&I and C&D figures are provided.

Combined C&I and C&D figures are provided for the national summary.

4.2 New South Wales waste disposal and recovery

Table 4-13 provides an overview of the sources of NSW waste disposal and recovery data, upon which the jurisdictional review and national figures for the 2008–09 reporting period are based.

Table 4-13 Sources of NSW waste disposal and recovery data

Data field	Data Sources	Data collation assumptions & calculation methods
Population data	Australian Bureau of Statistics, *ABS Release 3101.04 – Estimated Resident Population, States and Territories (Number),* June 2009, Canberra, Australia.	None.
Disposal to landfill - total quantity	1. Department of Environment and Climate Change NSW, *Waste Avoidance and Resource Recovery Strategy Progress Report, 2010*. 2. Ash Development Association of Australia, *Annual membership survey results*: January - December 2009. Prepared by HBM Group Pty Ltd. 3. Energy recovery estimates - various sources [Clean Energy Council (2010); Golder (2009); Green Energy Markets for Energy Developments (2008)].	1. Total disposal to landfill data for NSW during 2008–09 was primarily based upon data in the DECC (2010) report. 2. Fly ash disposal is based upon the national aggregated value, which is not disaggregated to the state level. NSW fly ash disposal is based upon the jurisdiction's proportion of national installed capacity of coal fired power stations. 3. An estimate of the relatively small quantity of organic materials recovered through energy recovery, was also subtracted from NSW disposal to landfill in 2008–09. See Section 3.1 (Recommendation 6) for a detailed outline of the method applied to determine the total quantity of waste recovered through energy recovery processes.
Recycling - total quantity	1. Department of Environment and Climate Change NSW, *Waste Avoidance and Resource, Recovery Strategy Progress Report, 2010.* 2. Recycled Organics Unit (ROU), *Organics Recycling in Australia: Industry Statistics 2009, revised edition* December 2009. 3. Ash Development Association of Australia, Annual membership survey results: January - December 2009. Prepared by HBM Group Pty Ltd.	1. Total recycling data for NSW during 2008–09 was primarily based upon data in the DECC (2010) report. 2. An exception to point 1 above relates to the quantification of organics recycling, which was sourced from ROU (2009). Primary production wastes relating to Recommendation 10 and 11 (Section 3.5) were excluded from the ROU (2009) data. 3. Fly ash recycling is based upon the national aggregated data. NSW fly ash recycling is based upon the jurisdiction's proportion of national installed capacity of coal fired power stations.
Energy recovery - total quantity	1 Landfill and AWT energy recovery estimates - various sources [Clean Energy Council (2010); Golder (2009); Green Energy Markets for Energy Developments (2008)].	1. The total quantity of waste recovered through energy recovery processes was calculated using the method outlined in detail in Section 3.1 (Recommendation 6). All energy recovery in NSW during 2008–09 was through methane capture at landfills, sewage treatment plants and AWTs. There was no energy recovery from solid waste combustion identified.

Data field	Data Sources	Data collation assumptions & calculation methods
Disposal to landfill - waste stream splits	1. Department of Environment and Climate Change NSW, *Waste Avoidance and Resource Recovery Strategy Progress Report, 2010*.	1. Data for the disposal to landfill by waste stream was calculated using percentage estimates calculated from DECC (2010), and the "Disposal to landfill - total quantity" value previously estimated.
Recycling - waste stream splits	1. Department of Environment and Climate Change NSW, *Waste Avoidance and Resource Recovery Strategy Progress Report, 2010.* 2. Ash Development Association of Australia, Annual membership survey results: January - December 2009. Prepared by HBM Group Pty Ltd.	1. Recycling by waste stream was primarily calculated using waste stream splits data estimated from DECC (2010), and the "Recycling - total quantity" value previously estimated. 2. The exception to point 1 above was fly ash recycling data, which was sourced from ADAA (2009), all this material was categorised as sourced from the C&I sector (see Section 3.3, Recommendation 14, for full details).
Energy recovery - waste stream splits	1. Landfill and AWT energy recovery estimates - various sources [Clean Energy Council (2010); Golder (2009); Green Energy Markets for Energy Developments (2008)].	1. Energy recovery by waste stream was calculated using the data sources identified here and the method outlined in detail in Section 3.1 (Recommendation 6). All energy recovery in NSW during 2008–09 was through methane capture at landfills and AWTs. There was no energy recovery from solid waste combustion identified.
Disposal to landfill - material splits	1. Ash Development Association of Australia, Annual membership survey results: January - December 2009. Prepared by HBM Group Pty Ltd. 2. Various MSW waste audits [APC (2007); DECC (2004); Hyder (2008); Murdoch (1999); WACS and Golder (2005); ZWSA (2007)]. 3. Various C&I waste audits [DEC NSW (2003); Golder and WACS (2007); WACS and Golder (2005); ZWSA (2007)]. 4. Various C&D waste audits [DECC (2007); Golder and WACS (2007); WACS and Golder (2005); ZWSA (2007)].	1. The material splits for disposal to landfill in NSW during 2008–09 were calculated separately for each waste stream (MSW, C&I and C&D), using the waste stream split quantifications determined as previously outlined. The estimated material quantities for each waste stream were calculated using the available audit data (described in points 2 to 4 immediately below), which were then aggregated to calculate disposal to landfill, by material type, for the jurisdiction. The exception to this approach was fly ash disposal data, which was sourced from ADAA (2009). 2. The material splits for the MSW waste stream were estimated based on the available large-scale MSW audit data. The available MSW audit data was weighted against the size of the audits that were undertaken, and then aggregated to generate default (average) material splits in percentage terms. 3. The material splits for the C&I waste stream were estimated based on the available large-scale C&I audit data. The available C&I audit data was weighted against the size of the audits that were undertaken, and then aggregated to generate default (average) material splits in percentage terms. 4. The material splits for the C&D waste stream were estimated based on the available large-scale C&D audit data. The available C&D audit data was weighted against the size of the audits that were undertaken, and then aggregated to generate default (average) material splits in percentage terms.

Data field	Data Sources	Data collation assumptions & calculation methods
Recycling - material splits	1. Department of Environment and Climate Change NSW, *Waste Avoidance and Resource Recovery Strategy Progress Report, 2010*. 2. Various recycling data studies [Hyder (2010b); Hyder (2010c); SV (2010)]. 3. Recycled Organics Unit, *Organics Recycling in Australia: Industry Statistics 2009, revised edition December 2009*. 4. Hyder, *2009 National Plastics Recycling Survey*, prepared for the Plastic and Chemicals Industry Association, December 2009d. 5. Ash Development Association of Australia, Annual membership survey results: January - December 2009. Prepared by HBM Group Pty Ltd.	1. The material splits for recycling in NSW during 2008-09 were calculated separately for the recycled component of each waste stream (MSW, C&I and C&D), using the recycling waste stream split quantifications determinations as previously outlined. The estimated material quantities for each waste stream were then calculated using the available recycling data, by waste stream (described in points 2 to 4 immediately below). These estimates were then aggregated to calculate recycling, by material type, for the jurisdiction. The exceptions to this approach were organics, plastics and fly ash recycling data, which were respectively sourced (in aggregate across MSW, C&I and C&D) from ROU (2009), Hyder (2009d) and ADAA (2009). 2. The recycled material splits for the MSW waste stream were estimated based on data provided in DECC (2010). 3. The recycled material splits for the C&I waste stream were estimated based on recycling quantification studies undertaken in Victoria, SA and WA. The available C&I recycling data was aggregated to generate default (average) material splits in percentage terms, which were then applied to NSW C&I recycling. 4. The recycled material splits for the C&D waste stream were estimated based on recycling quantification studies undertaken in Victoria, SA and WA. The available C&D recycling data was aggregated to generate default (average) material splits in percentage terms, which were then applied to NSW C&I recycling.
Energy recovery - material splits	See sources against "Energy recovery - total quantity" above.	See comments against "Energy recovery - total quantity" .

Figure 4-11 charts NSW waste disposal, recycling and energy recovery for the years 2002-03, 2006–07 and 2008–09. Data for 2002–03 and 2006–07 has been taken directly from the previous *Waste and Recycling in Australia* reports and has not had the new data compilation method introduced in this report retrospectively applied.

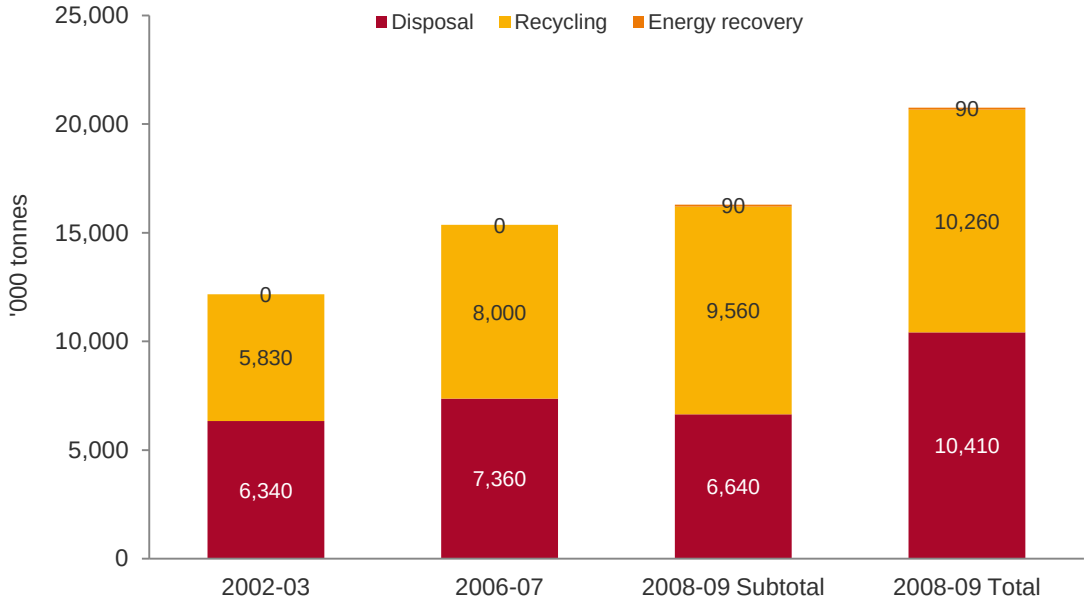

Figure 4-11 NSW total waste generation, disposal, recycling & energy recovery, 2002–03, 2006–07 & 2008–09

2002-03 and 2006-07 data sources are *Waste and Recycling in Australia 2009*.
2008-09 “Subtotal” excludes fly ash data.
2008-09 “Total” include fly ash data.

Table 4-14 details NSW waste generation and disposal to landfill data by material for 2008–09, and compares the associated per capita disposal for NSW with the national average.

Table 4-14 NSW waste generation and disposal data by material, 2008–09

		NSW waste generation	NSW waste disposal		National average disposal
Material Category	Material Type	tonnes	tonnes	kg per capita	kg per capita
Masonry materials		5,374,100	957,900	135	312
Metals		1,785,100	176,400	25	24
Organics		3,471,500	2,300,700	324	332
Paper & cardboard		2,595,500	904,400	127	113
Plastics		957,900	658,100	93	80
Glass		627,400	163,200	23	21
Other	Leather & textiles	174,200	174,200	25	22
	Tyres & other rubber	29,400	29,400	4	12
Hazardous	Quarantine	0	0	0	1
	Contaminated soil	371,600	371,600	52	57
	Industrial waste	467,900	467,900	66	34
	Asbestos	434,900	434,900	61	25
SUBTOTAL		**16,289,600**	**6,638,800**	**935**	**1,035**
Fly ash		4,477,900	3,772,100	531	532
TOTAL		**20,767,500**	**10,410,800**	**1,466**	**1,567**

Tonnage values have been rounded. Minor discrepancies may occur between the stated totals and the sums of the component items, as totals are calculated using the component item values prior to rounding.

Table 4-15 presents the total recycling by material for NSW during 2008–09, in terms of total tonnes, per capita rate and recycling rate. The per capita recycling rate for NSW is also compared to the national average per capita recycling rate.

Table 4-15 NSW recycling by material, 2008–09

		NSW recycling		National average	NSW recycling rate
Material Category	Material Type	tonnes	kg per capita	kg per capita	%
Masonry materials		4,416,200	622	462	82%
Metals		1,608,800	227	189	90%
Organics		1,076,000	152	172	32%
Paper & cardboard		1,691,000	238	178	65%
Plastics		299,800	42	24	31%
Glass		464,200	65	44	74%
Other	Leather & textiles	0	0	3	0%
	Tyres & other rubber	0	0	2	0%
Hazardous	Quarantine	0	0	0	0%
	Contaminated soil	0	0	8	0%
	Industrial waste	0	0	10	0%
	Asbestos	0	0	0	0%
SUBTOTAL		9,556,000	1,346	1,092	59%
Fly ash		705,800	99	110	16%
TOTAL		10,261,800	1,445	1,201	50%

Tonnage values have been rounded. Minor discrepancies may occur between the stated totals and the sums of the component items, as totals are calculated using the component item values prior to rounding.

Table 4-16 details energy recovery by material for NSW. Recovery for the jurisdiction is presented in terms of total tonnes, and the per capita rate. The national average per capita recovery rate is also provided.

Table 4-16 NSW energy recovery by material, 2008–09

		NSW energy recovery		National average
Material Category	Material Type	tonnes	kg per capita	kg per capita
Masonry materials		0	0	0
Metals		0	0	0
Organics		94,900	13	15
Paper & cardboard		0	0	0
Plastics		0	0	0
Glass		0	0	0
Other	Leather & textiles	0	0	0
	Tyres & other rubber	0	0	0
Hazardous	Quarantine	0	0	0
	Contaminated soil	0	0	0
	Industrial waste	0	0	1
	Asbestos	0	0	0
SUBTOTAL		**94,900**	**13**	**16**
Fly ash		0	0	0
TOTAL		**94,900**	**13**	**16**

Tonnage values have been rounded. Minor discrepancies may occur between the stated totals and the sums of the component items, as totals are calculated using the component item values prior to rounding.

Figure 4-12 charts waste disposal, recycling and energy recovery, by source sector for NSW. Energy recovery in NSW was entirely generated by recovered landfill gas, which was assumed to originate from the municipal stream. Due to the high organic content of C&I waste, it is likely that some landfill gas energy recovery was from C&I waste, however this was not able to be quantified. Energy recovery from C&I and C&D waste is associated with Anaerobic Digestion of materials at specific industrial facilities.

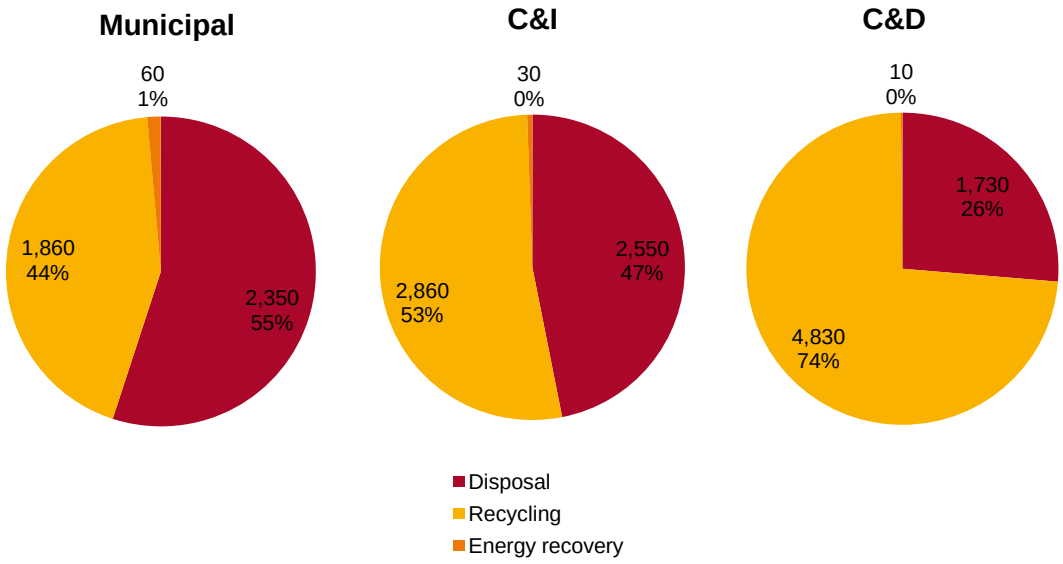

Figure 4-12 NSW waste disposal, recycling and energy recovery, by source sector, 2008–09 subtotals. Units in '000 tonnes.

4.3 Victoria waste disposal and recovery

Victorian data is for the 2008–09 financial year. The waste disposal data in this report does not deduct the 15% landfill cover rebate from the total tonnage, as was the case in the previous *Waste and Recycling in Australia* report. The composition of waste disposal was estimated using the Sustainability Victoria waste model, while the recycling source sector figures were calculated by applying the proportion recycled by each sector reported in the Sustainability Victoria *Victorian Recycling Industries Annual Survey 2008-2009*. Table 4-17 provides an overview of the sources of the Victorian waste disposal and recovery data, upon which the jurisdictional review and national figures for the 2008–09 reporting period are based.

Table 4-17 Sources of Victorian waste disposal and recovery data

Data field	Data Sources	Data collation assumptions & calculation methods
Population data	Australian Bureau of Statistics, *ABS Release 3101.04 – Estimated Resident Population, States and Territories* (Number), June 2009, Canberra, Australia.	None.
Disposal to landfill - total quantity	1. Hyder Consulting (2010), *Victorian waste model*, prepared for Sustainability Victoria, 2010e. 2. Environment Protection Authority (Victoria), *Prescribed industrial waste disposed to landfill - annual trends*. Available from http://www.epa.vic.gov.au/waste/docs/piw-annual-reporting.pdf, accessed March 2011. 3. Ash Development Association of Australia, Annual membership survey results: January - December 2009. Prepared by HBM Group Pty Ltd. 4. Energy recovery estimates - various sources [Clean Energy Council (2010); Golder (2009); Green Energy Markets for Energy Developments (2008)].	1. Total disposal to landfill data for Victoria during 2008–09 was primarily based upon data sourced from Hyder (2010e). This data did not account for the disposal of hazardous wastes and fly ash, or organic materials recovered through energy recovery, see points 2 to 4 for the description of the determination of the disposed quantities of these materials. 2. Data for the disposal to landfill of hazardous wastes (contaminated soil, industrial wastes and asbestos) was sourced from EPA Vic (2011). 3. Data for the disposal to landfill of fly ash is based upon the national aggregated value, which is not disaggregated to the state level. Victoria's fly ash disposal is based upon the jurisdictions proportion of national installed capacity of coal fired power stations. 4. An estimate of the relatively small quantity of organic materials recovered through energy recovery, was also subtracted from Victorian disposal to landfill in 2008–09. See Section 3.1 (Recommendation 6) for a detailed outline of the method applied to determine the total quantity of waste recovered through energy recovery processes.

Data field	Data Sources	Data collation assumptions & calculation methods
Recycling - total quantity	1. Sustainability Victoria, *Victorian Recycling Industries Annual Survey 2008-09*, June 2010. 2. Recycled Organics Unit, *Organics Recycling in Australia: Industry Statistics 2009*, revised edition December 2009. 3. Blue Circle Southern Cement (Boral), Updated waste-based fuel data, personal communication, 15 September 2010. 4. Ash Development Association of Australia, Annual membership survey results: January - December 2009. Prepared by HBM Group Pty Ltd.	1. The total recycling data for Victoria during 2008–09 was primarily based upon data in the SV (2010) report. Clean fill quantities were a significant exclusion from the SV reported data. 2. An exception to point 1 above relates to the quantification of organics recycling, which was sourced from ROU (2009), with an additional estimate for timber recovered from the C&I and C&D waste streams (ROU 2009 and SV 2010). Primary production wastes relating to Recommendation 10 and 11 (Section 3.5) were excluded from the ROU (2009) data. 3. An exception to point 1 above relates to the quantification of 'Tyres & other rubber', with a relatively small quantity of this material (see Table 4-18) shifted from recycling to energy recovery, as it was identified as being used as a fuel source for cement kilns (Blue Circle 2010). 4. Fly ash recycling is based upon the national aggregated data (ADAA 2009). Victorian fly ash recycling is based upon the jurisdictions proportion of national installed capacity of coal fired power stations.
Energy recovery - total quantity	1. Landfill energy recovery estimates - various sources [Clean Energy Council (2010); Golder (2009); Green Energy Markets for Energy Developments (2008)]. 2. Blue Circle Southern Cement (Boral), Updated waste-based fuel data, personal communication, 15 September 2010. 3. Cement Industry Federation, *Sustainability Report 2009*, Australia Cement Industry report, 2009.	1. Total energy recovery was calculated using the sources and method outlined in detail in Section 3.1 (Recommendation 6). The majority of energy recovery in Victoria during 2008–09 was through methane capture at landfills and sewage treatment plants, however a reasonable quantity of solid waste combustion was also identified (Blue Circle 2010 and CIF 2009), see Table 4-18 for the quantities of energy recovery.
Disposal to landfill - waste stream splits	1. Hyder Consulting (2010), *Victorian waste model*, prepared for Sustainability Victoria, 2010e. 2. Environment Protection Authority (Victoria), *Prescribed industrial waste disposed to landfill - annual trends*. Available from http://www.epa.vic.gov.au/waste/docs/piw-annual-reporting.pdf, accessed March 2011.	1. Data on the disposal to landfill by waste stream for Victoria in 2008–09 were sourced from Hyder (2010) and EPA Vic (2011).
Recycling - waste stream splits	1. Sustainability Victoria, *Victorian Recycling Industries Annual Survey 2008-09*, June 2010. 2. Ash Development Association of Australia, Annual membership survey results: January - December 2009. Prepared by HBM Group Pty Ltd.	1. Recycling by waste stream was primarily calculated using waste stream splits data sourced from SV (2010), and the "Recycling - total quantity" value previously estimated. 2. The exception to point 1 above was fly ash recycling data, which was sourced from ADAA (2009). All this material was categorised as sourced from the C&I sector (see Section 3.3, Recommendation 14, for full details).

Data field	Data Sources	Data collation assumptions & calculation methods
Energy recovery - waste stream splits	1. Landfill energy recovery estimates - various sources [Clean Energy Council (2010); Golder (2009); Green Energy Markets for Energy Developments (2008)]. 2. Blue Circle Southern Cement (Boral), Updated waste-based fuel data, personal communication, 15 September 2010. 3. Cement Industry Federation, *Sustainability Report 2009*, Australia Cement Industry report, 2009.	1. Energy recovery by waste stream was calculated using the data sources identified here and the method outlined in detail in Section 3.1 (Recommendation 6).
Disposal to landfill - material splits	1. Hyder Consulting (2010), Victorian waste model, prepared for Sustainability Victoria, 2010e. 2. Environment Protection Authority (Victoria), *Prescribed industrial waste disposed to landfill - annual trends*. Available from http://www.epa.vic.gov.au/waste/docs/piw-annual-reporting.pdf, accessed March 2011. 3. Ash Development Association of Australia, Annual membership survey results: January - December 2009. Prepared by HBM Group Pty Ltd. 4. See "Energy recovery - total quantity" sources above.	1. The material splits for disposal to landfill in Victoria during 2008–09 were primarily based upon data sourced from Hyder (2010e). This did not account for the disposal of hazardous wastes and fly ash, or organic materials recovered through energy recovery and subtracted from organics disposal. See points 2 to 4 for the description of the determination of the disposed quantities of these materials. 2. Material specific data for the disposal to landfill of hazardous wastes (contaminated soil, industrial wastes and asbestos) was sourced from EPA Vic (2011). 3. Data for the disposal to landfill of fly ash is based upon the national aggregated value (ADAA 2009), which is not disaggregated to the state level. Victoria's fly ash disposal is based upon the jurisdictions proportion of national installed capacity of coal fired power stations. 4. An estimate of the relatively small quantity of organic materials 'recovered' through energy recovery, was also subtracted from Victorian disposal to landfill of organics.
Recycling - material splits	See sources against "Recycling - total quantity" above.	See comments against "Recycling - total quantity" above.
Energy recovery - material splits	See sources against "Energy recovery - total quantity" above.	See comments against "Energy recovery - total quantity" above.

Figure 4-13 charts Victorian waste disposal, recycling energy recovery for the years 2002–03, 2006–07 and 2008–09. Data for 2002–03 and 2006–07 has been taken directly from the previous *Waste and Recycling in Australia* reports and has not had the new data compilation method introduced in this report retrospectively applied.

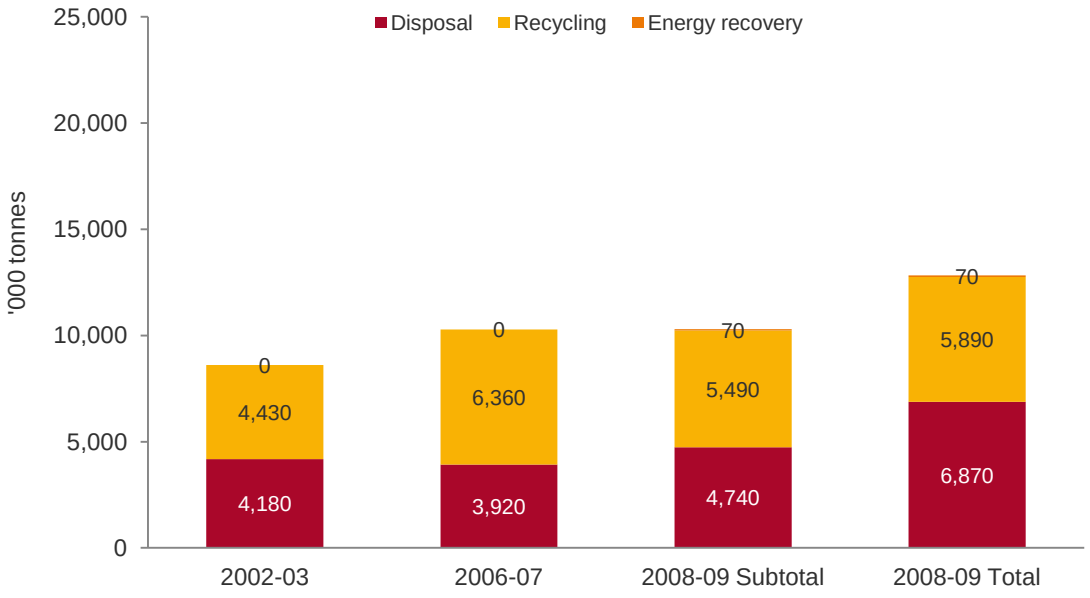

Figure 4-13 Victorian total waste generation, disposal, recycling and energy recovery, 2002–03, 2006–07 & 2008–09

2002–03 and 2006–07 data sources are *Waste and Recycling in Australia 2009*.
2008–09 "Subtotal" excludes fly ash data.
2008–09 "Total" include fly ash data.

Table 4-18 details Victorian waste generation and disposal data by material for 2008–09, and compares the associated per capita disposal (kg) for Victoria with the national average for all jurisdictions.

Table 4-18 Victorian waste generation and disposal data by material, 2008–09

		Vic waste generation	Vic waste disposal		National average disposal
Material Category	Material Type	tonnes	tonnes	kg per capita	kg per capita
Masonry materials		4,173,900	1,841,900	339	312
Metals		1,184,800	85,800	16	24
Organics		1,951,600	1,341,100	247	332
Paper & cardboard		1,566,300	434,300	80	113
Plastics		505,100	361,100	67	80
Glass		263,700	78,700	14	21
Other	Leather & textiles	143,100	139,100	26	22
	Tyres & other rubber	156,100	119,100	22	12
Hazardous	Quarantine	0	0	0	1
	Contaminated soil	246,400	246,400	45	57
	Industrial waste	73,200	59,700	11	34
	Asbestos	28,600	28,600	5	25
SUBTOTAL		**10,292,800**	**4,735,800**	**873**	**1,035**
Fly ash		2,532,400	2,133,200	393	532
TOTAL		**12,825,200**	**6,869,000**	**1,266**	**1,567**

Tonnage values have been rounded. Minor discrepancies may occur between the stated totals and the sums of the component items, as totals are calculated using the component item values prior to rounding.

Table 4-19 presents the total recycling by material for Victoria during 2008–09, in terms of total tonnes, per capita rate and recycling rate. The per capita recycling rate for Victoria is also compared to the national average per capita recycling rate.

Table 4-19 Victorian recycling by material, 2008–09

		Vic recycling		National average	Vic recycling rate
Material Category	Material Type	tonnes	kg per capita	kg per capita	%
Masonry materials		2,329,000	429	462	56%
Metals		1,099,000	202	188	93%
Organics		563,000	104	172	30%
Paper & cardboard		1,132,000	209	178	72%
Plastics		144,000	27	24	29%
Glass		185,000	34	44	70%
Other	Leather & textiles	4,000	1	3	3%
	Tyres & other rubber	35,000	6	2	23%
Hazardous	Quarantine	0	0	0	0%
	Contaminated soil	0	0	8	0%
	Industrial waste	0	0	10	0%
	Asbestos	0	0	0	0%
SUBTOTAL		**5,491,000**	**1,012**	**1,091**	**54%**
Fly ash		399,200	74	110	16%
TOTAL		**5,890,100**	**1,085**	**1,201**	**46%**

Tonnage values have been rounded. Minor discrepancies may occur between the stated totals and the sums of the component items, as totals are calculated using the component item values prior to rounding.

Table 4-20 details energy recovery by material type for Victoria. Recovery for the jurisdiction is presented in terms of total tonnes and the per capita rate. The national average per capita recovery rate is also provided.

Table 4-20 Victorian energy recovery by material, 2008–09

		Vic energy recovery		National average
Material Category	Material Type	tonnes	kg per capita	kg per capita
Masonry materials		3,000	1	0
Metals		0	0	0
Organics		47,600	9	15
Paper & cardboard		0	0	0
Plastics		0	0	0
Glass		0	0	0
Other	Leather & textiles	0	0	0
	Tyres & other rubber	2,000	0	0
Hazardous	Quarantine	0	0	0
	Contaminated soil	0	0	0
	Industrial waste	13,500	2	1
	Asbestos	0	0	0
SUBTOTAL		66,100	12	16
Fly ash		0	0	0
TOTAL		66,100	12	16

Tonnage values have been rounded. Minor discrepancies may occur between the stated totals and the sums of the component items, as totals are calculated using the component item values prior to rounding.

Figure 4-14 charts waste disposal, recycling and energy recovery, by source sector for Victoria.

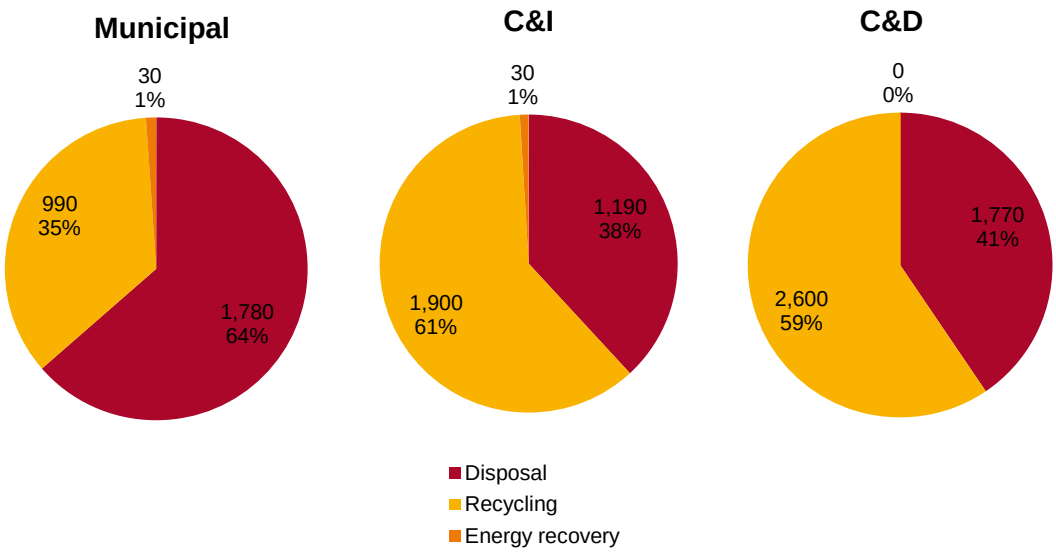

Figure 4-14 Victorian waste disposal, recycling and energy recovery, by source sector 2008–09 subtotals. Units in '000 tonnes.

4.4 Queensland waste disposal and recovery

Waste and recycling data for Queensland for the 2008–09 financial year was provided to Hyder via personal communication on March 30, 2011. Table 4-21 provides a more detailed overview of the sources of Queensland's waste disposal and recovery data, upon which the jurisdictional review and national figures for the 2008–09 reporting period are based.

Table 4-21 Sources of Queensland waste disposal and recovery data

Data field	Data Sources	Data collation assumptions & calculation methods
Population data	Australian Bureau of Statistics, ABS Release 3101.04 – *Estimated Resident Population, States and Territories (Number)*, June 2009, Canberra, Australia.	None.
Disposal to landfill - total quantity	1. Department of Environment and Resource Management (Qld), Waste to landfill and recycling by material type, personal communication, 30 March 2011. 2. Department of Environment and Resource Management (Qld), *The State of Waste and Recycling in Queensland – Technical Report*, December 2009. 3. Energy recovery estimates - various sources [Clean Energy Council (2010); Golder (2009); Green Energy Markets for Energy Developments (2008)].	1. Total disposal to landfill data for Queensland during 2008–09 was primarily based upon data sourced from DERM (2011). Clean fill quantities were a significant exclusion from the Queensland reported data. 2. An estimate of the relatively small quantity of organic materials recovered through energy recovery was also subtracted from Queensland disposal to landfill in 2008–09. See Section 3.1 (Recommendation 6) for a detailed outline of the method applied to determine the total quantity of waste recovered through energy recovery processes.
Recycling - total quantity	1. Department of Environment and Resource Management (Qld), Waste to landfill and recycling by material type, personal communication, 30 March 2011. 2. Department of Environment and Resource Management (Qld), *The State of Waste and Recycling in Queensland – Technical Report*, December 2009. 3. Recycled Organics Unit, Organics Recycling in Australia: Industry Statistics 2009, revised edition December 2009.	1. Total recycling data for Queensland during 2008–09 was primarily based upon data sourced from DERM (2011 and 2009). 2. The exception to point 1 above relates to the quantification of organics recycling, which was sourced from ROU (2009). Primary production wastes relating to Recommendation 10 and 11 (Section 3.5) were excluded from the ROU (2009) data.
Energy recovery - total quantity	1. Landfill and AWT energy recovery estimates - various sources [Clean Energy Council (2010); Golder (2009); Green Energy Markets for Energy Developments (2008)].	1. The total quantity of waste recovered through energy recovery processes was calculated using the method outlined in detail in Section 3.1 (Recommendation 6). All energy recovery in Queensland during 2008–09 was all through methane capture at landfills, sewage treatment plants and one bioreactor, there was no energy recovery from solid waste combustion identified.
Disposal to landfill - waste stream splits	1. National Greenhouse and Energy Reporting System (Measurement) *Technical Guidelines 2010*	1. Disposal to landfill by waste stream data was primarily based on the percentage values outlined in Section 5.10 of the NGER Technical Guidelines 2010, which for Queensland are 43% MSW; 14% C&I; and 43% C&D .

Data field	Data Sources	Data collation assumptions & calculation methods
Recycling - waste stream splits	1. Department of Environment and Resource Management (Qld), Waste to landfill and recycling by material type, personal communication, 30 March 2011. 2. Recycled Organics Unit, *Organics Recycling in Australia: Industry Statistics 2009*, revised edition December 2009. 3. Sustainability Victoria, *Victorian Recycling Industries Annual Survey* 2008–09, June 2010.	1. Recycling by waste stream was based primarily upon DERM (2011) provided material categorised data, which provided a degree of waste stream categorisation. Material types that were not categorised by waste stream were allocated to probable waste sectors and then the waste stream totals were aggregated. 2. An exception to point 1 above was that organics data (ROU 2009) was allocated to waste streams with a waste stream split assumed the same as for Victoria. 3. A further exception to point 1 above was that metals data (DERM 2011) was allocated to waste streams with a split assumed to be similar to Victoria.
Energy recovery - waste stream splits	1. Landfill and AWT energy recovery estimates - various sources [Clean Energy Council (2010); Golder (2009); Green Energy Markets for Energy Developments (2008)].	1. Energy recovery by waste stream was calculated using the data sources identified here and the method outlined in detail in Section 3.1 (Recommendation 6). All energy recovery in Queensland during 2008–09 was all through methane capture at landfills and AWTs, there was no energy recovery from solid waste combustion identified.
Disposal to landfill - material splits	1. Department of Environment and Resource Management (Qld), Waste to landfill and recycling by material type, personal communication, 30 March 2011. 2. Various MSW waste audits [APC (2007); DECC (2004); Hyder (2008); Murdoch (1999); WACS and Golder (2005); ZWSA (2007)]. 3. Various C&I waste audits [DEC NSW (2003); Golder and WACS (2007); WACS and Golder (2005); ZWSA (2007)]. 4. See "Energy recovery - total quantity" sources above.	1. The material splits for disposal to landfill in Queensland during 2008–09 were based primarily upon DERM (2011) provided material categorised data, which provided a degree of material categorisation. C&D data was provided separately. Two aggregated material categories (relating to MSW and C&I only) were allocated to specific material categories using the available audit data (described in points 2 and 3 immediately below), which were then aggregated to calculate disposal to landfill, by material type, for the jurisdiction. 2. The material splits for the MSW waste stream were estimated based on the available large-scale MSW audit data. The available MSW audit data was weighted against the size of the audits that were undertaken, and then aggregated to generate default (average) material splits in percentage terms. 3. The material splits for the C&I waste stream were estimated based on the available large-scale C&I audit data. The available C&I audit data was weighted against the size of the audits that were undertaken, and then aggregated to generate default (average) material splits in percentage terms. 4. An estimate of the relatively small quantity of organic materials 'recovered' through energy recovery, was also subtracted from Queensland disposal to landfill of organics.
Recycling - material splits	1. Department of Environment and Resource Management (Qld), Waste to landfill and recycling by material type, personal communication, 30 March 2011. 2. Recycled Organics Unit, *Organics Recycling in Australia: Industry Statistics 2009*, revised edition December 2009.	1. The material splits for recycling in Queensland during 2008–09 were based primarily upon DERM (2011) provided material categorised data, which provided a significant degree of recycled material categorisation. Two aggregated material categories (mostly relating to C&I) were allocated proportionally to specific material categories using the available data, which were then aggregated to calculate recycling, by material type, for the jurisdiction. 2. The exception to point 1 above relates to the quantification of organics recycling, which was sourced from ROU (2009). Primary production wastes relating to Recommendation 10 and 11 (Section 3.5) were excluded from the ROU (2009) data.
Energy recovery - material splits	See sources against "Energy recovery - total quantity" above.	See comments against "Energy recovery - total quantity" above.

Table 4-9 charts Queensland's waste disposal, recycling and energy recovery for the years 2002–03, 2006–07 and 2008–09. Data for 2002–03 and 2006–07 has been taken directly from the previous *Waste and Recycling in Australia* reports and has not had the new data compilation method introduced in this report retrospectively applied.

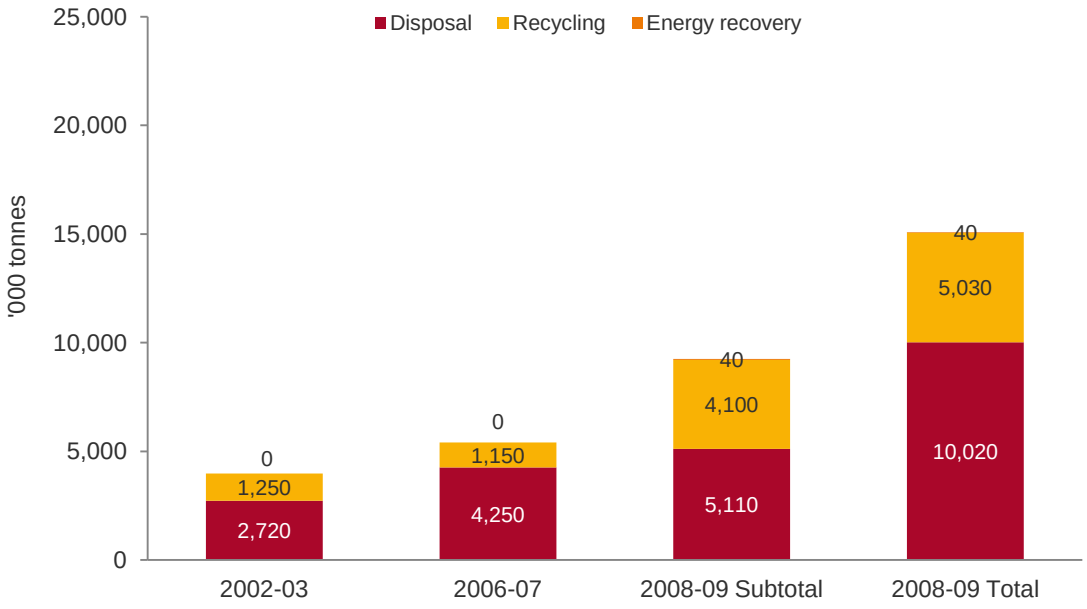

Figure 4-15 Queensland total waste generation, disposal, recycling and energy recovery, 2002–03, 2006–07 & 2008–09

2002–03 and 2006–07 data sources are *Waste and Recycling in Australia 2009*.
2008–09 "Subtotal" excludes fly ash data.
2008–09 "Total" include fly ash data.

Table 4-22 details Queensland's waste generation and disposal data by material for 2008–09, and compares the associated per capita disposal (kg) for Queensland with the national average for all jurisdictions.

Table 4-22 Queensland generation and disposal data by material, 2008–09

		Qld waste generation	Qld waste disposal		National average disposal
Material Category	Material Type	tonnes	tonnes	kg per capita	kg per capita
Masonry materials		2,617,500	1,433,700	325	312
Metals		788,700	100,900	23	24
Organics		2,861,100	1,756,000	398	332
Paper & cardboard		978,500	449,400	102	113
Plastics		389,700	350,500	80	80
Glass		294,400	99,400	23	21
Other	Leather & textiles	95,500	95,500	22	22
	Tyres & other rubber	62,000	62,000	14	12
Hazardous	Quarantine	0	0	0	1
	Contaminated soil	712,700	536,300	122	57
	Industrial waste	400,900	179,400	41	34
	Asbestos	44,200	44,200	10	25
SUBTOTAL		**9,245,200**	**5,107,300**	**1,159**	**1,035**
Fly ash		5,843,700	4,914,100	1,115	532
TOTAL		**15,088,900**	**10,021,400**	**2,274**	**1,567**

Tonnage values have been rounded. Minor discrepancies may occur between the stated totals and the sums of the component items, as totals are calculated using the component item values prior to rounding.

Table 4-23 presents the total recycling by material for Queensland during 2008–09, in terms of total tonnes, per capita rate and recycling rate. The per capita recycling rate for Queensland is also compared to the national average per capita recycling rate.

Table 4-23 Queensland recycling by material, 2008–09

		Qld recycling		National average	Qld recycling rate
Material Category	Material Type	tonnes	kg per capita	kg per capita	%
Masonry materials		1,183,900	269	462	45%
Metals		687,800	156	188	87%
Organics		1,069,000	243	172	38%
Paper & cardboard		529,100	120	178	54%
Plastics		39,200	9	24	10%
Other	Glass	195,000	44	44	66%
	Leather & textiles	0	0	3	0%
	Tyres & other rubber	0	0	2	0%
Hazardous	Quarantine	0	0	0	0%
	Contaminated soil	176,400	40	8	25%
	Industrial waste	221,500	50	10	55%
	Asbestos	0	0	0	0%
SUBTOTAL		**4,101,800**	**931**	**1,091**	**45%**
Fly ash		929,600	211	110	16%
TOTAL		**5,031,400**	**1,142**	**1,201**	**33%**

Tonnage values have been rounded. Minor discrepancies may occur between the stated totals and the sums of the component items, as totals are calculated using the component item values prior to rounding.

Table 4-24 details energy recovery by material type for Queensland. Recovery for the jurisdiction is presented in terms of total tonnes, and the per capita rate. The national average per capita recovery rate is also provided.

Table 4-24 Queensland energy recovery by material, 2008–09

		Qld energy recovery		National average
Material Category	Material Type	tonnes	kg per capita	kg per capita
Masonry materials		0	0	0
Metals		0	0	0
Organics		36,100	8	15
Paper & cardboard		0	0	0
Plastics		0	0	0
Other	Glass	0	0	0
	Leather & textiles	0	0	0
	Tyres & other rubber	0	0	0
Hazardous	Quarantine	0	0	0
	Contaminated soil	0	0	0
	Industrial waste	0	0	1
	Asbestos	0	0	0
SUBTOTAL		36,100	8	16
Fly ash		0	0	0
TOTAL		36,100	8	16

Tonnage values have been rounded. Minor discrepancies may occur between the stated totals and the sums of the component items, as totals are calculated using the component item values prior to rounding.

Figure 4-16 charts waste disposal, recycling and energy recovery, by source sector for Queensland.

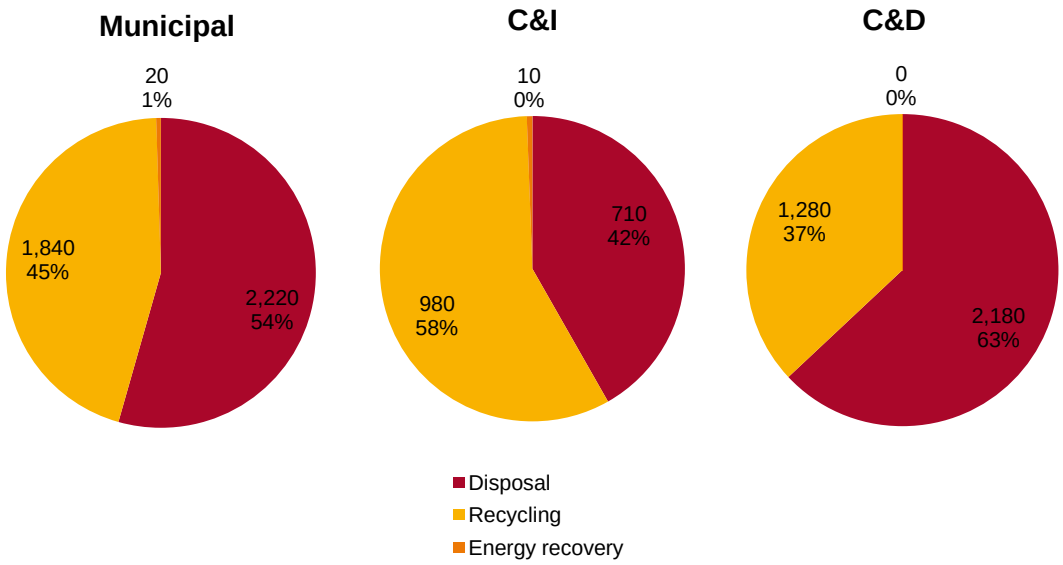

Figure 4-16 Queensland waste disposal, recycling and energy recovery, by source sector 2008–09 subtotals. Units in '000 tonnes.

4.5 South Australia waste disposal and recovery

South Australian disposal, recycling and energy recovery data is for the 2008-09 financial year. The waste disposal composition was estimated by applying compositions derived from disposal-based waste audits to landfill data published in the Hyder Consulting *Recycling Activity in South Australia* report.

Table 4-25 provides an overview of the sources of the South Australian waste disposal and recovery data, upon which the jurisdictional review and national figures for the 2008–09 reporting period are based.

Table 4-25 Sources of South Australian waste disposal and recovery data

Data field	Data Sources	Data collation assumptions & calculation methods
Population data	Australian Bureau of Statistics, ABS Release 3101.04 – Estimated Resident Population, States and Territories (Number), June 2009, Canberra, Australia.	None.
Disposal to landfill - total quantity	1. Hyder Consulting, *Recycling activity in South Australia 2008–09*, prepared for Zero Waste South Australia, 20 May 2010b. 2. Energy recovery estimates - various sources [Clean Energy Council (2010); Golder (2009); Green Energy Markets for Energy Developments (2008)]. 3. Ash Development Association of Australia, Annual membership survey results: January - December 2009. Prepared by HBM Group Pty Ltd.	1. Total disposal to landfill data for South Australia during 2008–09 was primarily based upon data sourced from Hyder (2010b). This data did not account for the disposal of fly ash, or the recovery of all organic materials recovered through energy recovery, see points 2 and 3 for the description of the determination of the disposed quantities of these materials. 2. Data for the disposal to landfill of fly ash is based upon South Australia's estimated generation as based upon its proportion of national installed capacity of coal fired power stations, and the known national total generation (ADAA 2009). From this estimated SA generation is subtracted the known recovery of fly ash in SA (Hyder 2010b) to determine disposal. 3. An estimate of the relatively small quantity of organic materials recovered through energy recovery was also subtracted from SA disposal to landfill in 2008–09. See Section 3.1 (Recommendation 6) for a detailed outline of the method applied to determine the total quantity of waste recovered through energy recovery processes.
Recycling - total quantity	1. Hyder Consulting, *Recycling activity in South Australia 2008–09*, prepared for Zero Waste South Australia, 20 May 2010b. 2. Recycled Organics Unit, *Organics Recycling in Australia: Industry Statistics 2009*, revised edition December 2009.	1. Total recycling data for South Australia during 2008–09 was primarily based upon data sourced from Hyder (2010b). 2. The exception to point 1 above relates to the quantification of organics recycling, which was sourced from ROU (2009). Primary production wastes relating to Recommendation 10 and 11 (Section 3.5) were excluded from the ROU (2009) data.
Energy recovery - total quantity	1. Landfill energy recovery estimates - various sources [Clean Energy Council (2010); Golder (2009); Green Energy Markets for Energy Developments (2008)]. 2. Cement Industry Federation, Sustainability Report 2009, Australia Cement Industry report, 2009. 3. Hyder Consulting, *Recycling activity in South Australia 2008–09*, prepared for Zero Waste South Australia, 20 May 2010b.	1. Total energy recovery was calculated using the sources and method outlined in detail in Section 3.1 (Recommendation 6). The majority of energy recovery in South Australia during 2008–09 was through solid waste combustion (primarily waste timber) in cement kilns (CIF 2009 and Hyder 2010b). However, a reasonable quantity methane capture at landfills also occurred.

Data field	Data Sources	Data collation assumptions & calculation methods
Disposal to landfill - waste stream splits	1. Hyder Consulting, *Recycling activity in South Australia 2008–09*, prepared for Zero Waste South Australia, 20 May 2010b. 2. Ash Development Association of Australia, Annual membership survey results: January - December 2009. Prepared by HBM Group Pty Ltd.	1. Disposal to landfill by waste stream data for South Australia during 2008–09 was primarily based upon data sourced from Hyder (2010b). This data did not account for the disposal of fly ash, which was allocated to the C&I sector.
Recycling - waste stream splits	1. Hyder Consulting, *Recycling activity in South Australia 2008–09*, prepared for Zero Waste South Australia, 20 May 2010b. 2. Recycled Organics Unit, *Organics Recycling in Australia: Industry Statistics 2009*, revised edition December 2009.	1. Recycling by waste stream data for South Australia during 2008–09 was primarily based upon data sourced from Hyder (2010b). 2. The exception to point 1 above relates to the quantification of organics recycling, which was sourced from ROU (2009). Primary production wastes relating to Recommendation 10 and 11 (Section 3.5) were excluded from the ROU (2009) data.
Energy recovery - waste stream splits	1. Landfill energy recovery estimates - various sources [Clean Energy Council (2010); Golder (2009); Green Energy Markets for Energy Developments (2008)]. 2. Cement Industry Federation, *Sustainability Report 2009*, Australia Cement Industry report, 2009. 3. Hyder Consulting, *Recycling activity in South Australia 2008–09*, prepared for Zero Waste South Australia, 20/5/10b.	1. Energy recovery by waste stream was calculated using the data sources identified here and the method outlined in detail in Section 3.1 (Recommendation 6).
Disposal to landfill - material splits	1. Hyder Consulting, *Recycling activity in South Australia 2008–09*, prepared for Zero Waste South Australia, 20 May 2010b. 2. Ash Development Association of Australia, Annual membership survey results: January - December 2009. Prepared by HBM Group Pty Ltd. 3. Various MSW waste audits [APC (2007); DECC (2004); Hyder (2008); Murdoch (1999); WACS and Golder (2005); ZWSA (2007)]. 4. Various C&I waste audits [DEC NSW (2003); Golder and WACS (2007); WACS and Golder (2005); ZWSA (2007)]. 5. Various C&D waste audits [DECC (2007); Golder and WACS (2007); WACS and Golder (2005); ZWSA (2007)].	1. The material splits for disposal to landfill in SA during 2008–09 were calculated separately for each waste stream (MSW, C&I and C&D), using the waste stream split quantifications determined as previously outlined. The estimated material quantities for each waste stream were calculated using the available audit data (described in points 2 to 4 immediately below), which were then aggregated to calculate disposal to landfill, by material type, for the jurisdiction. 2. The material splits for the MSW waste stream were estimated based on the available large-scale MSW audit data. The available MSW audit data was weighted against the size of the audits that were undertaken, and then aggregated to generate default (average) material splits in percentage terms. 3. The material splits for the C&I waste stream were estimated based on the available large-scale C&I audit data. The available C&I audit data was weighted against the size of the audits that were undertaken, and then aggregated to generate default (average) material splits in percentage terms. 4. The material splits for the C&D waste stream were estimated based on the available large-scale C&D audit data. The available C&D audit data was weighted against the size of the audits that were undertaken, and then aggregated to generate default (average) material splits in percentage terms.
Recycling - material splits	1. Hyder Consulting, *Recycling activity in South Australia 2008–09*, prepared for Zero Waste South Australia, 20 May 2010b. 2. Recycled Organics Unit, *Organics Recycling in Australia: Industry Statistics 2009*, revised edition December 2009.	1. Recycling data by material type for South Australia during 2008–09 was primarily based upon data sourced from Hyder (2010b). 2. The exception to point 1 above relates to the quantification of organics recycling, which was sourced from ROU (2009). Primary production wastes relating to Recommendation 10 and 11 (Section 3.5) were excluded from the ROU (2009) data.
Energy recovery - material splits	See sources against "Energy recovery - total quantity" above.	See comments against "Energy recovery - total quantity" above.

Figure 4-17 charts South Australia's waste disposal, recycling and energy recovery for the years 2002–03, 2006–07 and 2008–09. Data for 2002–03 and 2006–07 has been taken directly from the previous *Waste and Recycling in Australia* reports and has not had the new data compilation method introduced in this report retrospectively applied.

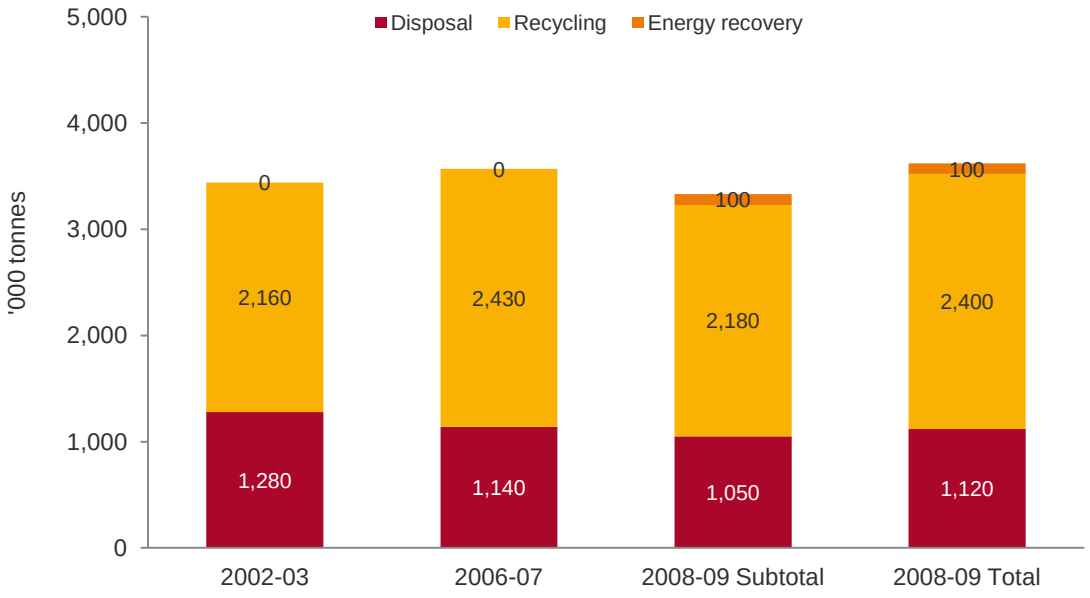

Figure 4-17 SA total waste generation, disposal, recycling and energy recovery, 2002–03, 2006–07 & 2008–09

2002–03 and 2006–07 data sources are *Waste and Recycling in Australia 2009*.
2008–09 "Subtotal" excludes fly ash data.
2008–09 "Total" include fly ash data.

Table 4-26 SA waste generation and disposal data by material, 2008–09

		SA waste generation	SA waste disposal		National average disposal
Material Category	Material Type	tonnes	tonnes	kg per capita	kg per capita
Masonry materials		1,563,100	343,100	211	312
Metals		344,700	33,000	20	24
Organics		821,700	369,600	228	332
Paper & cardboard		319,200	115,200	71	113
Plastics		74,700	55,300	34	80
Glass		88,500	27,000	17	21
Other	Leather & textiles	21,500	18,500	11	22
	Tyres & other rubber	16,300	6,100	4	12
Hazardous	Quarantine	0	0	0	1
	Contaminated soil	53,900	53,900	33	57
	Industrial waste	1,100	1,100	1	34
	Asbestos	27,000	27,000	17	25
SUBTOTAL		**3,331,800**	**1,049,800**	**647**	**1,035**
Fly ash		289,600	66,600	41	532
TOTAL		**3,621,400**	**1,116,400**	**688**	**1,567**

Tonnage values have been rounded. Minor discrepancies may occur between the stated totals and the sums of the component items, as totals are calculated using the component item values prior to rounding.

Table 4-27 presents the total recycling by material for South Australia during 2008–09, with recovery in terms of total tonnes, per capita rate and recycling rate. The per capita recycling rate for SA is also compared to the national average per capita recycling rate.

Table 4-27 SA recycling by material, 2008–09

		SA recycling		National average	SA recycling rate
Material Category	Material Type	tonnes	kg per capita	kg per capita	%
Masonry materials		1,220,000	752	462	78%
Metals		311,700	192	188	90%
Organics		355,800	219	172	49%
Paper & cardboard		204,100	126	178	64%
Plastics		13,800	8	24	20%
Other	Glass	61,600	38	44	70%
	Leather & textiles	3,100	2	3	14%
	Tyres & other rubber	10,100	6	2	62%
Hazardous	Quarantine	0	0	0	0%
	Contaminated soil	0	0	8	0%
	Industrial waste	0	0	10	0%
	Asbestos	0	0	0	0%
SUBTOTAL		**2,180,000**	**1,343**	**1,091**	**67%**
Fly ash		223,000	137	110	77%
TOTAL		**2,403,000**	**1,481**	**1,201**	**68%**

Tonnage values have been rounded. Minor discrepancies may occur between the stated totals and the sums of the component items, as totals are calculated using the component item values prior to rounding.

Table 4-28 details energy recovery by material type for SA. Recovery for the jurisdiction is presented in terms of total tonnes, and the per capita rate. The national average per capita recovery rate is also provided.

Table 4-28 SA energy recovery by material, 2008–09

		SA energy recovery		National average
Material Category	Material Type	tonnes	kg per capita	kg per capita
Masonry materials		0	0	0
Metals		0	0	0
Organics		96,400	59	15
Paper & cardboard		0	0	0
Plastics		5,600	3	0
Other	Glass	0	0	0
	Leather & textiles	0	0	0
	Tyres & other rubber	0	0	0
Hazardous	Quarantine	0	0	0
	Contaminated soil	0	0	0
	Industrial waste	0	0	1
	Asbestos	0	0	0
SUBTOTAL		**102,000**	**63**	**16**
Fly ash		0	0	0
TOTAL		**102,000**	**63**	**16**

Tonnage values have been rounded. Minor discrepancies may occur between the stated totals and the sums of the component items, as totals are calculated using the component item values prior to rounding.

Figure 4-18 charts waste disposal, recycling and energy recovery, by source sector for SA.

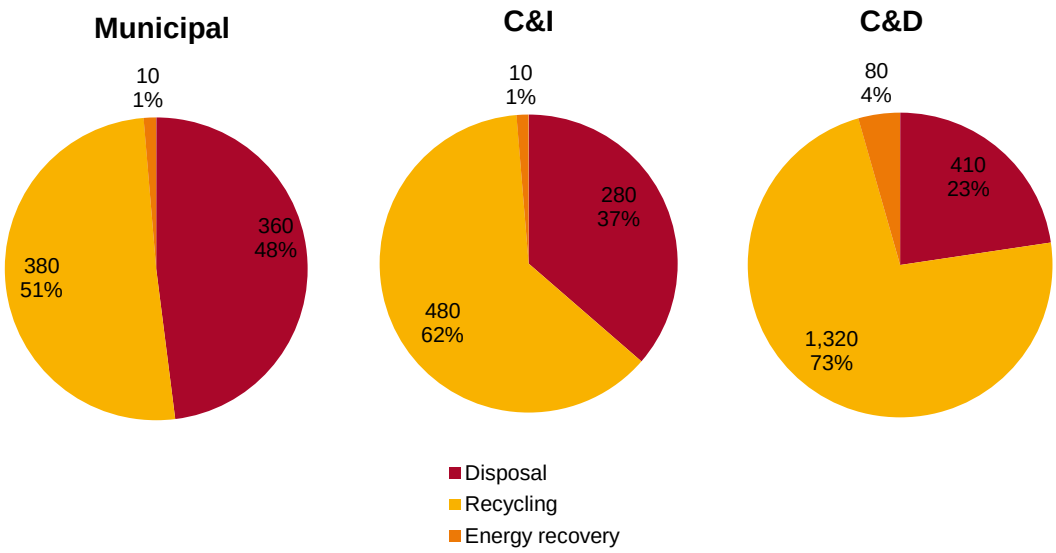

Figure 4-18 SA waste disposal, recycling and energy recovery, by source sector 2008–09 subtotals. Units in '000 tonnes.

4.6 Western Australia waste disposal and recovery

Western Australian disposal, recycling and energy recovery data is for the 2008-09 financial year. Disposal data for Western Australia is only collected for metropolitan landfills. State-wide landfill data was derived for the purposes of this report by applying a metropolitan to non-metropolitan population ratio to the metropolitan landfill data. The waste disposal composition was estimated by applying compositions derived from disposal-based waste audit to landfill data published in the Hyder Consulting *Recycling Activity in Western Australia* report.

Table 4-29 provides an overview of the sources of the Western Australian waste disposal and recovery data, upon which the jurisdictional review and national figures for the 2008-09 reporting period are based.

Table 4-29 Sources of Western Australian waste disposal and recovery data

Data field	Data Sources	Data collation assumptions & calculation methods
Population data	Australian Bureau of Statistics, ABS Release 3101.04 – *Estimated Resident Population, States and Territories (Number)*, June 2009, Canberra, Australia.	None.
Disposal to landfill - total quantity	1. Hyder Consulting, *Recycling activity in Western Australia* 2007-08 & 2008-09, prepared for the Department of Environment and Conservation (WA) on behalf of the Waste Authority, 19 July 2010c. 2. Australian Bureau of Statistics, 3218.0 - *Regional Population Growth Australia 2008–09*, 2009b. 3. Energy recovery estimates - various sources [Clean Energy Council (2010); Golder (2009); Green Energy Markets for Energy Developments (2008)]. 4. Ash Development Association of Australia, Annual membership survey results: January - December 2009. Prepared by HBM Group Pty Ltd.	1. Total disposal to landfill data for Western Australia during 2008–09 was based upon known metropolitan landfill (Hyder 2010b), which was extrapolated to include non-metropolitan areas on a population basis using ABS data (ABS 2009b). This data did not account for the disposal of fly ash, or the recovery of all organic materials recovered through energy recovery, see points 2 and 3 for the description of the determination of the disposed quantities of these materials. 2. Data for the disposal to landfill of fly ash is based upon the national aggregated value, which is not disaggregated to the state level. WA's fly ash disposal is based upon the jurisdictions proportion of national installed capacity of coal fired power stations. 3. An estimate of the relatively small quantity of organic materials recovered through energy recovery was also subtracted from WA disposal to landfill in 2008–09. See Section 3.1 (Recommendation 6) for a detailed outline of the method applied to determine the total quantity of waste recovered through energy recovery processes.
Recycling - total quantity	1. Hyder Consulting, *Recycling activity in Western Australia* 2007–08 & 2008–09, prepared for the Department of Environment and Conservation (WA) on behalf of the Waste Authority, 19 July 2010c. 2. Recycled Organics Unit, *Organics Recycling in Australia: Industry Statistics 2009*, revised edition December 2009.	1. Total recycling data for WA during 2008–09 was primarily based upon data sourced from Hyder (2010c). 2. The exception to point 1 above relates to the quantification of organics recycling, which was sourced from ROU (2009). Primary production wastes relating to Recommendation 10 and 11 (Section 3.5) were excluded from the ROU (2009) data.
Energy recovery - total quantity	1. Landfill energy recovery estimates - various sources [Clean Energy Council (2010); Golder (2009); Green Energy Markets for Energy Developments (2008)]. 2. Hyder Consulting, *Recycling activity in Western Australia* 2007–08 & 2008–09, prepared for the Department of Environment and Conservation (WA) on behalf of the Waste Authority, 19 July 2010c.	1. The total quantity of waste recovered through energy recovery processes was calculated using the method outlined in detail in Section 3.1 (Recommendation 6). All energy recovery in WA during 2008–09 was all through methane capture at landfills and sewage treatment plants. There was no energy recovery from solid waste combustion identified.

Data field	Data Sources	Data collation assumptions & calculation methods
Disposal to landfill - waste stream splits	1. Hyder Consulting, *Recycling activity in Western Australia* 2007–08 & 2008–09, prepared for the Department of Environment and Conservation (WA) on behalf of the Waste Authority, 19 July 2010c. 2. Ash Development Association of Australia, Annual membership survey results: January - December 2009. Prepared by HBM Group Pty Ltd.	1. Disposal to landfill by waste stream data for WA during 2008–09 was primarily based upon data sourced from Hyder (2010c). This data did not account for the disposal of fly ash, which was allocated to the C&I sector.
Recycling - waste stream splits	1. Hyder Consulting, *Recycling activity in Western Australia* 2007–08 & 2008–09, prepared for the Department of Environment and Conservation (WA) on behalf of the Waste Authority, 19 July 2010c. 2. Recycled Organics Unit, *Organics Recycling in Australia: Industry Statistics 2009*, revised edition December 2009.	1. Recycling by waste stream data for WA during 2008–09 was primarily based upon data sourced from Hyder (2010c). 2. The exception to point 1 above relates to the quantification of organics recycling, which was sourced from ROU (2009). Primary production wastes relating to Recommendation 10 and 11 (Section 3.5) were excluded from the ROU (2009) data.
Energy recovery - waste stream splits	1. Landfill energy recovery estimates - various sources [Clean Energy Council (2010); Golder (2009); Green Energy Markets for Energy Developments (2008)]. 2. Hyder Consulting, *Recycling activity in Western Australia* 2007–08 & 2008–09, prepared for the Department of Environment and Conservation (WA) on behalf of the Waste Authority, 19 July 2010c.	1. Energy recovery by waste stream was calculated using the data sources identified here and the method outlined in detail in Section 3.1 (Recommendation 6).
Disposal to landfill - material splits	1. Hyder Consulting, *Recycling activity in Western Australia* 2007–08 & 2008–09, prepared for the Department of Environment and Conservation (WA) on behalf of the Waste Authority, 19 July 2010c. 2. Ash Development Association of Australia, Annual membership survey results: January - December 2009. Prepared by HBM Group Pty Ltd. 3. Various MSW waste audits [APC (2007); DECC (2004); Hyder (2008); Murdoch (1999); WACS and Golder (2005); ZWSA (2007)]. 4. Various C&I waste audits [DEC NSW (2003); Golder and WACS (2007); WACS and Golder (2005); ZWSA (2007)]. 5. Various C&D waste audits [DECC (2007); Golder and WACS (2007); WACS and Golder (2005); ZWSA (2007)].	1. The material splits for disposal to landfill in WA during 2008–09 were calculated separately for each waste stream (MSW, C&I and C&D), using the waste stream split quantifications determined as previously outlined. The estimated material quantities for each waste stream were calculated using the available audit data (described in points 2 to 4 immediately below), which were then aggregated to calculate disposal to landfill, by material type, for the jurisdiction. The exception to this approach was fly ash disposal data, which was sourced from ADAA (2009). 2. The material splits for the MSW waste stream were estimated based on the available large-scale MSW audit data. The available MSW audit data was weighted against the size of the audits that were undertaken, and then aggregated to generate default (average) material splits in percentage terms. 3. The material splits for the C&I waste stream were estimated based on the available large-scale C&I audit data. The available C&I audit data was weighted against the size of the audits that were undertaken, and then aggregated to generate default (average) material splits in percentage terms. 4. The material splits for the C&D waste stream were estimated based on the available large-scale C&D audit data. The available C&D audit data was weighted against the size of the audits that were undertaken, and then aggregated to generate default (average) material splits in percentage terms.

Data field	Data Sources	Data collation assumptions & calculation methods
Recycling - material splits	1. Hyder Consulting, *Recycling activity in Western Australia* 2007–08 & 2008–09, prepared for the Department of Environment and Conservation (WA) on behalf of the Waste Authority, 19 July 2010c. 2. Recycled Organics Unit, *Organics Recycling in Australia: Industry Statistics 2009*, revised edition December 2009.	1. Recycling data by material type for WA during 2008–09 was primarily based upon data sourced from Hyder (2010c). 2. The exception to point 1 above relates to the quantification of organics recycling, which was sourced from ROU (2009). Primary production wastes relating to Recommendation 10 and 11 (Section 3.5) were excluded from the ROU (2009) data.
Energy recovery - material splits	See sources against "Energy recovery - total quantity" above.	See comments against "Energy recovery - total quantity" above.

Figure 4-19 charts Western Australia's waste disposal, recycling and energy recovery for the years 2002-03, 2006–07 and 2008–09. Data for 2002–03 and 2006–07 has been taken directly from the previous *Waste and Recycling in Australia* reports and has not had the new data compilation method introduced in this report retrospectively applied.

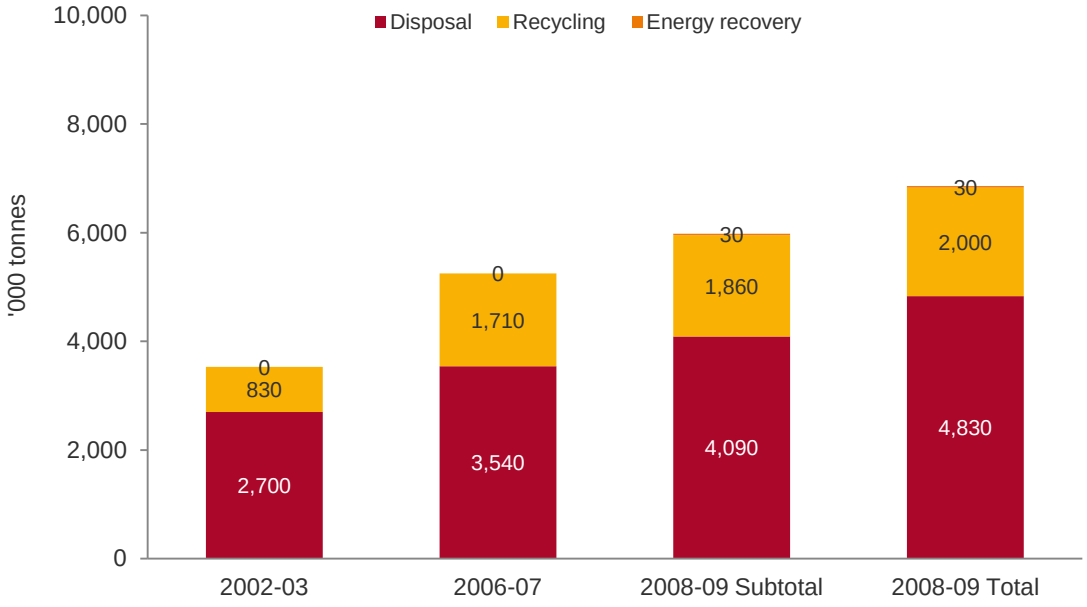

Figure 4-19 WA total waste generation, disposal, recycling and energy recovery, 2002–03, 2006–07 & 2008–09

2002–03 and 2006–07 data sources are *Waste and Recycling in Australia 2009*.

2008–09 "Subtotal" excludes fly ash data.

2008–09 "Total" include fly ash data.

Table 4-30 details Western Australia's waste generation and disposal data by material for 2008-09, and compares the associated per capita disposal for Western Australia with the national average for all jurisdictions.

Table 4-30 WA waste generation and disposal data by material, 2008–09

		WA waste generation	WA waste disposal		National average disposal
Material Category	Material Type	tonnes	tonnes	kg per capita	kg per capita
Masonry materials		2,818,200	2,094,700	936	312
Metals		478,700	103,500	46	24
Organics		1,538,300	1,078,000	482	332
Paper & cardboard		673,000	442,000	198	113
Plastics		245,300	225,900	101	80
Glass		102,200	75,500	34	21
Other	Leather & textiles	85,000	33,600	15	22
	Tyres & other rubber	24,100	22,100	10	12
Hazardous	Quarantine	0	0	0	1
	Contaminated soil	3,000	3,000	1	57
	Industrial waste	9,300	9,300	4	34
	Asbestos	0	0	0	25
SUBTOTAL		**5,977,100**	**4,087,500**	**1,827**	**1,035**
Fly ash		883,000	743,800	333	532
TOTAL		**6,860,100**	**4,831,300**	**2,160**	**1,567**

Tonnage values have been rounded. Minor discrepancies may occur between the stated totals and the sums of the component items, as totals are calculated using the component item values prior to rounding.

Table 4-31 presents the total recycling by material for WA during 2008–09, in terms of total tonnes, per capita rate and recycling rate. The per capita recycling rate for WA is also compared to the national average per capita recycling rate.

Table 4-31 WA recycling by material, 2008–09

		WA recycling		National average	WA recycling rate
Material Category	Material Type	tonnes	kg per capita	kg per capita	%
Masonry materials		723,500	323	462	26%
Metals		375,200	168	188	78%
Organics		435,200	195	172	29%
Paper & cardboard		231,000	103	178	34%
Plastics		19,400	9	24	8%
Other	Glass	26,700	12	44	26%
	Leather & textiles	51,400	23	3	60%
	Tyres & other rubber	2,000	1	2	8%
Hazardous	Quarantine	0	0	0	0%
	Contaminated soil	0	0	8	0%
	Industrial waste	0	0	10	0%
	Asbestos	0	0	0	0%
SUBTOTAL		**1,864,500**	**833**	**1,091**	**31%**
Fly ash		139,200	62	110	16%
TOTAL		**2,003,600**	**896**	**1,201**	**29%**

Tonnage values have been rounded. Minor discrepancies may occur between the stated totals and the sums of the component items, as totals are calculated using the component item values prior to rounding.

Table 4-32 details energy recovery by material type for WA. Recovery for the jurisdiction is presented in terms of total tonnes, and the per capita rate. The national average per capita recovery rate is also provided.

Table 4-32 WA energy recovery by material, 2008–09

		WA energy recovery		National average
Material Category	Material Type	tonnes	kg per capita	kg per capita
Masonry materials		0	0	0
Metals		0	0	0
Organics		25,100	11	15
Paper & cardboard		0	0	0
Plastics		0	0	0
Other	Glass	0	0	0
	Leather & textiles	0	0	0
	Tyres & other rubber	0	0	0
Hazardous	Quarantine	0	0	0
	Contaminated soil	0	0	0
	Industrial waste	0	0	1
	Asbestos	0	0	0
SUBTOTAL		**25,100**	**11**	**16**
Fly ash		0	0	0
TOTAL		**25,100**	**11**	**16**

Tonnage values have been rounded. Minor discrepancies may occur between the stated totals and the sums of the component items, as totals are calculated using the component item values prior to rounding.

Figure 4-20 charts waste disposal, recycling and energy recovery, by source sector for WA.

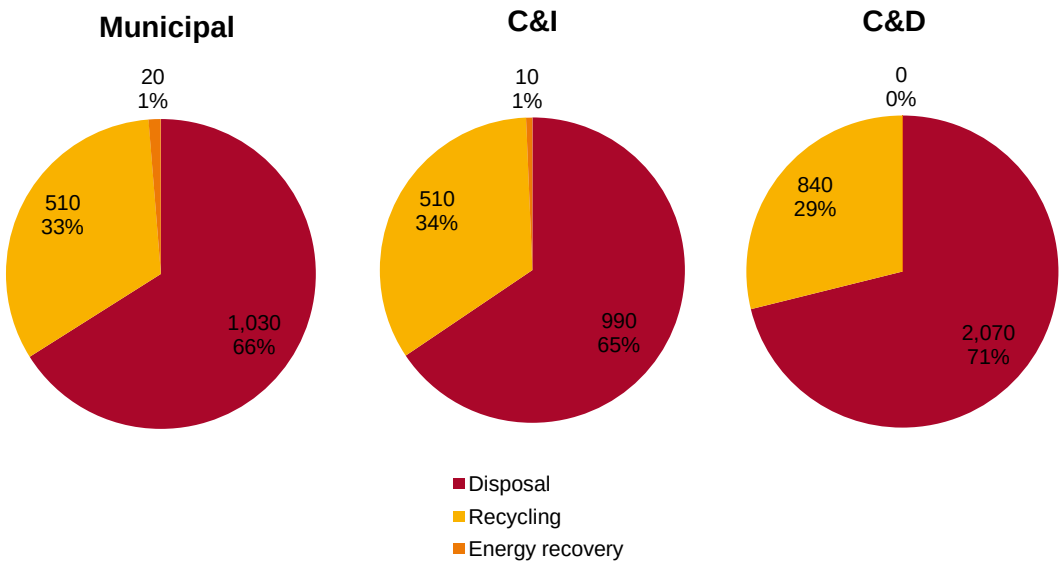

Figure 4-20 WA waste disposal, recycling and energy recovery, by source sector 2008–09 subtotals. Units in '000 tonnes.

4.7 Tasmania waste disposal and recovery

Tasmanian disposal, recycling and energy recovery data is for the 2008–09 financial year. The waste disposal composition was estimated by applying compositions derived from disposal-based waste audits to landfill data published by EPA Tasmania.

Table 4-33 provides an overview of the sources of the Tasmanian waste disposal and recovery data, upon which the jurisdictional review and national figures for the 2008-09 reporting period are based. It is understood that the development of more detailed waste composition data is planned. It is not known when this Tasmanian specific data will be available.

Table 4-33 Sources of Tasmanian waste disposal and recovery data

Data field	Source	Data collation assumptions & calculation methods
Population data	Australian Bureau of Statistics, ABS Release 3101.04 – *Estimated Resident Population, States and Territories (Number)*, June 2009, Canberra, Australia.	None.
Disposal to landfill - total quantity	1. Environment Protection Authority (Tasmania), *Annual Report 2008-09*, October 2009. 2. Energy recovery estimates - various sources [Clean Energy Council (2010); Golder (2009); Green Energy Markets for Energy Developments (2008)].	1. Total disposal to landfill data for Tasmania during 2008–09 was primarily based upon data sourced from EPA Tas (2009). 2. An exception to point 1 above was the relatively small quantity of organic material recovered through energy recovery, which was subtracted from Tasmanian disposal to landfill in 2008–09. See Section 3.1 (Recommendation 6) for a detailed outline of the method applied to determine the total quantity of waste recovered through energy recovery processes.
Recycling - total quantity	1. Environment Protection Authority (Tasmania), *Annual Report 2008–09*, October 2009.	1. Total recycling data for Tasmania during 2008–09 was sourced from EPA Tas (2009).
Energy recovery - total quantity	1. Landfill energy recovery estimates - various sources [Clean Energy Council (2010); Golder (2009); Green Energy Markets for Energy Developments (2008)].	1. The total quantity of waste recovered through energy recovery processes was calculated using the method outlined in detail in Section 3.1 (Recommendation 6). All energy recovery in Tasmania during 2008–09 was through methane capture at landfills and sewage treatment plants.
Disposal to landfill - waste stream splits	1. Environment Protection Authority (Tasmania), *Annual Report 2008–09*, October 2009.	1. Disposal to landfill by waste stream data for Tasmania during 2008–09 was based upon data sourced from EPA Tas (2009).
Recycling - waste stream splits	1. Environment Protection Authority (Tasmania), *Annual Report 2008–09*, October 2009.	1. Recycling by waste stream data for Tasmania during 2008–09 was based upon data sourced from EPA Tas (2009).
Energy recovery - waste stream splits	1. Landfill energy recovery estimates - various sources [Clean Energy Council (2010); Golder (2009); Green Energy Markets for Energy Developments (2008)].	1. Energy recovery by waste stream was calculated using the data sources identified here and the method outlined in detail in Section 3.1 (Recommendation 6).

Data field	Source	Data collation assumptions & calculation methods
Disposal to landfill - material splits	1. Environment Protection Authority (Tasmania), *Annual Report 2008–09*, October 2009. 2. Various MSW waste audits [APC (2007); DECC (2004); Hyder (2008); Murdoch (1999); WACS and Golder (2005); ZWSA (2007)]. 3. Various C&I waste audits [DEC NSW (2003); Golder and WACS (2007); WACS and Golder (2005); ZWSA (2007)]. 4. Various C&D waste audits [DECC (2007); Golder and WACS (2007); WACS and Golder (2005); ZWSA (2007)].	1. The material splits for disposal to landfill in Tasmania during 2008–09 were calculated separately for each waste stream (MSW, C&I and C&D), using the waste stream split quantifications determined as previously outlined. The estimated material quantities for each waste stream were calculated using the available audit data (described in points 2 to 4 immediately below), which were then aggregated to calculate disposal to landfill, by material type, for the jurisdiction. 2. The material splits for the MSW waste stream were estimated based on the available large-scale MSW audit data. The available MSW audit data was weighted against the size of the audits that were undertaken, and then aggregated to generate default (average) material splits in percentage terms. 3. The material splits for the C&I waste stream were estimated based on the available large-scale C&I audit data. The available C&I audit data was weighted against the size of the audits that were undertaken, and then aggregated to generate default (average) material splits in percentage terms. 4. The material splits for the C&D waste stream were estimated based on the available large-scale C&D audit data. The available C&D audit data was weighted against the size of the audits that were undertaken, and then aggregated to generate default (average) material splits in percentage terms.
Recycling - material splits	1. Environment Protection Authority (Tasmania), *Annual Report 2008–09*, October 2009.	1. Recycling data by material type for Tasmania during 2008–09 was based upon data sourced from EPA Tas (2009).
Energy recovery - material splits	See sources against "Energy recovery - total quantity" above.	See comments against "Energy recovery - total quantity" above.

Figure 4-21 charts Tasmanian waste disposal, recycling and energy recovery for the years 2006–07 and 2008–09. Data for 2006–07 has been taken directly from the previous *Waste and Recycling in Australia* reports and has not had the new data compilation method introduced in this report retrospectively applied. Insufficient 2002–03 data is available for reporting.

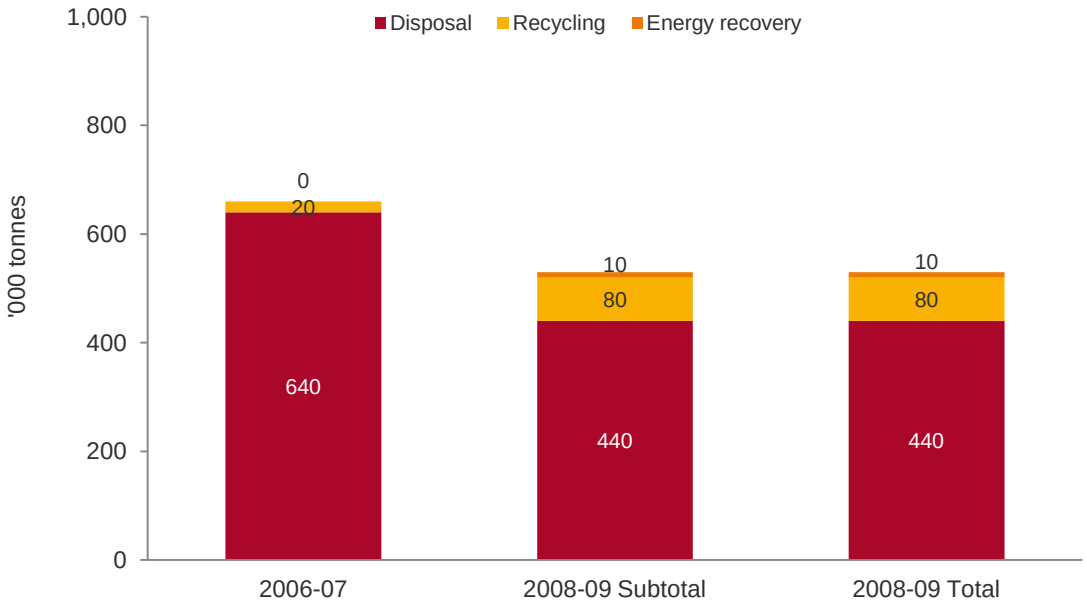

Figure 4-21 Tasmanian total waste generation, disposal, recycling and energy recovery, 2002–03, 2006–07 & 2008–09

2006–07 data sources are *Waste and Recycling in Australia 2009*.
2008–09 "Subtotal" excludes fly ash data.
2008–09 "Total" include fly ash data.

Table 4-17 details Tasmanian waste generation and disposal data by material for 2008–09, and compares the associated per capita disposal for Tasmania with the national average for all jurisdictions.

Table 4-34 Tasmanian waste generation and disposal data by material, 2008–09

		SA waste generation	SA waste disposal		National average disposal
Material Category	Material Type	tonnes	tonnes	kg per capita	kg per capita
Masonry materials		44,900	44,900	89	312
Metals		13,900	12,700	25	24
Organics		234,900	200,200	398	332
Paper & cardboard		98,300	57,900	115	113
Plastics		48,200	45,400	90	80
Other	Glass	18,800	11,600	23	21
	Leather & textiles	13,500	13,500	27	22
	Tyres & other rubber	9,100	9,100	18	12
Hazardous	Quarantine	27,000	27,000	54	1
	Contaminated soil	5,000	5,000	10	57
	Industrial waste	17,400	17,400	35	34
	Asbestos	3,600	3,600	7	25
SUBTOTAL		**534,600**	**448,500**	**892**	**1,035**
Fly ash		0	0	0	532
TOTAL		**534,600**	**448,500**	**892**	**1,567**

Tonnage values have been rounded. Minor discrepancies may occur between the stated totals and the sums of the component items, as totals are calculated using the component item values prior to rounding.

Table 4-35 presents the total recycling by material for Tasmania during 2008–09, in terms of total tonnes, per capita rate and recycling rate. The per capita recycling rate for Tasmania is also compared to the national average per capita recycling rate.

Table 4-35 Tasmanian recycling by material, 2008–09

		Tas recycling		National average	Tas recycling rate
Material Category	Material Type	tonnes	kg per capita	kg per capita	%
Masonry materials		0	0	462	0%
Metals		1,200	2	188	9%
Organics		25,400	51	172	11%
Paper & cardboard		40,300	80	178	41%
Plastics		2,800	6	24	6%
Other	Glass	7,100	14	44	38%
	Leather & textiles	0	0	3	0%
	Tyres & other rubber	0	0	2	0%
Hazardous	Quarantine	0	0	0	0%
	Contaminated soil	0	0	8	0%
	Industrial waste	0	0	10	0%
	Asbestos	0	0	0	0%
SUBTOTAL		**76,900**	**153**	**1,091**	**15%**
Fly ash		0	0	110	0%
TOTAL		**76,900**	**153**	**1,201**	**15%**

Tonnage values have been rounded. Minor discrepancies may occur between the stated totals and the sums of the component items, as totals are calculated using the component item values prior to rounding.

Table 4-36 details energy recovery by material type for Tasmania. Energy recovery for the jurisdiction is presented in terms of total tonnes, and the per capita rate. The national average per capita energy recovery is also provided.

Table 4-36 Tasmanian energy recovery by material, 2008–09

		Tas energy recovery		National average
Material Category	Material Type	tonnes	kg per capita	kg per capita
Masonry materials		0	0	0
Metals		0	0	0
Organics		9,200	18	15
Paper & cardboard		0	0	0
Plastics		0	0	0
Other	Glass	0	0	0
	Leather & textiles	0	0	0
	Tyres & other rubber	0	0	0
Hazardous	Quarantine	0	0	0
	Contaminated soil	0	0	0
	Industrial waste	0	0	1
	Asbestos	0	0	0
SUBTOTAL		**9,200**	**18**	**16**
Fly ash		0	0	0
TOTAL		**9,200**	**18**	**16**

Tonnage values have been rounded. Minor discrepancies may occur between the stated totals and the sums of the component items, as totals are calculated using the component item values prior to rounding.

Figure 4-22 charts waste disposal, recycling and energy recovery, by source sector for Tasmania. Insufficient data was available to provide separate estimates for the C&I and C&D waste streams.

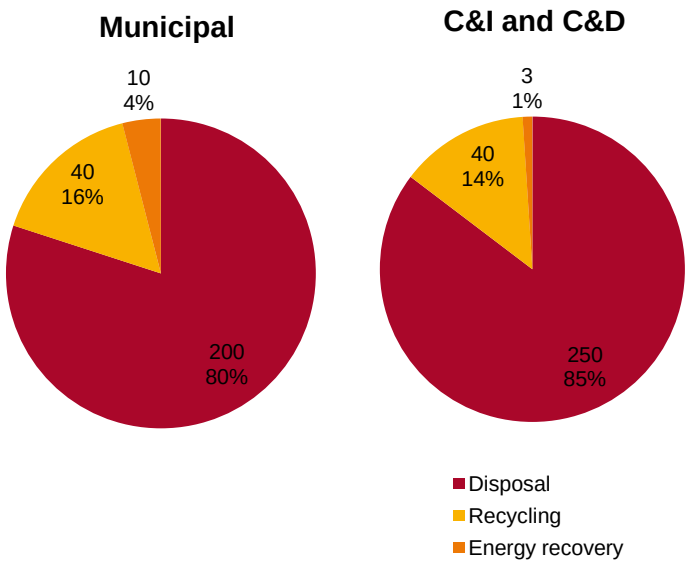

Figure 4-22 Tasmanian waste disposal, recycling and energy recovery, by source sector 2008–09 subtotals. Units in '000 tonnes.

4.8 Australian Capital Territory waste disposal and recovery

ACT disposal, recycling and energy recovery data is for the 2008–09 financial year. The waste disposal composition was estimated by applying compositions derived from disposal-based waste audit to landfill data published by the Department of Territory and Municipal Services.

Table 4-37 provides an overview of the sources of the ACT waste disposal and recovery data, upon which the jurisdictional review and national figures for the 2008–09 reporting period are based.

Table 4-37 Sources of Australian Capital Territory waste disposal and recovery data

Data field	Source	Data collation assumptions & calculation methods
Population data	Australian Bureau of Statistics, ABS Release 3101.04 – *Estimated Resident Population, States and Territories (Number)*, June 2009, Canberra, Australia.	None.
Disposal to landfill - total quantity	1. Department of Territory and Municipal Services (ACT), Time series landfill data, assessed from www.tams.act.gov.au, ACT, 2010a. 2. Energy recovery estimates - various sources [Clean Energy Council (2010); Golder (2009); Green Energy Markets for Energy Developments (2008)].	1. Total disposal to landfill data for the ACT during 2008–09 was primarily based upon data sourced from DTMS (2010a). 2. An exception to point 1 above was the relatively small quantity of organic material recovered through energy recovery, which was subtracted from ACT disposal to landfill in 2008–09. See Section 3.1 (Recommendation 6) for a detailed outline of the method applied to determine the total quantity of waste recovered through energy recovery processes.
Recycling - total quantity	1. Department of Territory and Municipal Services (ACT), *Time series resource recovery data*, assessed from www.tams.act.gov.au, ACT, 2010b.	1. Total recycling data for the ACT during 2008–09 was primarily based upon data sourced from DTMS (2010b).
Energy recovery - total quantity	1. Landfill energy recovery estimates - various sources [Clean Energy Council (2010); Golder (2009); Green Energy Markets for Energy Developments (2008)].	1. The total quantity of waste recovered through energy recovery processes was calculated using the method outlined in detail in Section 3.1 (Recommendation 6). All energy recovery, relating to waste generated in the ACT during 2008-09, was through methane capture at landfills and sewage treatment plants.
Disposal to landfill - waste stream splits	1. APC Environmental Management, *Domestic waste audit*, prepared for Thiess Services & ACT NoWaste, 2007.	1. Disposal to landfill by waste stream data for the ACT during 2008-09 was based on the source sector estimates provided in APC (2007).
Recycling - waste stream splits	1. Estimate of per capita MSW recycling based on weighted average rate for NSW, Vic, SA and WA.	1. Recycling by waste stream data for the ACT during 2008–09 was based upon an average per capita MSW waste generation estimate, which was used to estimate ACT municipal waste generation. From this, the previously calculated MSW disposal (above) was subtracted to estimate MSW recycling. This estimate of MSW recycling value was then subtracted from known overall recycling to provide an estimate of aggregated C&I and C&D recycling.
Energy recovery - waste stream splits	1. Landfill energy recovery estimates - various sources [Clean Energy Council (2010); Golder (2009); Green Energy Markets for Energy Developments (2008)].	1. Energy recovery by waste stream was calculated using the data sources identified here and the method outlined in detail in Section 3.1 (Recommendation 6).
Disposal to landfill - material splits	1. Department of Territory and Municipal Services (ACT), *Time series landfill data,* assessed from www.tams.act.gov.au, ACT, 2010a.	1. Disposal to landfill by material type data for the ACT during 2008-09 was based upon data sourced from DTMS (2010a).
Recycling - material splits	1. Department of Territory and Municipal Services (ACT), *Time series resource recovery data*, assessed from www.tams.act.gov.au, ACT, 2010b.	1. Recycling by material type data for the ACT during 2008–09 was primarily based upon data sourced from DTMS (2010b).
Energy recovery - material splits	See sources against "Energy recovery - total quantity" above.	See comments against "Energy recovery - total quantity" above.

Figure 4-23 charts ACT waste disposal, recycling and energy recovery for the years 2002–03, 2006–07 and 2008–09. Data for 2002–03 and 2006–07 has been taken directly from the previous *Waste and Recycling in Australia* reports and has not had the new data compilation method introduced in this report retrospectively applied.

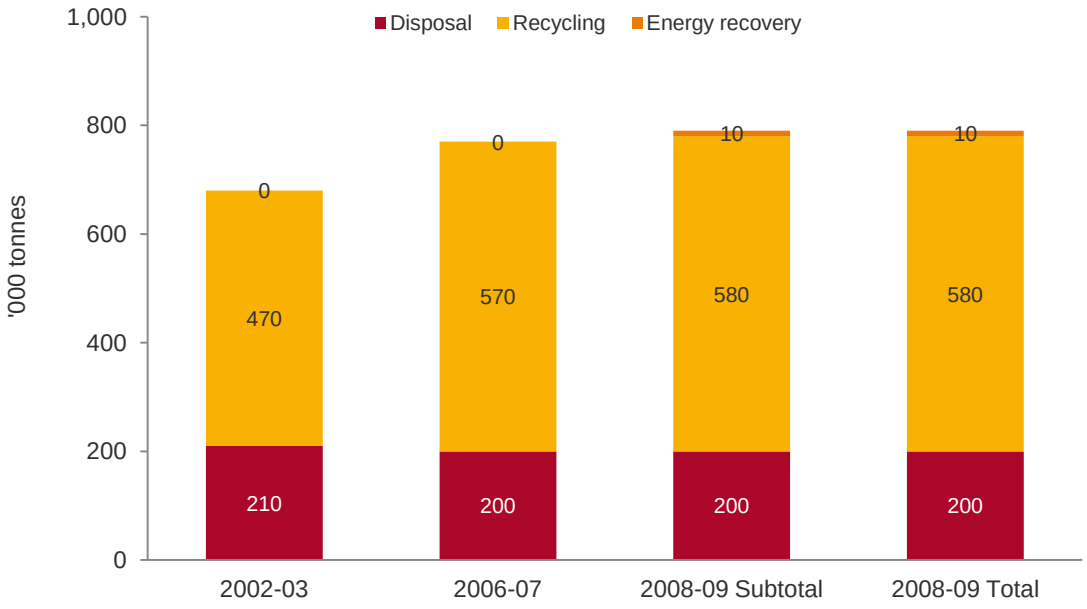

Figure 4-23 ACT total waste generation, disposal, recycling energy recovery, 2002–03, 2006–07 & 2008–09

2006–07 data sources are *Waste and Recycling in Australia 2009*.
2008–09 "Subtotal" excludes fly ash data.
2008–09 "Total" include fly ash data.

Table 4-38 details the ACT's waste generation and disposal data by material for 2008-09, and compares the associated per capita disposal (kg) for ACT with the national average for all jurisdictions.

Table 4-38 ACT waste generation and disposal data by material, 2008–09

		ACT waste generation	ACT waste disposal		National average disposal
Material Category	Material Type	tonnes	tonnes	kg per capita	kg per capita
Masonry materials		253,400	29,600	84	312
Metals		43,100	5,500	16	24
Organics		325,200	87,300	249	332
Paper & cardboard		84,400	27,500	78	113
Plastics		22,100	21,000	60	80
Glass		21,800	5,800	17	21
Other	Leather & textiles	14,700	8,000	23	22
	Tyres & other rubber	7,900	3,900	11	12
Hazardous	Quarantine	0	0	0	1
	Contaminated soil	4,700	4,700	13	57
	Industrial waste	11,600	7,900	22	34
	Asbestos	3,300	3,300	9	25
SUBTOTAL		**792,400**	**204,600**	**583**	**1,035**
Fly ash		0	0	0	532
TOTAL		**792,400**	**204,600**	**583**	**1,567**

Tonnage values have been rounded. Minor discrepancies may occur between the stated totals and the sums of the component items, as totals are calculated using the component item values prior to rounding.

Table 4-39 presents the total recycling by material for the ACT during 2008–09, in terms of total tonnes, per capita rate and recycling rate. Per capita recycling for the ACT is also compared to the national average.

Table 4-39 ACT recycling by material, 2008–09

		ACT recycling		National average	ACT recycling rate
Material Category	Material Type	tonnes	kg per capita	kg per capita	%
Masonry materials		223,800	637	462	88%
Metals		37,600	107	188	87%
Organics		228,400	650	172	72%
Paper & cardboard		56,900	162	178	67%
Plastics		1,100	3	24	5%
Other	Glass	16,000	46	44	73%
	Leather & textiles	6,700	19	3	45%
	Tyres & other rubber	4,000	11	2	50%
Hazardous	Quarantine	0	0	0	0%
	Contaminated soil	0	0	8	0%
	Industrial waste	3,800	11	10	32%
	Asbestos	0	0	0	0%
SUBTOTAL		**578,300**	**1,647**	**1,091**	**74%**
Fly ash		0	0	110	0%
TOTAL		**578,300**	**1,647**	**1,201**	**74%**

Tonnage values have been rounded. Minor discrepancies may occur between the stated totals and the sums of the component items, as totals are calculated using the component item values prior to rounding.

Table 4-40 details energy recovery by material type for the ACT. Recovery for the jurisdiction is presented in terms of total tonnes, and the per capita rate. The national average per capita recovery rate is also provided.

Table 4-40 ACT energy recovery by material, 2008–09

		ACT energy recovery		National average
Material Category	Material Type	tonnes	kg per capita	kg per capita
Masonry materials		0	0	0
Metals		0	0	0
Organics		9,400	27	15
Paper & cardboard		0	0	0
Plastics		0	0	0
Glass		0	0	0
Other	Leather & textiles	0	0	0
	Tyres & other rubber	0	0	0
Hazardous	Quarantine	0	0	0
	Contaminated soil	0	0	0
	Industrial waste	0	0	1
	Asbestos	0	0	0
SUBTOTAL		**9,400**	**27**	**16**
Fly ash		0	0	0
TOTAL		**9,400**	**27**	**16**

Tonnage values have been rounded. Minor discrepancies may occur between the stated totals and the sums of the component items, as totals are calculated using the component item values prior to rounding.

Figure 4-24 charts waste disposal, recycling and energy recovery, by source sector for the ACT. Insufficient data was available to provide separate estimates for the C&I and C&D waste streams.

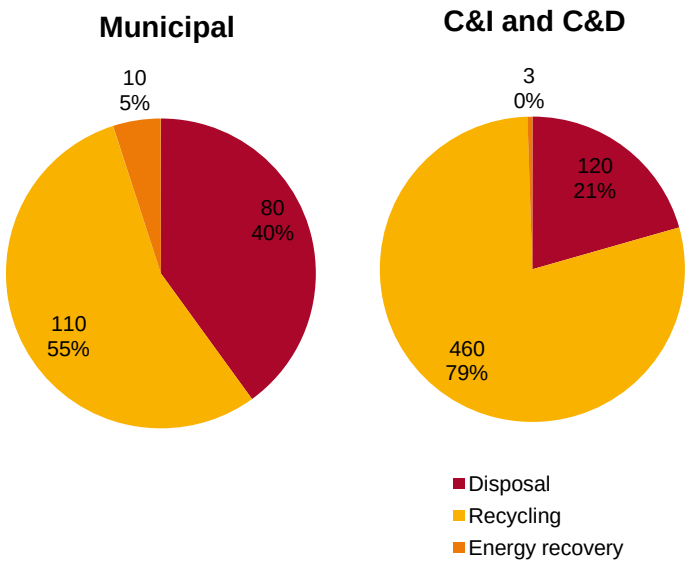

Figure 4-24 ACT waste disposal, recycling and energy recovery, by source sector 2008–09 subtotals. Units in '000 tonnes.

4.9 Northern Territory waste disposal and recovery

NT disposal, recycling and energy recovery data is for the 2008–09 financial year. Disposal and recycling data for NT is only available for Darwin. Territory-wide landfill and recycling data was derived for the purposes of this report by applying a metropolitan to non-metropolitan population ratio to the metropolitan data. The waste disposal composition was estimated by applying average national compositions obtained from audits undertaken in other states.

Table 4-41 provides an overview of the sources of the Northern Territory waste disposal and recovery data, upon which the jurisdictional review and national figures for the 2008–09 reporting period are based.

Table 4-41 Sources of Northern Territory waste disposal and recovery data

Data field	Source	Data collation assumptions & calculation methods
Population data	Australian Bureau of Statistics, ABS Release 3101.04 – *Estimated Resident Population, States and Territories (Number)*, June 2009, Canberra, Australia.	None.
Disposal to landfill - total quantity	1. Department Natural Resources, Environment, The Arts and Sport (NT), Environment and Heritage Division - personal communication, Darwin, 2010. 2. Hyder Consulting, *Australian landfill capacities into the future*: final report-amended and revised, prepared for the Department of the Environment, Water, Heritage and the Arts, 2009e. 3. Energy recovery estimates - various sources [Clean Energy Council (2010); Golder (2009); Green Energy Markets for Energy Developments (2008)].	1. Total disposal to landfill data for NT during 2008–09 was primarily based upon data for the disposal to landfill of Darwin only (DNREAS 2010 and Hyder 2009e). As 2006-07 Darwin only and 2006–07 territory-wide disposal data was available (DNREAS 2010) the 2008–09 Darwin disposal was scaled up to estimate total NT disposal by multiplying Darwin disposal by the ratio between the 2006–07 values. A per capita extrapolation approach was not used as it gave a distorted result relative to the known 2006–07 data. 2. An exception to point 1 above was the relatively small quantity of organic material recovered through energy recovery, which was subtracted from NT disposal to landfill in 2008-09. See Section 3.1 (Recommendation 6) for a detailed outline of the method applied to determine the total quantity of waste recovered through energy recovery processes.
Recycling - total quantity	1. Environment Protection and Heritage Council, 2008–09 *NEPC Annual Report*, NEPC Service Corporation, Canberra, ACT, 2010. 2. Hyder Consulting, Waste and Recycling in Australia, Amended Report, prepared for the Department of the Environment, Water, Heritage and the Arts, 19 November 2009c.	1. Total recycling data for NT during 2008–09 was primarily based upon data for recycling recovery of Darwin only (EPHC 2010). As 2006-07 Darwin only and 2006–07 territory-wide recycling estimates were available (Hyder 2009c), the 2008–09 Darwin recycling was scaled up to estimate total NT recycling by multiplying 2008–09 Darwin recycling by the ratio between the 2006–07 values. Using a per capita extrapolation approach was not used as it gave a distorted result relative to the 2006–07 data.
Energy recovery - total quantity	1. Landfill energy recovery estimates - various sources [Clean Energy Council (2010); Golder (2009); Green Energy Markets for Energy Developments (2008)].	1. The total quantity of waste recovered through energy recovery processes was calculated using the method outlined in detail in Section 3.1 (Recommendation 6). All energy recovery, relating to waste generated in the NT during 2008–09, was through methane capture at landfills.
Disposal to landfill - waste stream splits	1. Hyder Consulting, *Australian landfill capacities into the future*: final report-amended and revised, prepared for the Department of the Environment, Water, Heritage and the Arts, 2009e.	1. Data for the disposal to landfill by waste stream in NT were calculated using percentage estimates calculated from Hyder (2009e), and the "Disposal to landfill - total quantity" value previously estimated. The C&I and C&D waste streams are reported as an aggregated figure as insufficient information was available to allow the estimation of the separate values.
Recycling - waste stream splits	1. Environment Protection and Heritage Council, 2008-09 *NEPC Annual Report*, NEPC Service Corporation, Canberra, ACT, 2010.	1. All available recycling data for NT during 2008–09 (EPHC 2010) related to the MSW waste stream only.

Data field	Source	Data collation assumptions & calculation methods
Energy recovery - waste stream splits	1. Landfill energy recovery estimates - various sources [Clean Energy Council (2010); Golder (2009); Green Energy Markets for Energy Developments (2008)].	1. Energy recovery by waste stream was calculated using the data sources identified here and the method outlined in detail in Section 3.1 (Recommendation 6). The C&I and C&D waste streams are reported as an aggregated figure as insufficient information was available to allow the estimation of the separate values.
Disposal to landfill - material splits	1. Various MSW waste audits [APC (2007); DECC (2004); Hyder (2008); Murdoch (1999); WACS and Golder (2005); ZWSA (2007)]. 2. Various C&I waste audits [DEC NSW (2003); Golder and WACS (2007); WACS and Golder (2005); ZWSA (2007)]. 3. Various C&D waste audits [DECC (2007); Golder and WACS (2007); WACS and Golder (2005); ZWSA (2007)].	1. The material splits for disposal to landfill in NT during 2008–09 were calculated separately for MSW and aggregated C&I and C&D. This was done using the waste stream split quantifications determined as previously outlined. The estimated material quantities for each waste stream were calculated using the available audit data (described in points 2 to 4 immediately below), which were then aggregated to calculate disposal to landfill, by material type, for the jurisdiction. 2. The material splits for the MSW waste stream were estimated based on the available large-scale MSW audit data. The available MSW audit data was weighted against the size of the audits that were undertaken, and then aggregated to generate default (average) material splits in percentage terms. 3. The material splits for the C&I waste stream were estimated based on the available large-scale C&I audit data. The available C&I audit data was weighted against the size of the audits that were undertaken, and then aggregated to generate default (average) material splits in percentage terms. 4. The material splits for the C&D waste stream were estimated based on the available large-scale C&D audit data. The available C&D audit data was weighted against the size of the audits that were undertaken, and then aggregated to generate default (average) material splits in percentage terms.
Recycling - material splits	1. Environment Protection and Heritage Council, 2008–09 *NEPC Annual Report*, NEPC Service Corporation, Canberra, ACT, 2010. 2. Hyder Consulting, Waste and Recycling in Australia, Amended Report, prepared for the Department of the Environment, Water, Heritage and the Arts, 19 November 2009c.	1. Recycling data by material type for NT during 2008–09 was primarily based upon material specific data for recycling recovery of Darwin only (EPHC 2010). As 2006–07 Darwin only and 2006-07 territory-wide recycling estimates were available (Hyder 2009c), the 2008–09 Darwin recycling by material type was scaled up to estimate total NT recycling by multiplying 2008–09 Darwin recycling by the ratio between the 2006-07 values. Using a per capita extrapolation approach was not used as it gave a distorted result relative to the 2006–07 data.
Energy recovery - material splits	See sources against "Energy recovery - total quantity" above.	See comments against "Energy recovery - total quantity" above.

Figure 4-25 charts the Northern Territory's waste disposal, recycling and energy recovery, over 2006–07 and 2008–09. No earlier data was available.

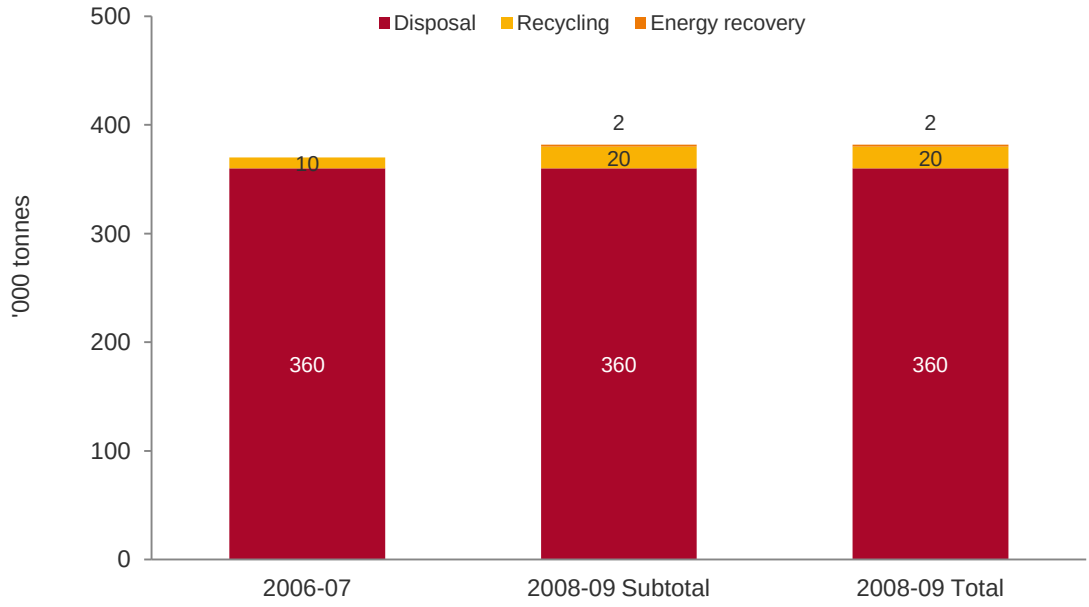

Figure 4-25 NT total waste generation, disposal, recycling energy recovery, 2006–07 & 2008–09

2006–07 data sources are *Waste and Recycling in Australia 2009*.
2008–09 "Subtotal" excludes fly ash data.
2008–09 "Total" include fly ash data.

Table 4-42 details the NT's waste generation and disposal data by material for 2008–09, and compares the associated per capita disposal (kg) for NT with the national average for all jurisdictions.

Table 4-42 NT waste generation and disposal data by material, 2008–09

		NT waste generation	NT waste disposal		National average disposal
Material Category	Material Type	tonnes	tonnes	kg per capita	kg per capita
Masonry materials		88,600	88,600	394	312
Metals		10,000	9,200	41	24
Organics		132,600	130,800	582	332
Paper & cardboard		47,500	36,400	162	113
Plastics		29,600	28,800	128	80
Other	Glass	11,000	7,000	31	21
	Leather & textiles	9,100	9,100	41	22
	Tyres & other rubber	5,900	5,900	26	12
Hazardous	Quarantine	0	0	0	1
	Contaminated soil	20,700	20,700	92	57
	Industrial waste	11,300	11,300	50	34
	Asbestos	14,600	14,600	65	25
SUBTOTAL		**380,800**	**362,400**	**1,612**	**1,035**
Fly ash		0	0	0	532
TOTAL		**380,800**	**362,400**	**1,612**	**1,567**

Tonnage values have been rounded. Minor discrepancies may occur between the stated totals and the sums of the component items, as totals are calculated using the component item values prior to rounding.

Table 4-43 presents the total recycling by material for the Northern Territory during 2008–09, in terms of total tonnes, per capita recycling, and recycling rate. Per capita recycling rate for the Northern Territory is also compared to the national average per capita recycling rate.

Table 4-43 NT recycling, by material, 2008–09

		NT recycling		National average	NT recycling rate
Material Category	Material Type	tonnes	kg per capita	kg per capita	%
Masonry materials		0	0	462	0%
Metals		800	4	188	8%
Organics		0	0	172	0%
Paper & cardboard		11,100	49	178	23%
Plastics		800	4	24	3%
Glass		4,000	18	44	36%
Other	Leather & textiles	0	0	3	0%
	Tyres & other rubber	0	0	2	0%
Hazardous	Quarantine	0	0	0	0%
	Contaminated soil	0	0	8	0%
	Industrial waste	0	0	10	0%
	Asbestos	0	0	0	0%
SUBTOTAL		**16,700**	**74**	**1,091**	**4%**
Fly ash		0	0	110	0%
TOTAL		**16,700**	**74**	**1,201**	**4%**

Tonnage values have been rounded. Minor discrepancies may occur between the stated totals and the sums of the component items, as totals are calculated using the component item values prior to rounding.

Table 4-44 details energy recovery by material type for the Northern Territory. Recovery for the jurisdiction is presented in terms of total tonnes, and the per capita rate. The national average per capita recovery rate is also provided.

Table 4-44 NT energy recovery by material, 2008–09

		NT energy recovery		National average
Material Category	Material Type	tonnes	kg per capita	kg per capita
Masonry materials		0	0	0
Metals		0	0	0
Organics		1,700	8	15
Paper & cardboard		0	0	0
Plastics		0	0	0
Glass		0	0	0
Other	Leather & textiles	0	0	0
	Tyres & other rubber	0	0	0
Hazardous	Quarantine	0	0	0
	Contaminated soil	0	0	0
	Industrial waste	0	0	1
	Asbestos	0	0	0
SUBTOTAL		**1,700**	**8**	**16**
Fly ash		0	0	0
TOTAL		**1,700**	**8**	**16**

Tonnage values have been rounded. Minor discrepancies may occur between the stated totals and the sums of the component items, as totals are calculated using the component item values prior to rounding.

Figure 4-26 charts waste disposal, recycling and energy recovery, by source sector for the Northern Territory. Insufficient data was available to provide separate estimates for the C&I and C&D waste streams.

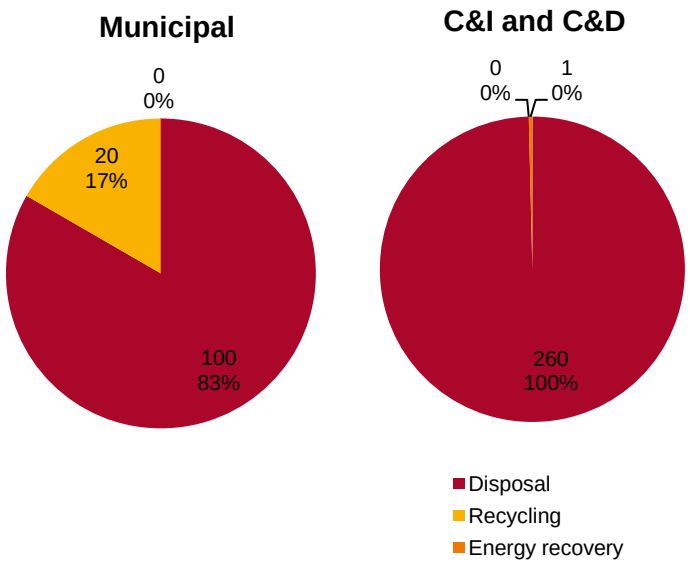

Figure 4-26 NT waste disposal, recycling and energy recovery, by source sector 2008–09 subtotals. Units in '000 tonnes.

5 ENVIRONMENTAL ASSESSMENT

This section provides an overview of the major environmental impacts and considerations associated with the disposal of solid waste to landfill, the recovery of energy from solid waste and the recycling of solid waste. This section of the report is an update from that provided in the 2009 report.

The method report noted that:

> ...mass alone does not provide a complete representation of the relative benefits of recycling or disposing of collected materials.

The method report also noted that:

> The full life cycle impacts of the disposal of materials requires a more detailed analysis of the embodied resources with a material, the relative benefits of recovering these resources, and any pollution or toxic impact associated with the extraction or recycling of a material. The availability of a raw material is also important to understanding the full benefits of recycling, recovering energy from, or disposal of that material.

This section also provides a preliminary assessment and quantification of the environmental impacts associated with the different disposal routes for solid waste. This assessment is limited in its scope and precision. However, it does provide a context for the data reported in Section 4 and the environmental significance of solid waste recycling, recovery and landfilling.

5.1 Environmental assessment of landfilling

In Australia, the legal disposal of solid waste is nearly all to landfill, with a small percentage of solid waste being illegally dumped. This section of the report discusses landfill types, numbers, emissions types, and how they are managed.

Types of landfill

Most landfills are regulated by the various state environmental agencies and can generally be classified into three categories: hazardous, putrescible and inert. There are a few specialist hazardous waste sites, but most hazardous waste is sent to high-quality engineered putrescible sites. Waste sites and their inputs are categorised in Table 5-45.

Table 5-45 Landfill types and wastes received

Landfill type	Waste types received
Hazardous	Industrial waste, contaminated soil and similar
Putrescible	Organic-rich materials, mainly MSW and C&I
Inert	Low organic and not readily degradable material; mainly C&D; also some C&I

MSW is dominated by kerbside collections, the bulk of which (by weight) is usually of biotic origin, especially food, paper and green waste. A trend towards increased organic content can in part be attributed to an increased removal of recyclables from the MSW stream to landfill. C&I wastes typically comprise a mixture of office, retail and industrial wastes and often include a high proportion of paper. C&D wastes generally comprise a mixture of dense, inert materials and a low organic content, but may include substantial quantities of timber.

Modern putrescible landfills are engineered structures, usually in large holes in the ground, with clay and geomembrane composite lining systems, leachate collection system, and gas collection system. Waste is usually placed in contained cells and covered daily, typically with soil, to control odour emission, pests and litter. When cells are completed they are covered, capped, rehabilitated and often rebirthed in metropolitan areas as parkland or sports fields.

Landfill sites in Australia are generally owned by local governments or waste management companies. Over time, the proportion of non-government owned landfills has increased, especially in urban areas where landfill is far more profitable than in regional areas where low waste disposal tonnages do not off-set construction and operational costs as effectively. In addition, many council-owned sites are now managed by private operators on a contract basis.

Landfill inventory

Over the past two decades there has been a rationalisation of landfills and the closure of many smaller sites, driven mainly by stricter environmental standards. Recycling facilities and transfer stations have often been established in their place.

The tables in Appendix 1 summarise the number and characteristics of landfills across Australia. It is derived from a Waste Management Association of Australia (WMAA) database, which was compiled from a 2006 survey and reporting in 2007. The WMAA database remains the most comprehensive listing of landfills in Australia; containing information about 446 sites that (according to WMAA) receive more than 95% of Australia's waste stream. The landfill survey provides the best available data on landfills across Australia. However, the accuracy of these figures is unable to be estimated given that the exact coverage of the survey in terms of number of landfills or amount of the total waste stream covered is not reported. A repeat of the landfill survey has recently been undertaken and figures will likely be updated.

There is a trend towards fewer, larger and better managed landfills. Stricter regulations regarding the design and management of landfill sites has meant greater financial commitment on the part of landfill operators, favouring landfill operation by larger waste management companies with a greater long-term capacity. Landfills in Western Australia epitomise this trend, with many councils moving towards regionalisation of their facilities and relying on a greater number of transfer stations[16].

Victoria generally has sufficient landfill space but there are some areas of localised shortages. Melbourne has an estimated airspace sufficient for 120 Mt at existing sites. Capacity is shifting towards the west and north-west of the metropolitan area, which has about ten times the capacity of the south and east. A number of landfill closures in the north and south-east have reduced disposal rates in these areas by about 25%, increasing disposal in the west.

In Western Australia, the majority of landfills reported a life expectancy of less than 10 years from 2007. Exceptions to this figure were generally rural councils, where land is abundant and waste generation minimal[17].

Adelaide is currently served by six landfill sites licensed to receive metropolitan waste streams. At current disposal rates, these landfills are expected to meet Adelaide's disposal requirements for several decades[18].

16 Department of Environment and Conservation Western Australia, *Zero Waste Plan Development Scheme*, phase 1 report 2007–08.

17 Ibid.

18 Zero Waste South Australia, *Background paper to South Australia's waste strategy 2005–10*.

Emissions from landfills

Landfill emissions are of two main types:

- liquids (leachate)—these may be discharged to groundwater, sometimes surface water, or recirculated back into the landfill
- landfill gas—primarily composed of methane and carbon dioxide.

Less significant emissions, such as odour and litter, are not discussed here.

Landfill gas emissions result mainly from the decomposition of organic wastes. Decomposition of organics proceeds in a series of phases characterised by different chemical environments. These phases occur in a predictable sequence but their timeframe varies between, and sometimes within landfills. Consequently, the types, quantities and timeframes of landfill emissions are difficult to predict.

Construction of new landfills is highly regulated in most states. Government approval is needed, usually from a specialist environment agency, at each stage of the siting, design, operation and rehabilitation phases. There is typically an operational licensing arrangement including performance monitoring and reporting, and this may extend for up to 30 years post-closure. Due to amenity concerns, some states may require a liaison arrangement with local residents. A more recent trend is the imposition of financial assurances to mitigate the risk of a bankruptcy or failure to fulfil post-closure responsibilities. These requirements have driven up the standards for environmental management of landfill emissions as discussed below.

5.1.1 Landfill leachate emissions and management

Pollutants found in MSW landfill leachate fall broadly into four categories:

- dissolved organic matter
- inorganic macro components - calcium, magnesium, sodium, potassium, ammonium, iron, manganese, chloride, sulphate and hydrogen carbonate
- heavy metals - cadmium, chromium, copper, lead, nickel and zinc
- xenobiotic organic compounds formed from household and industrial chemicals, such as aromatic hydrocarbons, phenols and pesticides.

The potential contamination of groundwater supplies by leachate varies greatly from one site to another according to a number of factors[19] including:

- the height of the water table (leachate is partially filtered as it passes through soil layers)
- the permeability of the soil
- the waste profile
- the concentration of contaminants in leachate.

Pollutant concentrations tend to attenuate as the leachate plume passes through clay in the soil. Regulatory requirements generally do not permit discharges to groundwater, however, it is also broadly recognised that all landfills will emit some leachate and that the lining systems are in place to slow and enable control of leachate migration.

19 Kjeldsen, Peter, Morton Barlaz, Alix Rooker, Anders Baun, Anna Ledin, and Thomas Christensen (2002) *Present and long-term composition of MSW landfill leachate: a review*, Critical reviews in Science and Technology 32: 397-336.

Modern landfills in all states are required to manage their leachate. There are a range of siting, design and management methods for this purpose, including:

- Siting standards in some states prohibit the development of landfills below the water table, preventing groundwater intrusion into the waste mass. WA banned the construction of new landfill sites on its coastal strip from 1990 due to the risk of groundwater contamination in areas where this resource is used for drinking water.
- Modern landfill design typically incorporates small cells that are rapidly filled and capped, limiting the stormwater contamination.
- To further control stormwater intrusion, waste is placed in a small area and regularly covered with soil.
- Putrescible landfill cells are generally lined with a layer of compressed clay and often a composite of clay combined with a geosynthetic or plastic layer. This limits leachate leaks and groundwater intrusion. Composite lining systems are now standard practice in Victoria, NSW, WA and SA.
- A high permeability drainage layer is usually placed at the bottom of the cell from which a series of perforated collection pipes drain leachate to a low point. Leachate is usually restricted to a depth of 300 millimetres in order to reduce the pressure head on the liner, preventing leaks. Leachate is pumped up from collection sumps for treatment.
- Landfills apply a range of leachate treatments. In drier environments such as WA it can be evaporated in shallow ponds and the residue returned to the landfill. Some treat the leachate in on-site facilities then spread the treated liquid on the site for dust control. Others discharge to sewer, often after pre-treatment. In some cases, leachate is recycled back through landfill, partly as a means of promoting decomposition and so reducing the period of post-closure aftercare.

Adoption of these landfill techniques has greatly limited groundwater pollution from landfills. There remains a legacy of older or smaller facilities that do not meet modern standards, and from which the pollution risks are higher. These will be phased out over time.

5.1.2 Landfill gas emissions and management

Landfill gas typically consists of approximately equal measures of carbon dioxide (CO_2) and methane (CH_4), with trace quantities of various other gases including hydrogen sulphide and VOCs. There are several reasons why landfills may need to manage their landfill gas, including:

- accumulations and migration of off-site landfill gas can give rise to on-site and immediate surrounding area risks of explosions or asphyxiation. Venting systems and landfill gas extraction systems are usually sufficient to alleviate this risk.
- landfill gas is associated with odours that can impact on neighbours and contribute to reduced air quality. Regulators have often required operators to install flares to manage this problem.
- the methane in landfill gas is a powerful greenhouse gas but can be destroyed by oxidation. Greenhouse policy responses have helped spread this practice by allowing operators to sell credits for reducing emissions. Credits have been sold in Australia and also to overseas purchasers.
- landfill gas is rich in methane, and at larger sites can be profitably collected and used for generating electricity and heat. Again, greenhouse policy responses have helped to spread this practice by pushing up the price for renewable, biogenically-derived power.

Greenhouse gas emissions from landfill

By convention, carbon dioxide from organic material degradation in landfill is not counted as an emission from waste since it is derived from biogenic sources. In the former Australian National Greenhouse Gas Inventory (NGGI) (now the National Greenhouse Accounts), carbon dioxide fluxes between the atmosphere and biogenic system are accounted for in the emission sector 'land use, land use change and forestry'.

The NGGI reports on the net emission of methane from solid waste; that is, the amount of methane generated at landfills less the amount of methane recovered for energy or flared at landfills. For the calendar year 2009 national greenhouse gas emissions from landfills were 11.0 Mt CO_2-e, with the year-on-year results flattening off somewhat since 2007, perhaps reflecting the higher levels of methane recovery that are now occurring. The 2009 NGGI stated that:

> Estimated emissions from solid waste disposal decreased by 3.8 Mt (25.5%) during the period 1990–2007 reflecting changing patterns of disposal, particularly higher rates of recycling, and from an increase in methane recovery). Net emissions from solid waste are estimated to have increased by 0.2 Mt (2.0%) in 2007 compared with 2006. Rates of methane recovery from solid waste have improved substantially since 1990, increasing from a negligible amount to 4.5 Mt CO_2-e of methane in 2007.

Table 5-46 provides an estimate of the methane emissions from landfill in each state and territory. These estimates have been generated using the national emissions total and the proportion of state and national solid waste disposal that is biodegradable waste (organics and paper/cardboard).

Table 5-46 Summary estimated net State emission of $CO_{2\text{-}e}$ from landfill

	NSW	VIC	QLD	SA	WA	TAS	ACT	NT	Total
Landfill emissions (net Mt CO_2-e)	3.2	2.3	2.5	0.5	2.0	0.2	0.1	0.2	11.0

Note it has been assumed that the amount of landfill gas energy recovery and flaring is consistent across the states for rates of tonnages disposed. For example, NSW has a higher number of gas burning and flaring units than Tasmania, however, it also has a significantly higher waste volume.

Emissions from waste have some characteristics that are quite different from those of other sectors. Firstly, most activities that result in emissions (e.g. burning fossil fuels) cause emissions to arise instantaneously. Disposal of waste in landfill, on the other hand, causes emissions to be generated over several decades. Secondly, the emissions from most other sectors can be measured with a reasonable degree of accuracy whereas emissions from landfills are highly variable and difficult to predict accurately even when data on waste composition is available. The solid waste calculator on the Clean Energy Regulator is available to landfill operators to calculate emissions.

The NGGI model for estimating emissions from waste is built up material-by-material based on various assumed factors. These include quantities disposed, average composition, degradable organic carbon content and degradation rate. Similar factors are used in other Department of Climate Change and Energy Efficiency (DCCEE) publications that provide guidance on how to estimate landfill-specific emissions or indirect Scope 3 emissions from an organisation's waste.

The Scope 3 method applies net emission factors ignoring the time factor of emission and can be used for estimating net greenhouse impacts by material stream and by waste type as shown in Figure 5-27. According to the figures, paper and paperboard are the most significant material types in both C&I and MSW streams. One of the implications of this is that some landfills currently classified as inert but able to accept commercial wastes may generate high levels of greenhouse gases.

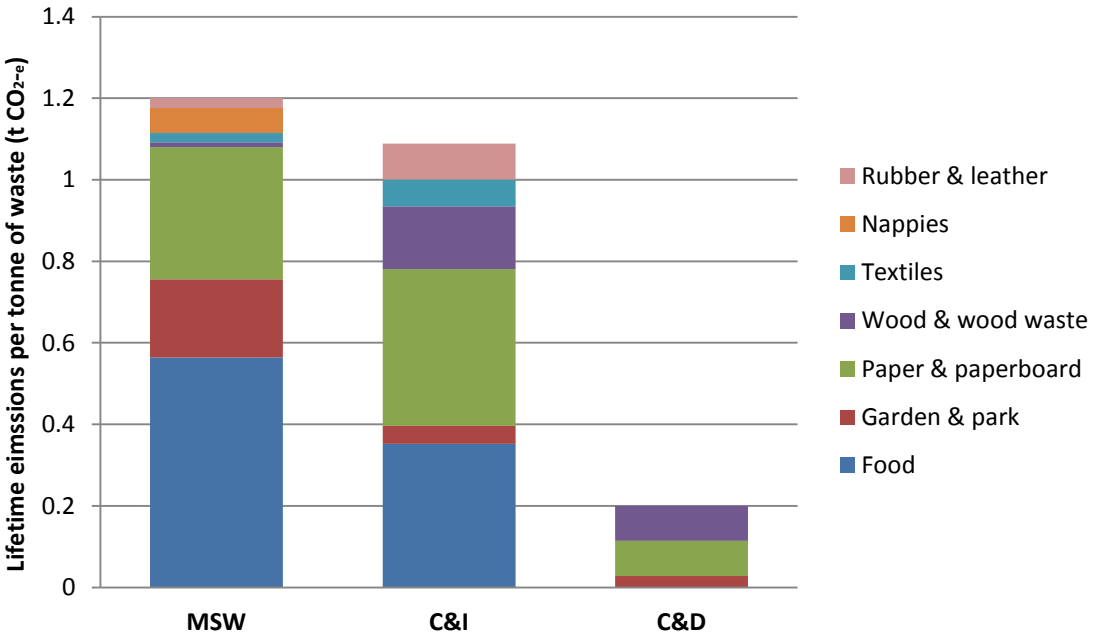

Figure 5-27 Predicted overall emissions from deposition of a tonne of waste in a landfill without gas capture, based on DCCEE methods and default values (2011)[20]

Reducing greenhouse gas emissions from landfill

The greenhouse implications of waste and landfills are an increasingly significant issue. A wide range of methods are available for managing the methane emissions from landfills, including:

- diversion of organic materials from landfill. This has been a favoured policy response. Green waste composting is well-established and some diversion of food waste is now occurring. Technologies that control odour risks and that deal with mixed waste streams are available, including mechanical-biological treatments, anaerobic digestion and controlled-environment composting.
- maximising methane oxidation in the upper layers. As methane passes through landfill covers and caps, microbial action can oxidise a proportion of the gas to CO_2. The proportion that is oxidised can be increased by reducing the timeframe for completion of cells and by encouraging emitted methane to pass through organically rich materials, such as compost-rich capping layers or biofilters.
- maximising methane recovery. Methane is generally recovered through vertical wells drilled into the waste body after completion of the cap. Strategies for enhancing gas collection include–
  - constructing small cells that are rapidly capped so that gas collection can start quickly.
  - using low permeability caps with below-cap aggregate layers that encourage gas migration to collection points.

[20] Department of Climate Change and Energy Efficiency *National Greenhouse Accounts Factors*, July 2011

- establishing horizontal gas collection pipes within the waste mass to increase the recovery rate and allow recovery before the site is capped.
- managing sites as bioreactors (see discussion below).
- establishing gas collection contracts that focus on maximising recovery rather than profitability.
- maximising the use of the energy content of methane through prioritising cogeneration and green power rather than just flaring. In addition, landfill gas can be compressed and used as a transport fuel, or stripped of CO_2 and sent to the gas pipeline network.

The recovery of methane from landfills has increased significantly in recent years, with more than a quarter of estimated methane generation now being captured. However, there remains capacity for much greater landfill gas recapture. The WMAA National Landfill Divisions suggest that a 50% average capture rate for methane across all landfills could be achieved by 2014 (WMAA National Landfill Division 2008).

Bioreactor landfills

Debate continues globally around the best method for managing MSW landfills. Traditionally, the 'dry tomb' strategy has been popular, in which waste is buried in an isolated and enclosed cell. The theory behind this strategy is that as long as wastes are kept dry, gas and leachate production will be minimised. The approach has been criticised since it relies on indefinite maintenance of the integrity of the liner system. It is proposed that this simply places the pollution risks and management responsibilities on to future generations.

Growing in popularity is the 'biocell' or 'bioreactor' strategy in which moisture is cycled through the waste mass. This is designed to enhance fermentation and flush leachable chemicals, and so decrease the time taken to achieve stabilisation. The optimum moisture content for this process is 40% and it is important that the waste mass does not become saturated. Leachate is often used as the source of moisture for this process, but may need to be supplemented by additional moisture.

Bioreactor management can reduce the intergenerational liability of the landfill, and by concentrating the methane generation period can enhance the viability of methane recovery. However, bioreactors are considered to be a developing technology in some jurisdictions and have the potential to pose increased groundwater pollution and methane migration risks if adequate management is not in place. Most jurisdictions require additional landfill lining and or management systems for the operation of bio-reactor cells.

Issues in comparing methane with carbon dioxide

Methane and other gases are compared with CO_2 by means of their relative global warming potential. It is often overlooked that this is a problematic and somewhat arbitrary measure.

A molecule of methane is typically resident in the atmosphere for a few decades whereas a molecule of CO_2 is likely to remain in the atmosphere for several centuries. This creates a difficulty in comparing global warming potentials – if we compare warming impacts over the whole lifespan of the gases we are placing the same importance on warming taking place centuries from now as we place on warming set to occur in the immediate decades. On the other hand, if we compare the warming over the residency period of the shorter-lived gas we are ignoring warming occurring after that time. The standard compromise response to this dilemma is to compare gases over a 100-year time frame.

The estimates of the impact of landfills given above are based on the 100-year time frame, on which basis the DCCEE puts methane as having a global warming potential of 21 times that of CO_2. This is in accordance with the Intergovernmental Panel on Climate Change.[21]

If the warming effects of the two gases are compared over a 20 year period, methane has 72 times the global warming potential of CO_2. Some leading climate change scientists have argued that methane management should be considered a separate management issue that is more urgent than standard CO_2 equivalence measures suggest[22].

A life cycle perspective to landfill emissions

The discussion above is based on standard inventory and accounting approaches for emissions from landfills using DCCEE factors and methods. The following two sections have a scope broader than that required for Australia's international reporting through the National Greenhouse Accounts, consistent with the scope of the *National Waste Policy: Less waste, more resources*. For some purposes it is better to consider the greenhouse gas implications of landfilling from a more holistic life cycle perspective, taking into account secondary effects. Significant additional factors are:

- 'credits' from re-use of landfill methane to offset the electricity generated from standard means, and similar credits for recovery of recyclables. (Recycling is considered separately below).
- long-term storage of organic carbon in landfills, preventing its degradation to carbon dioxide.

The importance of these two factors as a counterbalance to methane emissions varies with the waste types and the greenhouse profile of electricity generated from standard means. Using standard DCCEE factors and modelling to consider a landfill in Victoria, which has the most greenhouse-intensive electricity, inclusion of these two factors in the balance means that a landfill could be considered 'carbon neutral' by recovering about 60% of the landfill gas it generates over its whole life-cycle. This rate is thought to be readily achievable at a well-managed landfill. If the storage factor is discounted the threshold rate would be around 80%. Many researchers and landfill operators maintain that this level of capture over the whole life cycle of the landfill is achievable. This makes the significant assumption that the electricity generated at the landfill is avoiding the requirement to generate electricity through the combustion of coal.

On the other hand, if the assessment period for global warming potential is shortened to 20 years so that the global warming potential of methane is 72, then for carbon neutrality (taking storage into account) a whole of life capture rate of over 85% would be required. In addition, the accounting for methane emissions and carbon storage does not account for the loss of embodied energy in the non-degradable material that is sent to landfill, discussed further below.

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21 Forster P, Ramaswamy V, Artaxo P, Berntsen T, Betts R, Fahey DW, Haywood J, Lean J, Lowe DC, Myhre G, Nganga J, Prinn R, Raga G, Schulz M and Van Dorland R (2007) *Changes in Atmospheric Constituents and in Radiative Forcing*. In: Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M.Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, <ipcc-wg1.ucar.edu/wg1/Report/AR4WG1_Print_Ch02.pdf>

22 Hansen J and Sato M (2007*) Global Warming: East-West Connections*. NASA Goddard Institute for Space Studies and Columbia University Earth Institute <www.columbia.edu/~jeh1/East-West_070925.pdf>

Embodied greenhouse gas in waste disposal to landfill

The disposal of recyclable inorganic materials to landfill usually means the loss of non-renewable resources. In addition, materials that are landfilled have an embodied energy value that represents the energy that has been invested into extracting, refining and manufacturing materials. The embodied energy in materials can also be thought of as representing the embodied greenhouse gases (EGG) in materials, or the carbon intensity of materials, being the greenhouse gases emitted during the production process. Table 5-47 provides an estimate of the greenhouse gases embodied in inorganic material disposed of to landfill in Australia. Organics and paper and cardboard have been excluded from the calculation of EGG. For the purposes of this report, the methane emissions from landfill resulting from the decomposition of these material categories is taken as a measure of the greenhouse gas effect of disposal to landfill. Hazardous wastes have also been excluded from the calculation of EGG, again, for the purpose of this report, given the difficulties associated with identifying the material composition of hazardous waste.

The weight of greenhouse gases embodied in materials disposed to landfill is estimated to be 9Mt CO_2-e in 2008–09. This emphasises the importance of EGG in the assessment of environmental impacts of landfilling recyclable non organic materials.

These estimates have been calculated using values from the Inventory of Carbon and Energy (ICE)[23] and are the gross embodied CO_2-e in material types. The actual greenhouse gas abatement that would result in the recovery of materials is net of the greenhouse gases emitted during the recovery process. In most cases, the energy required to recover recycled materials is significantly less than that required to refine virgin materials.

The carbon intensity of material types in ICE is a world-wide average derived from publicly available literature. Whilst the raw material required to manufacture these materials is relatively consistent, the location of production can alter the carbon intensity of a material significantly. Given that the production of materials in Australia use a relatively carbon intensive power source, it is likely that the values provided in ICE are less than that for materials produced in Australia.

Even for materials produced within Australia, there is likely to be a significant variance in the amount of greenhouse gases embodied in materials depending on where they are produced. For example, materials produced in Tasmania (using electricity from hydro-electricity) would have less carbon intensity than the equivalent material manufactured in Victoria (using electricity from brown coal).

One of the most significant issues for materials recycling is the difficulty of separating out materials from a mixed landfill waste stream and dealing with issues of materials cross-contamination. Waste material ‘source segregation’ remains one of the most effective means of avoiding a reduction in net EGG recovery from wasted materials.

23 Prof. Geoff Hammond and Craig Jones, University of Bath, Inventory of Carbon and Energy, Version 1.6a, 2008

Material Categories		EGG ($t CO_2$-e/t)	NSW		Vic		Qld		SA		WA		Tas		ACT		NT		TOTALS	
			kt	kt CO_2-e	kt	kt CO_2-e	kt	kt CO_2-e	kt	kt CO_2-e	kt	kt CO_2-e	kt	kt CO_2-e	kt	kt CO_2-e	kt	kt CO_2-e	kt	kt CO_2-e
Masonry materials[24]		0.16	958	149	1842	287	1434	224	343	54	2095	327	45	7	30	5	89	14	6834	1066
Metals[25]		2.09	176	369	86	180	101	211	33	69	104	217	13	26	6	12	9	19	527	1103
Organics[i]		n/a	2301	0	1341	0	1756	0	370	0	1078	0	200	0	87	0	131	0	7264	0
Paper & cardboard[i]		n/a	904	0	434	0	449	0	115	0	442	0	58	0	27	0	36	0	2467	0
Plastics		2.53	658	1665	361	914	350	887	55	140	226	572	45	115	21	53	29	73	1746	4418
Other	Glass	163	139	79	67	99	84	27	23	76	64	12	10	6	5	7	6	468	398	378
	Leather & textiles	174	678	139	541	95	371	18	72	34	131	13	52	8	31	9	35	491	1912	2040
	Tyres & other rubber	29	93	119	379	62	197	6	20	22	70	9	29	4	13	6	19	258	820	749
Hazardous[i]		n/a	0	0	0	0	0	0	0	0	0	0	27	0	0	0	0	0	27	0
SUBTOTAL			**6639**	**3093**	**4736**	**2367**	**5107**	**1975**	**1050**	**377**	**4087**	**1380**	**448**	**240**	**205**	**118**	**362**	**166**	**22 635**	**9717**
Fly ash		0.01	3772	38	2133	21	4914	49	67	1	744	7	0	0	0	0	0	0	11 630	116
TOTALS			**10,411**	**3131**	**6869**	**2389**	**10,021**	**2024**	**1116**	**377**	**4831**	**1388**	**448**	**240**	**205**	**118**	**362**	**166**	**34,264**	**9833**

i. For the purposes of this report, these materials have been excluded from the calculation of embodied greenhouse gases. Further explanation is provided in section 5.2.

Table 5-47 Embodied greenhouse gas in material disposed to landfill by jurisdiction (2008–09)

24 0.16 is the average of all masonry material types.

25 2.09 is the weighted average of ferrous and non ferrous EE ratios and assumes a that metals disposed of to landfill are 95% ferrous and 5% non-ferrous by weight.

5.2 Environmental assessment of resource recovery

There are many different processes that are involved in the resource recovery sector. A complete assessment of resource recovery processes and the net emissions and abatement is beyond the scope of this study.

Life cycle assessments have consistently demonstrated that for most materials and most circumstances, recycling results in net savings in energy and net reductions in greenhouse gas emissions (Ackerman 1997, Grant et al. 2003, Eriksson et al. 2005, Diaz and Warith 2006) compared to production from virgin materials. A recent Australian study was carried out by Hyder for the Australian Council of Recyclers (2008). It suggests recycling saved 8.8 Mt CO_2-e in 2006, equivalent to about 1.5% of Australia's total emissions. Figure 5-28 is derived from that report and shows the greenhouse benefits of recycling various materials on an annual basis.

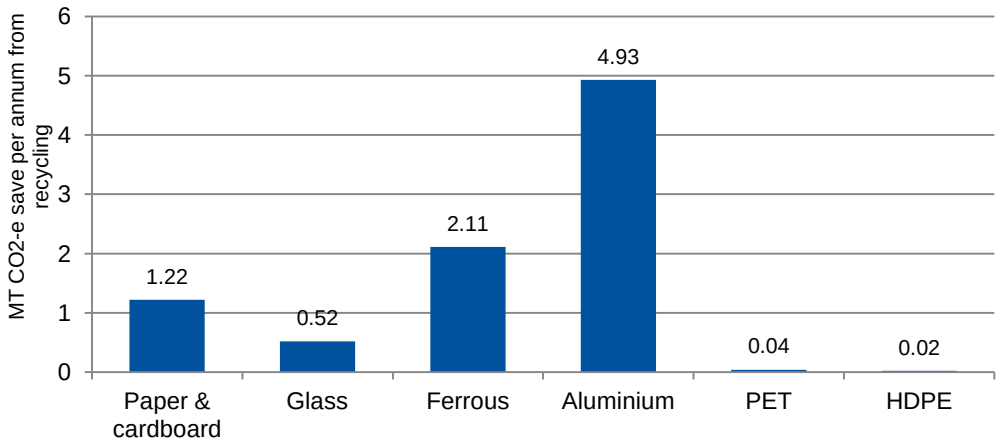

Figure 5-28 The greenhouse benefits of recycling by material type
Source: ACOR (2008)

Whilst the above lifecycle analysis is net of the energy required to recover and recycle these materials, it may not reflect the energy benefits per tonne of material that is being disposed to landfill in a mixed landfill waste stream. The energy inputs required to separate and recover materials from a mixed waste stream can be significant and would reduce the net benefits outlined above. Once again, this emphasises the importance of material segregation to ensure an efficient materials recycling process.

There is also a greenhouse benefit from the use of compost. This is derived from substitution of chemical fertilisers (the manufacture of which is greenhouse intensive) and from long-term enhancement of carbon in soil humic materials. The magnitude of these benefits is difficult to estimate and circumstance specific.

A major European study (Smith *et al*. 2001) attempted to estimate rough average values for these factors. It assigned a credit of 35 kg CO_2-e from offsetting fertiliser use for each tonne of compost used in agriculture. It also estimated that a rough average of 8% of carbon in compost would remain stored after 100 years, which is equivalent to 54 kg CO_2-e per tonne of compost. Both of these quantities are relatively small compared with the methane potential of organic inputs. This means that the main benefit of compost would typically be avoidance of landfill emissions, but this benefit would be debatable where landfill gas recovery rates are high.

6 STRATEGIES & POLICIES

The data review period for this report is the 2008–09 financial year. However, due to the timeframe of production (2010–11), the following jurisdictional summary provides a context for both the data review period and the waste management framework at the time of production, being generally the middle of the 2011 calendar year. The material presented in this section of the report is intended to provide an overview for each jurisdiction. Further detailed information and clarification of jurisdictional definitions and variations should be sought from the source documents referenced for each jurisdiction.

This section of the report is based on desktop research undertaken to obtain an overview of the key waste management strategies/policies in place in Australia at the state and territory level. Where there was little information available, state agencies were contacted to confirm any further details. This section of the report has been updated from the 2009 report.

In November 2008, Australian governments committed to developing a National Waste Policy. This national approach to key areas in waste management, recycling and resource recovery has been seen as a way to improve consistency of regulatory and administrative arrangements across jurisdictions. The National Waste Policy commitment and process has helped to stimulate and inform a range of reviews of jurisdictional strategies and programs across Australia, which are outlined in this section of the report.

Beyond the recent work in reviewing and developing jurisdictional strategies, the National Waste Policy process has also seen the Australian Government commit to developing and implementing requirements under the National Product Stewardship Framework. The Environment Protection and Heritage Council (EPHC) agreed to consider a comprehensive work program in 2011, including timeframes for addressing existing product stewardship priority waste issues.

Following is an overview of key policies and strategies in place across jurisdictions. Some similarities exist and these include:

- **Strategy documents** - All jurisdictions have a current waste strategy or overarching strategy directives for waste management. In most cases these documents include targets for overall waste generation, diversion of waste from landfill and resource recovery. Where strategies have recently been reviewed and endorsed, they acknowledge the overarching objectives of the *National Waste Policy* and associated processes.
- **Landfill levies** - Most jurisdictions now have some form of levy applied or scheduled for introduction on waste disposed to landfill. The application of the levies varies across jurisdictions. Some jurisdictions have a levy based on the stem source sector of the waste and / or geographic area in which it was generated.
- **Extended producer responsibility** - Many jurisdictions have acknowledged the importance of EPR programs and have developed priority products, or committed support to national initiatives the National Product Stewardship Framework.
- **Partnership programs** - Acknowledgement and support for partnership programs with industry, government and the community is strong across all jurisdictions. These programs are focused primarily on addressing resource recovery, and include support for infrastructure and awareness.

6.1 New South Wales

Information on the programs and strategies being implemented in NSW has been primarily sourced from:

- the Office of Environment and Heritage – OEH (formerly Department of Environment, Climate Change and Water – DECCW) website, www.environment.nsw.gov.au
- NSW DECC (2007) *Waste Avoidance and Resource Recovery Strategy 2007*
- NSW Government (2006) *State Plan, A New Direction for NSW*
- NSW DECCW (2010) *Review of Waste Strategy and Policy in New South Wales* Report by the Steering Committee for the Review of NSW Waste Strategy and Policy (Richmond Review)
- NSW DECCW (2010) *NSW Waste Avoidance and Resource Recovery Strategy – Discussion Draft: Strategic Directions and Implementation Plan 2011 – 2015*
- NSW DECCW (2010) *NSW Extended Producer Responsibility Priority Statement 2010*
- Renew NSW website: www.renewnsw.com.au
- Greenhouse Gas Reduction Scheme: www.greenhousegas.nsw.gov.au.

The NSW OEH oversees a regulatory and policy framework that aims to minimise harm to the environment, avoid waste and increase resource recovery. The framework is administered under the principal legislation of the:

- *Protection of the Environment Operations Act 1997* (POEO Act)
- *Waste Avoidance and Resource Recovery Act 2001 (WARR Act)*.

Waste is administered across three geographic regions in NSW. These are the Sydney Metropolitan Area (SMA), the Extended Regulated Area (ERA) which covers the Hunter, Central Coast and Illawarra regions; and the Regional Regulated Area (RRA) which encompasses the remainder of the state. The majority of waste is produced in the SMA and ERA.

Waste Avoidance and Resource Recovery Strategy

The NSW *Waste Avoidance and Resource Recovery Strategy* was initially developed in 2003 and revised in 2007. It provides targets for waste reduction and diversion, and sets the programs and policies to achieve these targets.

The Strategy sits under the NSW Government's *State Plan, A New Direction for NSW* released in 2006. One of the five focus areas within the Plan is Environment for Living. The NSW *Waste Avoidance and Resource Recovery Strategy* has been identified as contributing to the following priorities listed under Environment for Living:

- a secure and sustainable water supply for all users
- a reliable electricity supply with increased use of renewable energy
- cleaner air and progress on greenhouse gas reductions
- better outcomes for native vegetation, biodiversity, land, rivers and coastal waterways.

The 2007 strategy retained the four key result areas identified in the development of the original strategy in 2003. These areas, as well as broad targets for each, are outlined in Table 6-48.

Table 6-48 NSW WARR Strategy key result areas and broad targets

Key result area	Broad targets
Preventing and avoiding waste	To hold level the total waste generated for 5 years from the release of *Waste Strategy 2003.*
Increasing recovery and use of secondary materials	By 2014, to: • Increase recovery and use of materials from the municipal waste stream, from 26% (in 2000) to 66%; • Increase recovery and use of materials from the commercial and industrial waste stream, from 28% (in 2000) to 63%; and • Increase recovery and use of materials from the construction and demolition sector, from 65% (in 2000) to 76%.
Reducing toxicity in products and materials and	By 2014 or earlier: to phase out priority substances in identified products as a first choice or, if not possible, to achieve maximum recovery for re-use.
Reducing litter and illegal dumping.	Reduce total amount of litter reported annually. Reduction in total tonnages of illegally dumped material reported by regulatory agencies and RID (illegal dumping) squads annually.

To fulfil ongoing review requirements of the Strategy, it must again be updated by 2012. To meet this obligation, the NSW Minister for Climate Change and the Environment in May 2010 commissioned a further review of waste policy and strategy in NSW (Richmond Review). That review, like the 2007 process, assessed the progress of the Strategy, particularly in relation to how it is tracking towards meeting the targets established for 2014.

Further consideration in the review has also been given to the State's obligations under the Federal Government's *National Waste Policy* agenda for the management of waste and resource recovery across all Australian jurisdictions including NSW.

In December 2010, a draft discussion paper, *Strategic Directions and Implementation Plan 2011–2015* was released in NSW for public comment until February 2011. This was a response to the Richmond Review.

The discussion paper proposes sub-targets for each of the 2014 waste targets outlined in Table 6-48 be developed and implemented, to avoid waste generation and increase resource recovery for specific material types. The specific waste materials identified included food and organics, paper and cardboard.

For government, industry and the community to meet the 2014 targets, the discussion paper also proposes five new focus areas be established, each with a series of strategies to ensure appropriate action is taken to achieve the established targets. The five proposed focus areas are:

- making it easier for households to manage their waste
- making it easier for businesses to manage their waste
- reducing or removing problem wastes from the waste streams to ensure that resource recovery is cost effective and produces environmentally safe materials
- facilitating investment in waste infrastructure
- reducing litter and combating illegal dumping.

Waste and environment levy

The waste and environment levy is a regulatory mechanism designed to provide an economic incentive to reduce waste disposal and promote alternative waste technologies.

Under Section 88 of the POEO Act, licensed waste facilities pay a contribution for waste received at the facility. A range of exemptions and deductions are applied to the levy in order to promote resource recovery. The levy rates increase annually. The rates for 2008–09 to 2011–12 are outlined in Table 6-49. They are scheduled to increase by a further $10+CPI each year until 2015–16.

Table 6-49 NSW Landfill levy fee schedule: 2008–09 to 2011–12

Period	Levy ($ per tonne) per geographic area		
	SMA	ERA	RRA
2008–09	46.70	40.00	NA
2009–10	58.80	52.40	10.00
2010–11	70.30	65.30	20.40
2011–12	80.30	76.80	30.40

Extended producer responsibility

The NSW *Waste Avoidance and Resource Recovery Act 2001* allows for extended producer responsibility (EPR) schemes to be introduced. A series of four EPR priority statements have been released by the Department between 2004 and 2010. The 2010 statement updates the progress of the 17 wastes of concern that have been nominated in previous priority statements. The 2010 priority statement was open for public submission until 1 April 2010, with a submission report scheduled to be released by 30 June 2011.

The NSW Minister for Climate Change and the Environment wrote to the Environment Protection Heritage Council (EPHC) in November 2010 recommending urgent action for a selection of the 17 wastes of concern. These included e-waste, tyres, packaging and plastic bags. The request also sought action to accelerate programs for paints, timber and mercury containing lamps.

Other programs of interest

A number of other programs or initiatives of interest are described in Table 6-50.

Table 6-50 Other programs or initiatives of interest, NSW

Program	Details
Waste and Sustainability Improvement Payment (WaSIP)	Councils in the SMA, ERA and RRA are required to commit to meeting the current and future years' WaSIP Standards. The Standards are established by DECCW in consultation with an Advisory Group and the Local Government and Shires Associations. Compliant Councils are eligible for annual reward payments.
Voluntary regional waste management groups	Renew NSW develops and implements regional waste management and resource recovery plans. Renew NSW consists of eight voluntary regional waste management groups. These groups cover 90% of rural and regional NSW, representing over 100 councils and 1.2 million residents.
NSW Greenhouse Gas Reduction Scheme (known as GGAS)	This scheme has been in place since 2003 provides incentives for smaller landfill sites to capture landfill gas and use it to generate electricity, and for projects that divert putrescible waste from landfill to make electricity. A review of the scheme was announced in November 2010, due to ongoing uncertainty associated with the timing, form and scope of national carbon pricing arrangements. GGAS ceased on 30 June 2012.
Environment protection licences	These licences are issued to owners or operators of various industrial premises. Licence conditions and assessment relate to the waste strategy in force under the *Waste Avoidance and Resource Recovery Act (2001)*.
Household chemical clean out	This program allows a free collection service for householders to safely dispose of household hazardous waste such as paints, oils, lead acid batteries, cleaning products etc. The program facilitated through the DECCW and local government includes the recovery of materials through permanent drop-off sites, and a mobile service delivered through a series of scheduled collection days across the State.
Waste Reduction and Purchasing Policy (WRAPP)	The WRAPP commenced in 1997. It requires all NSW government agencies and state owned corporations to develop and implement a WRAPP Plan aimed at reducing waste and increasing purchase of products of recycled content materials. This includes items such as paper and cardboard, office consumables, toner cartridges, computers and monitors, vegetation waste and construction and demolition waste. *WRAPP Reporting Guidelines 2009* were released to offer agencies with a revised framework for the program and associated reporting.

6.2 Victoria

Information on the programs and strategies being implemented in Victoria has been sourced from:

- Sustainability Victoria website: www.sustainability.vic.gov.au
- EPA Victoria website: www.epa.vic.gov.au
- Metropolitan Waste Management Group website: www.mwmg.vic.gov.au
- State Government of Victoria (2005) *Towards Zero Waste Strategy*
- Department of Sustainability and Environment (2009) *Metropolitan Waste and Resource Recovery Strategic Plan*
- Sustainability Victoria (2010*) Towards Zero Waste Strategy Progress Report for 2008–09*.

Towards Zero Waste strategy

The Victorian Towards Zero Waste Strategy (TZW) sets the strategic direction for solid waste management in Victoria across all sectors. Although released in 2005, the Strategy seeks to minimise solid waste generation and maximise recovery of materials based on 2003 levels, with targets set to 2014. The 2014 targets are outlined in Table 6-51.

Table 6-51 Victorian TZW Strategy targets

Target	Description
Target 1	A 1.5 million tonne reduction in the projected quantity of solid waste generated, by 2014.
Target 2	75% by weight of solid waste recovered for re-use, recycling and/or energy generation by 2014
Target 3	Sectoral targets achieved by 2008–09 and 2014
Target 4	A 25% improvement, from 2003 levels, in littering behaviours by 2014.

The sectoral targets referred to in Target 3 are outlined in Table 6-52.

Table 6-52 Victorian TZW Strategy sectoral targets

Recovery rate (by weight)	2002–03	2008–09 Progress target	2014 Target
Municipal waste	35%	45%	65%
Commercial & Industrial waste	59%	65%	80%
Construction & Demolition waste	57%	65%	80%
All solid waste streams	51%	60%	75%

TZW also outlines the priority materials and products for each sector. Criteria for determining priority materials focused on the quantity disposed to landfill, the adequacy of recycling systems in place, and the environmental and social costs associated with disposal. Priority products have the same criteria but an emphasis on shared responsibility across the product life cycle. Priority materials and products identified for the municipal sector are outlined in Table 6-53.

Table 6-53 Priority materials and products within the municipal sector

Materials
Garden organics
Food organics
Paper/ cardboard
Timber
Products
Electrical and electronic appliances (including televisions and mobile phones)
Computers and peripheral IT equipment
Tyres
Consumer packaging
Paint
Mercury-containing lamps including fluorescent lamps
Treated timber
Batteries
Plastic shopping bags
Motor vehicles

The *Towards Zero Waste Strategy Progress Report for 2008–09* (the fifth year mid-point of the ten year Strategy), reported the following achievements against the Strategy targets as outlined in Table 6-54.

Table 6-54 Progress on interim targets (2008–09) towards achieving projected targets for 2014

2014 Targets	2008–09		
	Projected target	Interim target	Actual target
1.5 million tonne reduction in solid waste generated (reported as total solid waste generated)	10 million tonnes generated		10.3 million tonnes generated
75% by weight of solid waste recovered for re-use, recycling and/or energy generation		60%	64%
Sectoral recovery rates achieved:			
• Municipal solid waste (65%)		45%	43%
• Commercial & industrial waste (80%)		65%	71%
• Construction & demolition waste (80%)		65%	71%
A 25% improvement in littering behaviour from 2003 levels	13.6%		17.2%

Landfill levy

A levy on waste sent to landfill was introduced in metropolitan Melbourne in the early 1990s and later expanded to all other areas of Victoria. The levy provides a financial incentive for diversion of waste from landfill.

Funds collected through the landfill levy are distributed as required by the *Environment Protection (Distribution of Landfill Levy) Regulations 2002*. On this basis, Victorian landfill levy monies are reinvested to facilitate environmental protection, foster environmentally sustainable resource use, and best practice in waste management.

This includes levy monies funding defined activities of the Metropolitan Waste Management Group (MWMG), regional waste management groups (RWMGs), Sustainability Victoria (SV) and EPA Victoria. Program funding through these agencies supports waste management and recovery infrastructure, industry waste reduction programs, education, regulatory controls and enforcement. Levy funds are also allocated through the State Government managed Sustainability Fund, under the directive of the Treasurer and Minister responsible for the Environment portfolio.

The landfill levy payable per tonne of solid municipal and industrial waste since July 2001 is outlined in Table 6-55.

Table 6-55 Amount payable under the landfill levy per tonne of solid waste disposed

Financial year	Amount payable (per tonne)			
	Metropolitan & provincial		Rural	
	Municipal	Industrial	Municipal	Industrial
2001–02	$4	$4	$2	$2
2002–03	$4	$5	$2	$3
2003–04	$5	$7	$3	$5
2004–05	$6	$9	$4	$7
2005–06	$7	$11	$5	$9
2006–07	$8	$13	$6	$11
2007–08	$9	$15	$7	$13
2008–09	$9	$15	$7	$13
2009–10	$9	$15	$7	$13
2010–11	$30	$30	$15	$25
2011–12	$40	$40	$20	$35

The Victorian State Government agencies involved in the allocation of landfill levy funds announced in October 2010 a range of funding programs to support waste avoidance, reduction and recovery. There are three programs commencing in 2010–11 and running for four years.

EPA Victoria's Beyond Waste Fund (formerly the Waste Reduction Fund) is a $14 million initiative over four years, designed to help businesses avoid generating waste, and reduce what is sent to landfill by supporting innovations that lessen the waste generated from their daily operations.

Sustainability Victoria's Driving Investment for New Recycling Fund is a $14 million initiative over four years, designed to assist councils, waste management groups and the recycling sector provide new infrastructure, and upgrade and increase infrastructure capacity and capability.

The Metropolitan Waste Management Group's Metropolitan Local Governments Waste and Resource Recovery Fund is a $5.5 million fund over four years designed to support the delivery of the Metropolitan Waste and Resource Recovery Strategic Plan and the associated achievement of the TZW municipal solid waste targets.

Waste management groups

The Metropolitan Waste Management Group (MWMG) was established in October 2006 under the *Environment Protection (Amendment) Act 2006*. The MWMG is the successor to the four former waste management groups located within metropolitan Melbourne. The role of the MWMG is to:

- plan for waste management and resource recovery facilities and services across metropolitan Melbourne
- facilitate procurement of efficient and sustainable resource recovery and residual waste disposal services for Councils
- help build the capacity and knowledge of Councils and their communities of world best practice waste minimisation and the opportunities and options available to reach the TZW targets and beyond.

In addition to the MWMG, there are twelve Regional Waste Management Groups (RWMGs) covering all of Victoria beyond metropolitan Melbourne. In 2007, the Department of Sustainability and Environment commenced a review of the twelve RWMGs. In February 2009, Sustainability Victoria accepted major responsibility for the review. On the basis of extensive consultation, the *Review of Regional Waste Management Groups Future Directions Paper Consultation Draft* was released in 2009. In late 2009 the RWMG were informed of amalgamations of selected RWMGs, however the November 2010 change in the Victorian State Government has seen the proposed amalgamations put on hold. On this basis, the current structure of twelve RWMGs remains.

Metropolitan plan

The *Metropolitan Waste and Resource Recovery Strategic Plan* was released in May 2009. The Plan was developed to ensure that the key deliverables and targets of TZW for the metropolitan Melbourne would be met. The Plan includes three components, the Metropolitan Plan, the Municipal Solid Waste Infrastructure Schedule and the Metropolitan Landfill Schedule.

The *Metropolitan Local Government Waste and Resource Recovery Fund,* outlined previously in reference to the distribution of landfill levy funding in Victoria, is aimed at supporting local government in Metropolitan Melbourne implement actions outlined in the *Metropolitan Waste and Resource Recovery Strategic Plan*.

Product specific programs

A number of programs have been implemented in Victoria, focusing on improving diversion of specific products or materials. These are outlined in Table 6-56.

Table 6-56 Product specific programs, Victoria

Program	Product focus	Details
Batteryback	Rechargeable batteries from products such as laptops, phones and cameras.	Batteryback is an industry-government initiative which provides a free recycling service via containers located in selected retail stores.
Detox Your Home	Household hazardous waste, including paint, cleaners and pesticides	A number of permanent Detox Your Home centres have been established, which are supplemented by a series of mobile collections held across Victoria annually.
Byteback	Computer equipment and peripherals	A number of permanent collection locations have been established for residents and small business owners in Victoria to safely dispose of unwanted, old and unused computers for recycling.
Flashback – trial	End-of-life household light globes	The Flashback 12 month trial was established to collect and recycle end-of-life household light globes. The trial ended on 30 June 2009 and an evaluation report was prepared for Sustainability Victoria. Although the future of an ongoing program has not been determined, Mercury-containing lamps can be still be disposed of through the Detox Your Home permanent and mobile collections.

6.3 Queensland

Information on the programs and strategies being implemented in Queensland has been primarily sourced from:

- the Department of Environment and Resource Management (DERM) website: www.derm.qld.gov.au
- Department of Environment and Resource Management (2010) *Queensland's Waste Reduction and Recycling Strategy 2010–2020.*

Queensland's Waste Reduction & Recycling Strategy 2010–2020

In Queensland, DERM has statutory responsibility to '*manage the environmental impacts of waste in Queensland and to minimise adverse effects on human health and the environment*.'

Before becoming part of DERM, the former EPA released a discussion paper for Queensland in 2007 titled, '*Let's not waste our Future: Queensland's Waste Strategy'*. On the basis of consultation around the draft 2007 strategy, a revised draft strategy, *Queensland's Waste Strategy 2010–2020 Waste Avoidance and Recycling Consultation Draft*, was released by DERM in June 2010. The draft Strategy was accompanied by a companion document titled, *Queensland's Waste Strategy 2010–2020: Proposed Industry Waste Levy Consultation Draft*.

The feedback from the second draft Strategy and companion document was used to inform the final Strategy, *Queensland's Waste Reduction and Recycling Strategy 2010–2020*, which was released by DERM in December 2010.

The Strategy acknowledges that it is seeking to ensure that Queensland is meeting a range of obligations including those under the *National Waste Policy* and the Queensland Government's targets outlined in *Toward Q2: Tomorrow's Queensland*.

The Strategy outlines guiding principles that are based on the waste and resource management hierarchy. On this basis it highlights that its broad goals are to:

- reduce waste
- optimise recovery and recycling
- develop sustainable waste industries and jobs.

The Strategy has adopted a five-part approach to achieve these goals, which includes:

- clear targets and priorities
- setting a price signal – the waste disposal levy
- stronger regulation
- new programs and investment strategies
- partnering for change.

The Strategy is to be reviewed every three years, and the targets as articulated in the ten year Strategy are outlined in Table 6-57.

Table 6-57 Key targets and dates, Queensland

Target	2008 baseline	By 2014	By 2017	By 2020
Reduce waste disposal to landfill, compared to business-as-usual projections	Business-as-usual – no strategy	Reduce landfill disposal by 25% – 4.6 million tonnes of avoided landfill disposal since 2010	Reduce landfill disposal by 40% – 9.9 million tonnes of additional avoided landfill disposal since 2014	Reduce landfill disposal by 50% – 16.3 million tonnes of additional avoided landfill disposal since 2017
Increase recycling of construction and demolition waste	35%	50%	60%	75%
Increase recycling of commercial and industrial waste	18%	40%	50%	60%
Increase recycling of regulated waste	30%	35%	40%	45%
Increase recycling of municipal solid waste Target 150: increase recycling of household waste to 150 kg per person per year	23% 64 kg per person per year	50% 80 kg per person per year	55% 100 kg per person per year	65% 150 kg per person per year
Reduce generation of waste	2.4 tonnes per person per year	5% reduction 2.4 tonnes per person per year	10% reduction 2.2 tonnes per person per year	15% reduction 2 tonnes per person per year

Waste disposal levy

One of the mechanisms to be introduced is a waste disposal levy which is intended to send a pricing signal to influence disposal behaviour. The levies, which are due to commence on December 1, 2011, will be introduced in 34 of the 74 local government areas in the State, all with populations greater than 10,000 people. The waste disposal levies are summarised in Table 6-58.

Table 6-58 Waste disposal levies for Queensland

Waste stream	Disposal levy amount (July 1, 2011)
Commercial & industrial waste	$35 per tonne
Construction & demolition waste	$35 per tonne
Contaminated & acid sulphate soils	$35 per tonne
Lower hazard regulated waste	$50 per tonne
Higher hazard regulated waste	$150 per tonne
Municipal solid waste	No levy

The Strategy indicates that over the first four years of collection, the levy funds will be distributed by the Queensland Government as follows:

- $159 million towards targeted programs to help business and industry reduce the amount of waste they generate, and to encourage industry investment in recycling technologies, particularly in regional areas
- $120 million for local governments to spend on environmental projects, focusing on better waste management facilities and practices
- Any surplus funds will be dedicated to priority Queensland Government environmental initiatives, including acquiring land for national parks.

Priority products

The Strategy identifies a series of priority waste and products for attention. A range of products / materials have been given a high or secondary priority rating in relation to their significance in the three key waste streams of municipal solid waste, C&I waste and C&D waste. The range of products / materials includes:

- Mixed C&D materials
- Packaging
- Computers & televisions
- Batteries and fluorescent lights
- Tyres
- Organic – green & garden
- Organic – processing & food scraps
- Timber & concrete
- Gas bottles
- Higher hazard regulated.

To facilitate state-based action, that supports national approaches to these products / materials, the Queensland Government is proposing to introduce new legislation in 2011 which identifies priority products and materials, preferred management options and performance measures.

Potential actions being considered in this process, which have been identified in the Strategy, include:

- voluntary or mandatory ‘product stewardship’ or take-back schemes
- disposal bans
- education and awareness campaigns to target reduced generation and enhanced recovery
- support for collection programs or reprocessing infrastructure
- investing in design-for-environment to increase recyclability or reduce toxicity of inputs.

6.4 South Australia

In South Australia, the key agencies responsible for waste management include the Environment Protection Authority (EPA) South Australia, and Zero Waste South Australia (Zero Waste SA). Both organisations sit within the State Government portfolio of Environment and Conservation. The EPA is the independent State regulator with responsibility for administering the *Environment Protection Act 1993* (the Act). Zero Waste SA is the State Government agency with the primary objective of promoting waste management practices through partnerships with all levels of government, business, the waste industry and the community to meet the State's recycling and resource efficiency objectives.

Information on the programs and strategies being implemented in South Australia has been sourced from:

- Zero Waste SA website: www.zerowaste.sa.gov.au
- EPA South Australia website: www.epa.sa.gov.au
- Zero Waste SA (2010) *South Australia's Waste Strategy 2010–2015 Consultation Draft*
- *South Australia Environment Protection (Waste to Resources) Policy 2010*, under the *Environment Protection Act 1993*
- EPA South Australia (2010) *Waste Guidelines–Waste Levy Regulations*.

Draft waste strategy

The State's first waste strategy, *South Australia's Waste Strategy 2005–2010* (Strategy) has been reviewed, and in August 2010 *South Australia's Waste Strategy 2010–2015* Consultation Draft (Draft Strategy) was released for public comment, which closed on October 8, 2010.

The Draft Strategy sits under *South Australia's Strategic Plan 2007*, and like the previous Strategy the focus of this revised Draft Strategy continues to be on reducing waste to landfill. Over time, the intention of the Draft Strategy is that other waste streams beyond solid waste, such as liquid and agricultural wastes, will gradually be included.

The two key objectives of the Draft Strategy are to:

- maximise the value of resources
- avoid and reduce waste.

A series of actions are proposed in the Draft Strategy that seeks to support the State in meeting these overarching objectives. These are outlined in Table 6-59.

Table 6-59 Draft Strategy targets, South Australia

Target area	By 2012	By 2014	By 2015	Comments
Reduction in landfill disposal		25% reduction (from 2002-03 base year)		Per capita reduction: 5% over five year
Municipal solid waste	60%		65%	Based on 2009 estimated diversion of 55% of MSW from landfill, Adelaide metro only
Commercial & industrial	65%		75%	Based on 2009 estimated diversion of 60% of C&I from landfill, Adelaide metro only
Construction & demolition	85%		90%	Based on 2009 estimated diversion of 80% of C&D from landfill, Adelaide metro only
Problematic & hazardous waste			Effective extended producer responsibility schemes in place	
Disposal & illegal dumping	Decreased incidences & tonnages (based on 2009 baseline)			

The Draft Strategy sets out a series of actions that seeks to deliver these targets within the five year timeframe. This is further supported by actions that address the importance of research and development in the delivery and evaluation of the Draft Strategy in meeting its two overarching objectives.

Environment Protection (Waste to Resources) Policy 2010

To support the delivery of *South Australia's Strategic Plan 2007* target to reduce landfill disposal by 25% by 2014, and to facilitate the delivery of the objectives of the Draft Strategy, EPA South Australia delivered a new regulatory framework in 2010. Under the *Environment Protection Act 1993* (the Act), the EPA introduced the *Environment Protection (Waste to Resources) Policy 2010* (W2REPP), which came into effect on 1 September 2010.

As articulated in the W2REPP, its overarching objective is to:

> *'achieve sustainable waste management by applying the waste management hierarchy consistently with the principles of ecologically sustainable development set out in section 10 of the Act.*

To achieve this objective, the W2REPP highlights that waste management in South Australia should also:

- promote best practice and accountable waste management, taking into account regional differences within the State
- include effective recording, monitoring and reporting systems with respect to waste transport, resource recovery and waste disposal

- promote environmental responsibility and involvement in waste avoidance, waste minimisation and waste management within the community.

The objective and goals articulated in the Policy will be achieved through a series of actions which are outlined on the EPA website and summarised in Table 6-60.

Table 6-60 Key elements of W2REPP

Key element	From 1 Sept 2010	From 1 Sept 2011	From 1 Sept 2012	From 1 Sept 2013
Landfill bans	With a range of qualifications the following materials have some form of disposal limitation: Hazardous waste; Lead acid batteries; Liquid waste; Medical waste; Oil; Whole tyres; Aggregated cardboard and paper; Aggregated glass packaging; Aggregated metals; Aggregated PET or HDPE plastic packaging; Vegetative matter collected by councils.	With a range of qualifications the following materials have some form of disposal limitation: Vehicles; PP or LDPE plastic packaging; Whitegoods.	With a range of qualifications the following materials have some form of disposal limitation: PVC or PS plastic packaging; Fluorescent lighting (Adelaide Metro only); Computer monitors & televisions (Adelaide Metro only); Whole earth mover tyres.	With a range of qualifications the following materials have some form of disposal limitation: Fluorescent lighting; Computer monitors & televisions; Other electrical or electronic equipment.
Illegal dumping	Improved illegal dumping and unauthorised stockpiling controls come into effect, with penalties of up to $250,000. An EPA licence is still required for the for the receipt and disposal of waste.			
Waste transport	Risk management requirements will apply for any person who transports waste (licensed or unlicensed) with penalties of up to $30,000 for non-compliance. An EPA licence, compliance with all licence conditions and the completion of waste transport certificates is still needed for the transport of waste.			
Listed wastes	Disposal obligations will apply to unlicensed activities involving listed wastes, with penalties of up to $30,000 for non-compliance.			
Medical wastes	New treatment or disposal methods for medical waste may be approved by the EPA.		Medical sharps will be banned from household kerbside bins.	

Key element	From 1 Sept 2010	From 1 Sept 2011	From 1 Sept 2012	From 1 Sept 2013
When waste constitutes a product	EPA standards may specify when a waste constitutes a product. The following relevant documents are for waste derived fill, waste derived soil enhancers and refuse derived fuel.			
Weekly waste collection	Weekly collection of residual domestic waste will be mandated for metropolitan councils.			
EPA to consider	1. The waste management objective that requires application of the waste management hierarchy consistently with the principles of ecologically sustainable development. 2. Specified management plans for particular hazardous wastes. 3. Specified guidelines for landfill depots, material recovery facilities, beverage container collection depots and transfer depots.			
Waste management codes of practice	Industry specific waste management codes of practice to specify what actions will satisfy the general environmental duty may be prescribed. Currently, the only one code of practice has been prescribed, the nationally developed *Industry Code of Practice for the Management of Clinical and Related Wastes*.			
Treatment of waste prior to landfill			Waste from metropolitan Adelaide (subject to exemptions) will be required to be subject to resource recovery processes prior to disposal at landfill.	

Landfill levy

South Australia has landfill levies on certain wastes. Levy monies are used in part to fund activities such as Zero Waste SA's waste minimisation and resource recovery programs, Keep South Australia Beautiful's (KESAB) litter strategies, and to support the EPA in administering the *Environment Protection Act 1993*, including activities such as licensing, waste tracking and compliance.

The waste disposal levies for 2010–2011 are summarised in Table 6-61.

Table 6-61 Waste disposal levies 2010–2011, South Australia

Waste	Qualifications	Disposal levy (1 July 2010)
Solid waste	**Non-metro rate** - A non-metropolitan depot disposing of non-metropolitan waste	$13 / tonne
	Non-metro rate - A metropolitan depot disposing of non-metropolitan waste brought to the depot by or on behalf of a wholly non-metropolitan council	$13 / tonne
	Metro rate - Any other case	$26 / tonne
Liquid waste	All cases	$10.90 / kilolitre
These levies are subject to increases annual Consumer Price Index (CPI) increases		

Other programs

Other South Australian programs of interest are outlined in Table 6-62.

Table 6-62 Other South Australian programs of interest

Instruments/programs	Waste type	Details
Container Deposit Legislation	Beverage Containers -aluminium, glass, LPB, PET, HDPE	Refundable deposit for returns Sorted and rinsed to lower contamination and increase value relative to non CDL recovered material.
Food Waste Pilot	Municipal solid waste - organic	Zero Waste SA piloted a kerbside collection service with 10 SA councils. The pilot project combined food waste with green organics, and included the option of a fortnightly residual waste collection.
Resource Efficiency Assistance Program (REAP)	C&I	Zero Waste SA's REAP supports companies to address waste management and resource use to improve sustainability with a focus on seeking improved financial, environmental and social returns.
Recycle Right at Work	C&I	The program encourages waste and recycling collection companies to offer improved recycling collection services for Adelaide's SMEs. Some funding assistance is available through Zero Waste SA for the introduction of new services.
Oil Recycling	Motor oil & oil containers	There is a network of 85 sites across South Australia where used oil can be safely disposed for recycling. Approximately 50 sites also collect the used oil

Instruments/programs	Waste type	Details
		containers for recycling into new oil containers and other plastic products.
Household Hazardous Waste Collection	Household hazardous waste	Zero Waste SA and Local Government provides free household hazardous waste collections to help disposal of unwanted chemicals in an environmentally safe way. This includes mobile collections and permanent sites for collection.
Zero Waste SA Environment Users System (ZEUS)	Illegal Dumping, C&I, C&D	ZEUS is a web-based data collection system for Councils. ZEUS allows Zero Waste SA to measure the State's performance against targets set in the SA Strategic Plan. Data collection modules include Illegal Dumping, C&I, C&D.
Kerbside Performance Incentives	Municipal solid waste	SA councils are eligible to received Kerbside Performance Incentive payments from Zero Waste SA must submit kerbside performance reports.
Zero Waste SA Grants Program	Varied depending on program	Illegal Dumping; Metropolitan Infrastructure; Showcase Projects; Kerbside Performance Plus (Food waste incentives); Regional Implementation Program; School & Community Grants – other programs are also listed in this table.
TV Recycling Program	E-waste	To coincide with the digital switchover in selected regional areas of SA, residents were offered free drop off opportunities for unwanted televisions for recycling at various locations.
Wipe Out Waste (WOW)	Municipal solid waste	Aims to encourage schools to reduce waste and raise student awareness about waste recycling and disposal. Resources and professional development available for teachers and schools.
Zero Waste Lifeline	Solid waste	Art program with works located in the Range Wetlands, Adelaide. The artwork aims to symbolise SA's commitment to a zero waste society and to raise public awareness about environmental sustainability.

6.5 Western Australia

Information on the programs and strategies being implemented in WA has been sourced from:

- Department of Environment and Conservation website: www.dec.wa.gov.au
- ZeroWaste WA website: www.zerowastewa.com.au
- Western Australian Waste Authority (2010) *Draft II Waste Strategy for Western Australia* March 2010.

Strategy and policy

The introduction of the *Waste Avoidance and Resource Recovery Act 2007* (WARR Act), in December 2007 resulted in the establishment in May 2008 of the Western Australian Waste Authority, which replaced the former Waste Management Board. The Waste Authority commenced full operation on 1st July 2008. The Waste Authority funding is sourced from the Waste Avoidance and Resource Recovery Account.

The Department of Environment and Conservation (DEC) supports the Waste Authority with the provision of executive, administrative, and contract management support, and also coordinates project specific activities on behalf of the Authority.

One of the key deliverables of the Waste Authority is the development of a long term Waste Strategy for Western Australia. The Strategy is required to plan for continuous improvement of waste services, waste avoidance and resource recovery, and be benchmarked against best practice. In addition, the directive for the Strategy requires that it must set whole of state targets for waste reduction, resource recovery and the diversion of waste from landfill disposal.

A first draft of the *Waste Strategy for Western Australia* was released in September 2009 with public comment open until December 2009. On the basis of comments received, a further draft was prepared *Draft II Waste Strategy for Western Australia March 2010*, (Draft II Strategy) with public comment sought until April 19, 2010.

The Draft II Strategy acknowledges that it builds on a range of work and policy development including the following:

- 2005 *Extended Producer Responsibility Policy Statement*
- 2004 *Statement of Strategic Direction for Waste Management in Western Australia*
- 2001 *Towards Zero Waste Action Plan*
- 2007 Stakeholder Advisory Group *Investigation into Best Practice Container Deposit Systems for Western Australia*.

The Draft II Strategy outlines that a series of principles will be applied to deliver on an overarching aim that seeks best practice in waste management in the State by 2022. The principles as articulated in the Draft II Strategy are:

- promoting the most efficient use of resources, including resource recovery and waste avoidance
- reducing environmental harm, including pollution through waste
- consideration of resource management options against the following waste management hierarchy–
    i. avoidance of unnecessary resource consumption
    ii. resource recovery (including re-use, reprocessing, recycling or energy recovery)

iii. disposal.

- identifying and supporting solutions that offer value for money when social, environmental and financial considerations are taken into account
- application of both the 'polluter pays' and the 'user pays' principles where appropriate
- pursuit of continuous improvement
- favouring mechanisms which can achieve the desired outcomes with minimal central control over how these are achieved.

To fulfil these principles, a series of strategies and targets have been articulated in the Draft II Strategy, as outlined in Table 6-63.

Table 6-63 Draft II Strategy Targets, Western Australia

Waste hierarchy focus	2016 Target / outcome	2020 Target / outcome
Resource recovery	70% MSW recovery rate in metropolitan Perth (up from approximately 45%)	
	Contamination rate of kerbside recyclable collections reduced from approximately 25% to 10%	
	At least a 45% waste recovery rate in regional areas of populations greater than 25,000	
	C&D waste recovery rate of 50% (up from 14% in 2006/07)	C&D waste recovery rate of 70%
	A commitment that C&I waste resource recovery rates will continuously increase over the lifespan of the strategy. At least one facility for processing C&I waste will be established by 2016	A commitment that C&I waste resource recovery rates will continuously increase over the lifespan of the strategy. A second C&I waste processing facility will be established by 2020
	The Waste Authority will assist Local Government and Industry (with guidance from the EPA) to determine which forms of resource recovery are acceptable	
Waste disposal	2011 Target / outcome	2015 Target / outcome
	All landfills servicing metropolitan Perth will be operating to appropriate standards	All landfills servicing regional areas with a population greater than 25,000 will be operating to existing standards consistent with those used by larger landfills in WA. Those not complying to these standards will be closed if they lie within a 100km radius of a landfill that does meet the agreed standards. Non-compliant sites will be replaced with transfer stations
		Residual waste from all regions with a population of less than 25,000 will be managed in accordance with a local or regional strategic waste management plan

Landfill levy

The landfill levy, introduced in 1998, applies to waste generated within metropolitan Perth and wastes disposed at landfill sites within the metropolitan area. The levy acts to increase the price of landfill compared with recovery options in order to make the latter more cost effective, and to provide resources for strategic programs. The funds generated by the levy are hypothecated for programs in the areas of management, reduction, re-use, recycling, monitoring or measurement of waste. Legislation requires a minimum 25% of the forecast levy income must be spent on the implementation of the Waste Strategy.

The *Waste Avoidance and Resource Recovery Levy Regulations* 2008 (WARR Levy Regulations) outlines the levy requirements for the disposal of waste to landfill.

Simplified guidance on the WARR Levy Regulations and levy calculation is available in a document called *Waste Avoidance and Resource Recovery Levy Regulations Administration Policy 2009* (The Administration Policy).

The Administration Policy outlines the landfill levy calculation equations for inert and putrescible landfill waste disposal. A summary of per unit costs is provided in Table 6-64. The per unit landfill levy cost is part of a more complex calculation of the landfill levy payable by a site.

Table 6-64 Western Australia levy

Levy per cubic metre – Inert landfills	Levy per tonne – Putrescible landfills
$12 / cubic metre	October 1, 2006 – June 30, 2008, $6 / tonne
	July 1, 2008 – June 30, 2009, $7 / tonne
	July 1, 2009 – December 31, 2009: $8 / tonne
	January 1, 2010 – onwards, $28 / tonne

Extended producer responsibility (EPR)

In June 2005, the Western Australian Government released its *Extended Producer Responsibility Policy Statement* (the Statement). The Statement outlines the Government's commitment to EPR and how it will be applied in Western Australia. This was further reinforced by the inclusion of EPR in the *Waste Avoidance and Resource Recovery Act 2007*. To ensure implementation of EPR programs, the Draft II Strategy has identified the following 'problem wastes' as priorities for product stewardship schemes:

- packaging and containers
- glass
- domestic hazardous materials and products containing hazardous materials, including chemicals, paint, fluorescent lights and batteries
- electronic waste
- tyres
- mattresses
- used oil.

Programs

A range of programs are identified on the ZeroWaste WA website. These are summarised in Table 6-65.

Table 6-65 Other Western Australia programs of interest

Title	Details
Zero Waste Plan Development Scheme (ZWPDS) and Regional Funding Program (RFP) pilot	The ZWPDS was intended to assist local governments in the preparation of Strategic Waste Management Plans (SWMP). An independent review was undertaken of the ZWPDS and RFP Pilot to assess the value of the programs and provide recommendations for future consideration. A report on the review was released in 2010. On the basis of the findings and the release of the Draft II Strategy, the Waste Authority has indicated that a review of SWMP criteria is planned for 2010–11 to ensure alignment with Waste Strategy priorities.
Investigation into best practice CDL for WA	In 2006 the WA Minister for the Environment formed a Stakeholder Advisory Group (SAG) on Best Practice Container Deposit Systems. The SAG investigated the potential for the introduction of container deposits on beverage containers. The report of the investigation released in 2007 stated that the SAG expected container deposits to significantly increase recycling beyond current levels for WA. This was noted to be especially the case for containers of beverages consumed away from home. Reference has been made in the Draft II Strategy to CDL being one mechanism that may be addressed in consideration of 'advance recycling fees' on problematic wastes during the life of the Strategy.
The Household Hazardous Waste Program	14 local government household hazardous drop-off centres located throughout the Perth metropolitan area. These facilities provide interim storage and some recovery and disposal avenues for various household hazardous wastes that are deposited by householders and the general public. The program includes the promotion of the safe storage, recovery and disposal of household hazardous. A strategy to seek long-term funding to sustain the program is being pursued. This will include the promotion of product stewardship programs to identify and avoid the production of harmful household hazardous wastes.
Grant programs	The Community Grants Scheme (CGS) has been established to support local, community-scale projects that improve the management of waste in Western Australia. The Strategic Waste Initiatives Scheme (SWIS) is aimed at providing support and encouragement to business and industry, local government, community groups and individuals in tackling priority waste issues.

6.6 Tasmania

Information on the programs and strategies being implemented in Tasmania has been sourced from:

- Department of Primary Industries, Parks, Water and Environment website: www.environment.tas.gov.au
- Taswaste website: www.taswaste.com.au
- Tasmania Department of Environment, Parks, Heritage and the Arts (2009) *Tasmanian Waste and Resource Management Strategy*.

Waste strategy

Under the *Environmental Management and Pollution Control Act 1994* (the Act), the Environment Protection Authority is responsible for regulating waste management activities in Tasmania. To fulfil this responsibility for waste management, a draft Waste Management Strategy was prepared in 2007, and on the basis of consultation, a final Strategy was released in June 2009.

The *Tasmanian Waste and Resource Management Strategy* (the Strategy) supports the Tasmanian Government's 'Tasmania Together' Goal 12 for achieving *Sustainable Management of our Natural Resources*.

As outlined in the Strategy, the overarching framework of the Resource Management and Planning System (RMPS) has been applied, which also provides the framework for Tasmania's environmental and planning legislation and policies.

The guiding principles of the Strategy include:

- sustainable development
- the waste management hierarchy
- environmental stewardship
- precautionary principle
- life-cycle principle
- polluter and user pays.

On the basis of these guiding principles, the Strategy sets out a series of objectives that are applicable State-wide, as follows:

- improved partnerships, coordination and planning
- waste avoidance and sustainable consumption
- waste minimisation and resource recovery
- improved regulation and management of residual wastes
- improved data collection and management systems
- reduction of greenhouse gas emissions.

The Strategy has taken these objectives and developed a series of strategic actions for which it seeks to be considered and incorporated into 'stakeholder action plans'. Performance measures are also identified for the objectives, however specific targets are not articulated. The Strategy notes that the performance measures are often written in broad terms due to a lack of available data. It is noted that once the data is collected, that performance measures will be further developed and incorporated with timeframes.

Regional programs

Taswaste is a consortium of three regional waste bodies in Tasmania that represent local government, and seeks to facilitate the delivery of consistent waste management and recovery programs State-wide.

The three regional bodies within the consortium are:

- Cradle Coast Waste Management Group (North West Tasmania)
- Northern Tasmanian Waste Management (North Tasmania)
- Southern Waste Strategy Authority (Southern Tasmania).

Cradle Coast Waste Management Group (CCWMG) is responsible for managing the regional waste revenues which are collected from the Waste Levy in region, and the coordination of waste management projects which support the delivery of the regional and State Strategies. On its behalf, Dulverton Waste Management (DWM) administers the regional strategy and associated projects in direct consultation with the CCWMG.

Northern Tasmanian Waste Management Group (NTWMG) was formed in 2008. Its regional waste strategy was adopted in early 2009 by the grouping of Northern Regions Councils which participate in the voluntary waste levy.

Southern Waste Strategy Authority (SWSA) is a longest established and largest grouping of local government Councils in a regional waste structure in the State. It was also the first region to have a regional waste management strategy.

Funding for the regional bodies is supported through a voluntary local government levy of $2 per tonne on waste disposed to landfill.

6.7 Australian Capital Territory

Information on the programs and strategies being implemented in the ACT has been sourced from:

- Department of the Environment, Climate Change, Energy and Water (DECCEW) website: www.environment.act.gov.au
- Department of Territory and Municipal Services (TAMS) website: www.tams.act.gov.au/live/recycling-waste
- Department of the Environment, Climate Change, Energy and Water (2010) *Draft ACT Sustainable Waste Strategy 2010–2025*.

In the Australian Capital Territory (ACT) the Department of the Environment, Climate Change, Energy and Water (DECCEW) develops and implements sustainable environmental policies and practices, including in the area of waste management. This includes the development of the ACT's waste strategy. The Environment Protection Authority (EPA) sits within the DECCEW. It has legislative responsibility through the *Environment Protection Act 1997* for activities including waste transport and disposal.

The Department of Territory and Municipal Services (TAMS) is responsible for the implementation of the ACT waste strategy through its business unit ACT NOWaste.

Draft ACT Sustainable Waste Strategy 2010–2025

The *No Waste by 2010 Strategy* (2010 Strategy) was released in 1996 and set the vision and future directions for waste management in the ACT. The DECCEW is currently revising the 2010 Strategy, and in late 2010 released the *Draft ACT Sustainable Waste Strategy 2010–2025* (Draft Strategy). Consultation on the Draft Strategy closed in late February 2011.

The Draft Strategy highlights that its aim is to ensure that the ACT leads innovation to achieve full resource recovery and a carbon neutral waste sector.

To achieve this Draft Strategy outlines four overarching outcomes that is it seeking. These are:

- less waste generated
- full resource recovery
- a clean environment
- carbon neutral waste sector.

For each of the outcomes the Draft Strategy presents a series of targets which are outlined in Table 6-66.

Table 6-66 Draft Waste Strategy Target, ACT

Less Waste Generated	Full Resource Recovery	A Clean Environment	Carbon Neutral Waste Sector
The growth in ACT waste generation is less than the rate of population growth	The rate of resource recovery increases: – over 80% by 2015 – over 85% by 2020 – over 90% by 2025 (with no recoverable waste sent to landfill)	ACT leads Australia in low littering and incidents of illegal dumping. ACT's natural resources are protected and, where feasible, enhanced through waste management	The ACT Waste Sector is carbon neutral by 2020

Waste charges

To deliver on each of the targets outlined, the Draft Strategy also presents a series of 'strategies' which are waste stream and program specific.

One of the strategies the ACT has adopted in the past, and which has worked well in supporting the diversion of waste from landfill, has been to put a price on waste. The ACT has found that landfill disposal charges have changed behaviour, when compared with alternatives such as drop-off facilities that are free or have nominal fees which are less than landfill charges.

From 1 July 2011, the landfill fee for ACT household waste will be $68.67 per tonne, or $109.70 from non-ACT households. The landfill fee for general commercial and industrial waste will be $121.90 per tonne. Should the mixed C&I waste contain greater than 50% recyclable material, then the fee payable will be $166.25 per tonne.

The Draft Strategy highlights that the ACT Government will continue to develop its regulatory and pricing approach as the system for waste management evolves to incorporate new treatment and sorting facilities.

6.8 Northern Territory

Information on the programs and strategies being implemented in the Northern Territory has been sourced from:

- Northern Territory Government website www.territory2030.nt.gov.au
- Northern Territory Department of Natural Resources, Environment and the Arts website: www.nt.gov.au/nreta/
- Environment Protection Authority website www.epa.nt.gov.au
- The Department of the Chief Minister (2009) *Territory 2030 Strategic Plan*
- Packaging Stewardship Forum of the Australian Food and Grocery Council website www.afgc.org.au/psf/remote-and-indigenous.html.

The Northern Territory Environment Protection Authority (EPA) is an independent statutory body responsible for advising and making recommendations to NT Government, business and the community in relation to ecologically sustainable development. This includes addressing priority issues associated with human settlements and resource consumption, which include waste management.

The NT Department of Natural Resources, Environment, the Arts and Sports (NRETAS) also has the Waste and Pollution Management unit which supports the Government to achieve its commitment to waste management.

The Department of the Chief Minister began a process in 2008 to prepare a 20 year Strategic Plan for the NT. The NT Government appointed an independent steering committee, which defined six areas of importance to the Territory. These were:

- education
- society
- economic sustainability
- health and wellbeing
- the environment
- knowledge, creativity and innovation.

After releasing and consulting on a draft Strategic Plan, the *Territory 2030 Strategic Plan* (the Plan), was released in 2009.

The Plan acknowledges that waste is a real issue for the NT. Waste management is addressed under some key areas of the Plan. These include objectives addressing the Territory making headway into lifestyle illnesses, where a target has been set to 'improve environmental health in remote communities to a standard similar to rural and urban communities by 2020.' Delivering effective waste management systems is seen as one action to deliver on this target.

A further objective addresses sustainable living, and identifies a target to 'reduce the amount of waste being taken to our rubbish dumps by 50% by 2020'.

The measures that the Plan recommends be adopted to achieve this include:

- measure and monitor aggregated landfill at licensed landfill locations
- measure and monitor the volume of recycling

- provide more apartment complexes and residential areas with the capacity to recycle
- encourage better packaging of products by Territory manufacturers
- establish a container deposit system
- encourage a reduction of waste from Territory building and development sites.

It is proposed the Plan is reviewed every five years over its lifetime to ensure that it is meeting the objectives and outcomes it has set for the NT. The first review is scheduled for 2015.

To support the practical implementation of the objectives of the Plan, the NT Government makes funding available through its annual EnvironmeNT Grants. The grants are available to schools, community groups, local government and industry associations for environmental projects and educational activities. Funding includes support for projects with a waste and resource recovery focus.

To support opportunities in remote areas of the NT, organisations including the NT Government, Packaging Stewardship Forum of the Australian Food and Grocery Council (PSF) and Keep Australia Beautiful NT, have been working in partnership with Indigenous communities to support their clean up and material recovery efforts. The partnership program has included the development and provision of guidance ('Clean Up' Book) and recovery services in remote indigenous communities. The initiative was launched in the NT in December 2007 and the partnership has seen the introduction of new recycling systems into many communities which were previously without services.

7 BARRIERS TO RESOURCE RECOVERY & WASTE MINIMISATION

This section contains an overview discussion of the main barriers to increasing the level of resource recovery in Australia. Information from a wide range of sources was drawn together to provide an updated perspective on the barriers to resource recovery. This section of the report is an update from that provided in the 2009 report. The overarching framework for the discussion is based on a series of assumptions, which include:

- increased resource recovery and reduced waste disposal to landfill are desirable due to the environmental and social benefits that they deliver
- the optimal point of resource recovery has not yet been achieved in Australia
- different barriers apply in varying measure to the diverse products and materials reaching end-of-life.

On the basis of these considerations the discussion that follows is therefore of a general nature, and applies to resource recovery and waste avoidance nationally.

7.1 Unrestricted disposal

In most Australian states and territories recyclable materials can be disposed to landfill without restriction. In 2010 Hyder completed a desk top study into the international application of landfill bans and disposal restrictions[26]. This review found many overseas jurisdictions have successfully introduced bans or restrictions on the disposal of recyclables to landfill.

In Europe for example, some landfill bans have been in existence for a decade and offer a good guide as to how bans can impact on waste outcomes. In all of the cases examined a combination of bans and other instruments (such as levies) have produced strong results in reducing waste disposal to landfill.

The investigation highlighted that overseas bans and restrictions took a range of different forms. Some addressed unsorted waste; wastes determined by their organic content; by their sources; or by waste type, such as e-waste, liquid wastes, batteries, packaging, vehicles, timber, paper and biodegradable wastes.

There are, however, a number of different landfill bans and restrictions in place in Australian jurisdictions. These landfall bans and restrictions are supported by a range of federal and state regulations and programs.

The Hyder study found each Australian jurisdiction was using a different set of tools to control wastes. In addition, motivations for waste management in Australia were usually different from those overseas. In Europe there were often pressures to move away from landfill for capacity reasons (as well as legislation). With some exceptions, jurisdictions within Australia do not have this problem, so capacity concerns may not apply.

Landfill bans or restrictions in Australia are mostly based on the properties of waste, and are identified by either this factor (waste property) or waste type. Examples included:

26 Hyder Consulting for the Department of Sustainability, Environment, Water, Population and Communities, *Landfill Ban Investigation*, 16 November 2010.

- contaminated soil which was banned in Victoria on the basis of its chemical properties and was also characterised by these chemical properties
- medical waste in South Australia which was banned on the basis of its potentially infectious properties but the ban was by waste type.

The Hyder study determined the barriers which needed to be addressed in planning for and implementing landfill bans or restrictions should include:

- analysis of environmental and financial outcomes and technologies
- local involvement and implementation
- clear responsibilities and cooperation between government levels
- juridical and financial instruments
- transparency and clear communication to the public
- clarity in establishing timelines for compliance.

The review indicated the successful implementation of landfill bans benefited from a clear articulation of the goals of the ban. One barrier for future implementation of landfill bans in Australia may be that each jurisdiction has its own specific conditions and motivations for introducing bans.

7.1.1 Pre-sorting at landfills

The Hyder review found that another important element of the successful implementation of a landfill ban was to build an understanding of where waste would be diverted. Understanding of the alternative avenue of treatment usually improved support for landfill bans and the development of regulations and associated programs.

Pre-sort facilities at landfill sites are one such alternative treatment. A pre-sort condition on waste destined for landfill is in place in a number of countries in Europe. A cost-benefit analysis by the United Kingdom Waste and Resources Action Programme (WRAP) indicated the application of a pre-sort condition delivered positive benefits.

Australia has the technological capabilities to manage the application of pre-sort conditions on landfilling. This has been demonstrated most effectively in South Australia where a ban is in place on the disposal of waste to landfill of material that has not first been subjected to a resource recovery process (pre-sort) in Metropolitan Adelaide.

In addition, South Australia has introduced a schedule of landfill bans, (as previously detailed in Section 6). These bans include the targeting of disposal to landfill of recyclable materials. South Australia's initiative extends the scope of landfill bans beyond those in other Australian jurisdictions to one that is more reflective of the European approach.

Both the Australian and overseas experience highlights that complimentary policy instruments to support landfill bans include:

- landfill levies
- national resource recovery targets and objectives for products and materials
- extended producer responsibility programs
- purchasing polices
- resource recovery infrastructure development.

With thorough waste management planning and suitable complimentary instruments, landfill bans could offer Australia robust hazard control and reduction – as they already do in a number of jurisdictions – while also delivering improved resource recovery and diversion outcomes in a cost efficient manner.

7.2 Disposal pricing

For most materials the financial unit cost of disposal to landfill is cheaper than the financial unit cost of resource recovery. In part, this is because of the low price of virgin materials which recycled materials compete with (see Section 7.3).

Landfill is also cheaper because landfill charges do not reflect the full direct, indirect and correlated environmental and social costs of landfill, including; greenhouse gas impacts, the depletion of non-renewable resources, the loss of environmental amenity, insurance against future environmental contingencies, and remediation of sites.

In the absence of restrictions on disposal, low landfill charges generally result in low recovery. This is particularly the case for C&D waste and self-hauled domestic (municipal) waste where the pricing signal at the gate is most directly felt. Where the price of disposal to landfill is forcibly increased, there are usually improvements in recovery. However, increases in landfill pricing can encourage the practise of illegal dumping or landfilling.

7.2.1 Landfill levies

Figure 7-29 indicates that, over the timeframes represented, the two best performing jurisdictions – ACT and SA – were those with fully hypothecated levies where monies go directly back into waste management and resource recovery programs. The next best jurisdiction – Victoria – has a partially hypothecated levy system (monies also go into other environmental programs beyond waste management). Next is NSW, which directs levy monies into central revenue. In the years charted, Queensland was without a levy, and Western Australia had only recently introduced a levy that was more strongly focused on MSW rather than C&D and C&I. As outlined in Section 6, Queensland will introduce a levy on defined wastes in 2011, but this will not include MSW. To enable year-on-year comparison the 2008–09 data in this chart has not been modified to be consistent with the method described in Section 3 of this report.

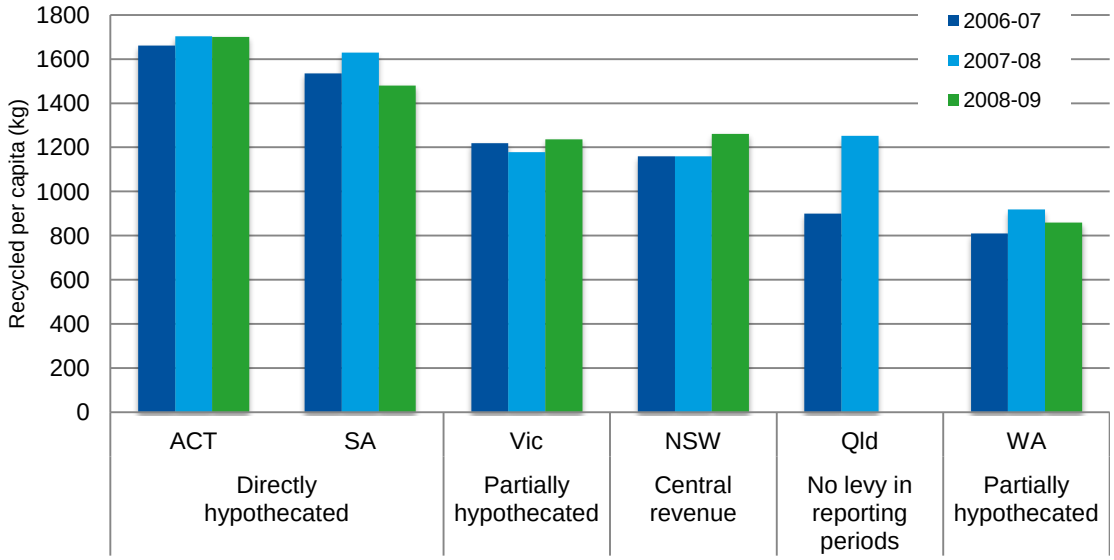

Figure 7-29: Comparison of percentage of reported recycling activity to waste generation by state 2006–07, 2007–08 and 2008–09

Figure 7-29 presents an estimate of responses to the price of landfill, (including through levy rises) for certain waste streams. Figure 7-29 indicates MSW diversion is unlikely to increase unless disposal prices increase by around $20/t, at which point the diversion of food waste to the green waste system becomes competitive. At around $60/t increase in disposal prices, diversion of the entire residual stream from landfill is likely to occur.

C&I waste has a more complex response as it is more varied and responds more rapidly and directly to market pricing signals.

C&D waste generation responds most rapidly to a pricing signal. The non-recycled portion of C&D is generally mixed materials from small construction and demolition sites, particularly in the residential sector where source separation is more difficult to achieve.

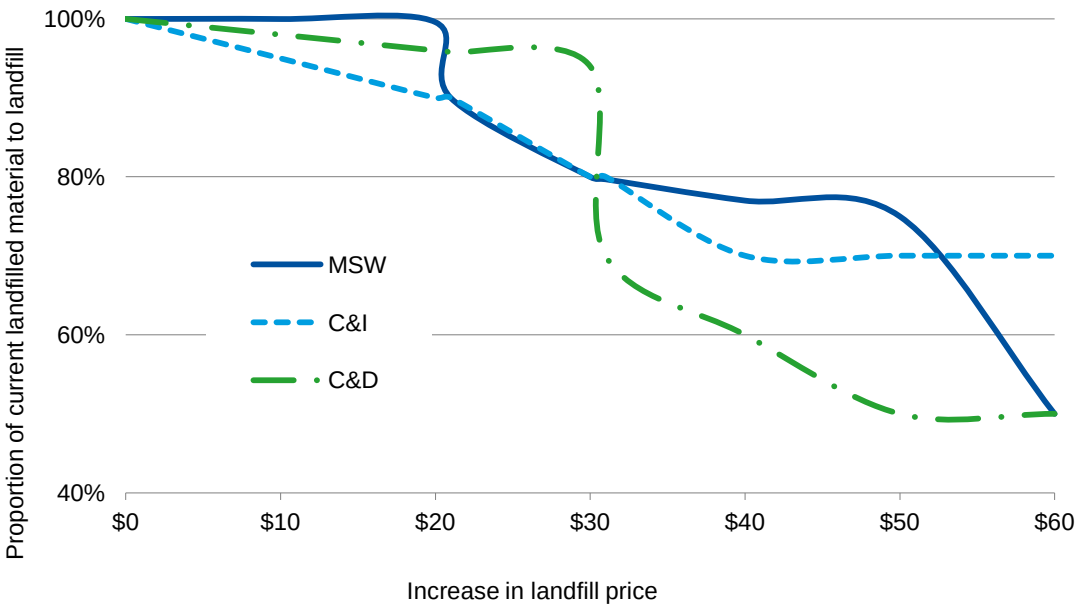

Figure 7-30: Assumed diversion responses of waste streams to increases in the prices of landfill

Note: Developed by Hyder Consulting based on work undertaken Sustainability Victoria in 2009. The chart does not take into account time delays due to fixed contractual arrangements and lack of infrastructure.

7.2.2 Product Stewardship

Product stewardship schemes can also be used to bridge the gap between the cost of landfill and the cost of recycling. Either as a regulatory or voluntary measure, product stewardship schemes usually involve the provision of the recycling of end-of-life products at a reduced cost, no cost, or even with a cost incentive to consumers.

For example, South Australia's container deposit scheme relies on the incentive of consumers regaining the deposit on beverage containers at designated return facilities. These facilities separate beverage containers into material types on site which provides a good quality, source separated feed stock for reprocessors.

The Australian Government committed to introducing Product Stewardship Framework Legislation to provide for the regulation or endorsement of a range of product stewardship schemes, and the *Product Stewardship Act 2011* officially commenced on August 8, 2011.

The Government has also committed to supporting the establishment of a co-regulatory scheme for televisions and computers as the first scheme under this legislation. The television and computer scheme will require producers to meet increasing collection and recycling targets. Producers will do so by paying for the cost of recycling televisions and computers and offering consumers disposal facilities free of charge. In doing so, producers are taking on the cost of the scheme, and will either absorb that into the operation of the business, or pass it onto consumers at the point of sale.

7.3 Market demand and resource pricing

Market demand and commodity prices also have a significant effect on the rate of resource consumption and recovery of products and materials in Australia.

Resource recovery levels generally tend to be higher and more stable for materials, such as ferrous and non-ferrous metals, cardboard and newspaper, where:

- the price of the recyclate material compares favourably to the price of the competing non-recyclate (or virgin) material
- there is a clear profit to be made from the sale of the recyclate material following the cost of the material's collection and reprocessing
- there are generally low levels of contamination in the process of recyclate recovery
- there is a strong market demand for the recyclate material.

Conversely, resource recovery levels tend to be lower and less sustainable for materials, such as plastic film and timber, where:

- the price of the recyclate material does not compare favourably to the price of the competing non-recyclate (or virgin) material
- there is limited or varied market demand for the recyclate material
- the price paid for the recyclate material is less likely to meet the cost of the material's collection and reprocessing
- subsidies may be necessary to fund the gap between the price of the recyclate material's sale and the cost of the material's collection and reprocessing
- there are generally high levels of contamination in the process of recyclate recovery.

Beyond these considerations there are further reasons that the price of recyclate material may not compare to the competing virgin material. These include:

- technical efficiency – Virgin resource extraction and refining activities have economies of scale beyond those possible in the collection and reprocessing of recovered materials.
- quality – Virgin material may be superior or perceived to be superior to that of the recyclate material, or be considered to better conform to manufacturers' specifications and requirements.
- subsidies – The production and supply of virgin material may benefit from some form of direct or indirect public subsidisation. A 1998 OECD report[27] concluded that many subsidies damage the environment by encouraging over-production and the wasteful use of inputs.

27 Organisation for Economic Co-operation and Development (OECD), *Improving the Environment through Reducing Subsidies*, 22 April 1998.

7.4 Services, technology and infrastructure

As noted in Section 7.3, virgin resource extraction and refining often have economies of scale beyond those possible in the collection and reprocessing of waste products and materials. The technological and engineering complexity required for resource recovery often adds significantly to the cost of resource recovery, especially where source separation is not in place and contamination becomes an issue. Equally, because the overall market for the recyclate material tends to be emerging and smaller, there may be less than optimal investment and innovation in technological and engineering processes to address these challenges.

As also noted in Section 7.2, landfill levies and direct hypothecation of these funds have direct waste diversion and recovery outcomes, as well as funding government and industry investment in resource recovery infrastructure and community awareness programs. The effect of levies can be enhanced by policy measures that set consistent and long term waste minimisation targets. This provides certainty and incentives for private sector investment in a range of resources and programs to meet the associated market demand for services, as well as the ability to explore and develop new markets.

With the exception of the businesses who are now, or will soon be, participants in product stewardship schemes, there is limited incentive for businesses to improve their resource recovery performance. Where they do exist, they often apply to other environmental impacts, such as pollution control and energy and water management.

Case Study: Flexible Plastics

Investment in services, technology and infrastructure can be achieved where there is a clear framework for waste management.

The Australian Packaging Covenant (formerly the National Packaging Covenant) has encouraged the C&I sector to invest in the recovery of more challenging materials such as flexible plastics.

On the basis of Sustainability Victoria audit data for waste to landfill, disposal information has highlighted some landfill sites were receiving almost 8% by weight of flexible plastics in the form of films from the C&I sector (which includes freight packaging/pallet wrap) and packaging from the MSW stream, (including food packaging, mostly in the form of polyethylene and polypropylene).

Major Australian supermarket chains have implemented programs to support the recovery and reprocessing of source separated flexible plastics. The challenge in extending the recovery of flexible plastics into the domestic sector, include issues previously highlighted, such as:

- the pricing variability of the recyclate material
- the quality of recyclable material which will be subject to contamination.

Flexible plastics are often considered contaminants in kerbside recycling, which for some systems may include both the comingled recycling stream and organics recycling stream. They also present a litter issue when not disposed of appropriately, and also at landfill sites.

Opportunities exist to overcome barriers to recovering challenging materials, such as flexible plastics, where the policy instruments previously discussed contribute to investment in collection systems and resource recovery infrastructure that seeks to minimise waste disposal and maximise material recovery.

This can stimulate investment and innovation in technology and engineering processes, which may address challenges for kerbside collection systems or make options such as pre-sorting of residual waste at landfill more viable. The viability for pre-sorting would include the recovery of other higher value materials from the residual waste stream, which may subsidise the recovery of materials like flexible plastics, while improving litter management and reducing these costs for sites.

7.5 Waste minimisation

While resource recovery has increased over the past decade in all Australian jurisdictions, overall waste generation has also increased. Increased waste generation and, to a lesser extent, increased recycling are linked to increased consumption of products and materials.

There is a range of associated trends and behaviours which have contributed to the increase in consumption and subsequent waste generation, including:

- decreases in product prices
- advances in technology resulting in increased product range and shorter retention of goods
- design for obsolescence reducing the lifespan of products
- increased interest and desire for more products and materials.

The Australia Institute's 2005 study into wasteful consumption[28] estimated that $10.5 billion dollars is spent each year on goods and services that were either never used or hardly ever used. The study found food accounted for most of this wasteful consumption. Overall, Australians threw away $5.3 billion worth of food each year (this included fresh food, uneaten food and drink, and take-away foods).

The report indicated that levels of wasteful consumption reported were likely to be an underestimate due to a range of exclusions, but also because:

> ...there is evidence that respondents appear to have understated the extent of their wasteful consumption.

An ABS study released in 2006 (*Environmental issues: People's views and practices*) indicated the behaviours that are most commonly performed to help the environment are related to waste. The majority of Australian households recycle (98%) and reuse products or materials that would otherwise become waste (87%). Over the last decade, kerbside recycling has regularly been cited as the behaviour most commonly performed to help the environment.

The ABS study found the practice of reusing waste materials increased from 37% in 1996 to 87% in 2006, with the most frequently re-used materials being plastic bags (89%), old clothing or rags (41%), motor oil (28%) and kitchen or food waste (27%).

The ABS study also highlighted that between 1996 and 2006 there was an increase in community involvement in recycling organic waste. In 2006, 66% of Australian households recycled garden waste, an increase from 51% in 1996. It is likely that this increase in recycling of organic waste is due to increased organic kerbside collection services. The survey found 46% of households in 2006 practised composting, which was down from 54% in 1996.

These findings suggest the community's concern about waste translates into a limited range of resource recovery behaviours and practices, such as supporting kerbside recycling and shopping bag re-use. Behaviours embraced by the community generally tend to be those which are affordable, easily accessible and visibly linked to an environmental benefit.

Conversely, reducing consumption is perhaps the most challenging barrier to reducing waste generation. Consumption of products and materials is an important component of popular measures of economic prosperity. Furthermore, the environmental benefits of reducing product and material consumption are not widely understood, and are often not linked to waste and recycling policy.

28 The Australia Institute, *Wasteful Consumption in Australia*, March 2005.

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APPENDIX 1: WMAA Landfill Inventory (2007)

State	Total Sites	Total Size (tonnes)*	Waste - Domestic	Waste - Commercial	Waste - Solid Inert	Waste - Sewage Sludge	Environmental Controls - Waste Compaction	Environmental Controls - Daily Cover	Environmental Controls - Leachate Treatment	Environmental Controls - Lfg Flaring	Environmental Controls - Energy Recovery	Rehabilitation - Progressive Restore
NSW	30	136,182	27 (90%)	27 (90%)	27 (90%)	5 (16.7%)	28 (93.3%)	21 (70%)	10 (33.3%)	0 (0%)	0 (0%)	14 (46.7%)
	21	379,544	21 (100%)	20 (95.2%)	21 (100%)	4 (19%)	19 (90.5%)	19 (90.5%)	9 (42.9%)	0 (0%)	0 (0%)	13 (61.9%)
	9	316,400	9 (100%)	9 (100%)	9 (100%)	1 (11.1%)	9 (100%)	8 (88.9%)	3 (33.3%)	0 (0%)	0 (0%)	3 (33.3%)
	10	708,595	9 (90%)	8 (80%)	9 (90%)	3 (30%)	10 (100%)	8 (80%)	7 (70%)	3 (30%)	2 (20%)	7 (70%)
	5	705,000	5 (100%)	5 (100%)	5 (100%)	2 (40%)	5 (100%)	4 (80%)	3 (60%)	0 (0%)	0 (0%)	3 (60%)
	10	4,200,000	5 (50%)	9 (90%)	9 (90%)	4 (40%)	10 (100%)	10 (100%)	7 (70%)	4 (40%)	5 (50%)	7 (70%)
Sub Total	85	6,445,721	76(89.4%)	78(91.8%)	80(94.1%)	19(22.4%)	81(95.3%)	70(82.4%)	39(45.9%)	7(8.2%)	7(8.2%)	47(55.3%)
QLD	63	142,472	61 (96.8%)	54 (85.7%)	28 (44.4%)	8 (12.7%)	31 (49.2%)	29 (46%)	3 (4.8%)	0 (0%)	2 (3.2%)	13 (20.6%)
	9	149,409	9 (100%)	8 (88.9%)	9 (100%)	3 (33.3%)	7 (77.8%)	9 (100%)	3 (33.3%)	0 (0%)	0 (0%)	6 (66.7%)
	6	244,689	6 (100%)	6 (100%)	6 (100%)	3 (50%)	6 (100%)	6 (100%)	2 (33.3%)	0 (0%)	0 (0%)	3 (50%)
	7	504,900	7 (100%)	7 (100%)	6 (85.7%)	4 (57.1%)	7 (100%)	6 (85.7%)	2 (28.6%)	1 (14.3%)	0 (0%)	5 (71.4%)
	8	1,142,000	4 (50%)	8 (100%)	8 (100%)	3 (37.5%)	7 (87.5%)	7 (87.5%)	4 (50%)	1 (12.5%)	1 (12.5%)	3 (37.5%)
	4	1,830,000	3 (75%)	4 (100%)	4 (100%)	2 (50%)	4 (100%)	4 (100%)	4 (100%)	3 (75%)	2 (50%)	3 (75%)
Sub Total	97	4,013,470	90(92.8%)	87(89.7%)	61(62.9%)	23(23.7%)	62(63.9%)	61(62.9%)	18(18.6%)	5(5.2%)	5(5.2%)	33(34%)

State	Total Sites	Total Size (tonnes)*	Waste - Domestic	Waste - Commercial	Waste - Solid Inert	Waste - Sewage Sludge	Environmental Controls - Waste Compaction	Environmental Controls - Daily Cover	Environmental Controls - Leachate Treatment	Environmental Controls - Lfg Flaring	Environmental Controls - Energy Recovery	Rehabilitation - Progressive Restore
SA	58	110,475	54 (93.1%)	49 (84.5%)	55 (94.8%)	6 (10.3%)	40 (69%)	49 (84.5%)	1 (1.7%)	0 (0%)	0 (0%)	18 (31%)
	6	89,300	6 (100%)	6 (100%)	6 (100%)	3 (50%)	5 (83.3%)	5 (83.3%)	1 (16.7%)	0 (0%)	0 (0%)	5 (83.3%)
	2	60,000	2 (100%)	2 (100%)	2 (100%)	0 (0%)	2 (100%)	2 (100%)	1 (50%)	0 (0%)	0 (0%)	0 (0%)
	1	100,000	1 (100%)	1 (100%)	1 (100%)	0 (0%)	0 (0%)	1 (100%)	0 (0%)	1 (100%)	1 (100%)	1 (100%)
	1	120,000	1 (100%)	1 (100%)	1 (100%)	0 (0%)	1 (100%)	1 (100%)	1 (100%)	1 (100%)	0 (0%)	0 (0%)
	3	800,000	3 (100%)	3 (100%)	3 (100%)	0 (0%)	3 (100%)	2 (66.7%)	3 (100%)	0 (0%)	2 (66.7%)	3 (100%)
Sub Total	71	1,279,775	67(94.4%)	62(87.3%)	68(95.8%)	9(12.7%)	51(71.8%)	60(84.5%)	7(9.9%)	2(2.8%)	3(4.2%)	27(38%)
TAS	3	9,650	3 (100%)	3 (100%)	3 (100%)	1 (33.3%)	3 (100%)	3 (100%)	3 (100%)	1 (33.3%)	1 (33.3%)	1 (33.3%)
	3	57,400	3 (100%)	3 (100%)	3 (100%)	1 (33.3%)	3 (100%)	3 (100%)	1 (33.3%)	0 (0%)	0 (0%)	1 (33.3%)
	1	38,000	1 (100%)	1 (100%)	1 (100%)	1 (100%)	1 (100%)	1 (100%)	1 (100%)	0 (0%)	0 (0%)	1 (100%)
	3	196,000	3 (100%)	3 (100%)	2 (66.7%)	2 (66.7%)	3 (100%)	2 (66.7%)	3 (100%)	1 (33.3%)	0 (0%)	2 (66.7%)
	1	120,000	1 (100%)	1 (100%)	1 (100%)	1 (100%)	1 (100%)	1 (100%)	1 (100%)	1 (100%)	0 (0%)	1 (100%)
Sub Total	11	421,050	11(100%)	11(100%)	10(90.9%)	6(54.5%)	11(100%)	10(90.9%)	9(81.8%)	3(27.3%)	1(9.1%)	6(54.5%)
VIC	8	28,000	6 (75%)	4 (50%)	4 (50%)	0 (0%)	7 (87.5%)	6 (75%)	1 (12.5%)	0 (0%)	0 (0%)	4 (50%)
	13	229,100	13 (100%)	13 (100%)	13 (100%)	0 (0%)	10 (76.9%)	13 (100%)	7 (53.8%)	0 (0%)	0 (0%)	8 (61.5%)
	12	453,000	10 (83.3%)	11 (91.7%)	11 (91.7%)	0 (0%)	12 (100%)	11 (91.7%)	8 (66.7%)	1 (8.3%)	0 (0%)	5 (41.7%)
	8	688,000	6 (75%)	8 (100%)	7 (87.5%)	1 (12.5%)	7 (87.5%)	7 (87.5%)	5 (62.5%)	5 (62.5%)	1 (12.5%)	6 (75%)
	7	1,148,121	6 (85.7%)	7 (100%)	7 (100%)	0 (0%)	7 (100%)	7 (100%)	4 (57.1%)	1 (14.3%)	5 (71.4%)	5 (71.4%)
	8	2,443,592	8 (100%)	8 (100%)	8 (100%)	0 (0%)	7 (87.5%)	8 (100%)	7 (87.5%)	3 (37.5%)	5 (62.5%)	6 (75%)
Sub Total	56	4,989,813	49(87.5%)	51(91.1%)	50(89.3%)	1(1.8%)	50(89.3%)	52(92.9%)	32(57.1%)	10(17.9%)	11(19.6%)	34(60.7%)

State	Total Sites	Total Size (tonnes)*	Waste - Domestic	Waste - Commercial	Waste - Solid Inert	Waste - Sewage Sludge	Environmental Controls - Waste Compaction	Environmental Controls - Daily Cover	Environmental Controls - Leachate Treatment	Environmental Controls - Lfg Flaring	Environmental Controls - Energy Recovery	Rehabilitation - Progressive Restore
WA	90	172,460	79 (87.8%)	72 (80%)	76 (84.4%)	27 (30%)	26 (28.9%)	21 (23.3%)	8 (8.9%)	1 (1.1%)	0 (0%)	23 (25.6%)
	8	124,750	8 (100%)	8 (100%)	8 (100%)	5 (62.5%)	6 (75%)	7 (87.5%)	0 (0%)	0 (0%)	0 (0%)	6 (75%)
	8	289,000	3 (37.5%)	5 (62.5%)	8 (100%)	2 (25%)	7 (87.5%)	5 (62.5%)	1 (12.5%)	0 (0%)	0 (0%)	3 (37.5%)
	4	346,000	2 (50%)	4 (100%)	2 (50%)	2 (50%)	3 (75%)	2 (50%)	1 (25%)	1 (25%)	1 (25%)	1 (25%)
	5	935,000	3 (60%)	3 (60%)	5 (100%)	0 (0%)	4 (80%)	3 (60%)	1 (20%)	2 (40%)	3 (60%)	2 (40%)
	6	1,762,306	2 (33.3%)	3 (50%)	6 (100%)	0 (0%)	6 (100%)	5 (83.3%)	2 (33.3%)	2 (33.3%)	2 (33.3%)	2 (33.3%)
Total	**441**	**20,779,345**	**390 (88.4%)**	**384 (87.1%)**	**374 (84.8%)**	**94 (21.3%)**	**307 (69.6%)**	**296 (67.1%)**	**118 (26.8%)**	**33 (7.5%)**	**33 (7.5%)**	**184 (41.7%)**

APPENDIX 2: THE METHOD REPORT

National Waste and Recycling Reporting – A more uniform approach to data (the Method Report) was developed in 2010 and contained recommendations for a more consistent compilation of state and territory datasets. The recommendations of the method report were tested in the compilation of *Waste and Recycling in Australia 2011.*

For the most part, the recommendations contained in the method report were found to be appropriate for the compilation of the jurisdictions data. However, a number of further refinements are described in Section 3 of *Waste and Recycling in Australia 2011.*

The method report should therefore only be read in conjunction with *Waste and Recycling in Australia 2011*.

DEPARTMENT OF SUSTAINABILITY, ENVIRONMENT, WATER, POPULATION AND COMMUNITIES

WASTE AND RECYCLING IN AUSTRALIA 2011

INCORPORATING A REVISED METHOD FOR COMPILING WASTE AND RECYCLING DATA

FINAL REPORT

Hyder Consulting Pty Ltd
ABN 76 104 485 289
Level 16, 31 Queen Street
Melbourne VIC 3000
Australia
Tel: +61 3 8623 4000
Fax: +61 3 8623 4111
www.hyderconsulting.com

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FINAL REPORT

Author Katherine Smith, Kyle O'Farrell, Fraser Brindley, Peter Allan

Checker Paul Randell, Garth Lamb, Ylva Engqvist

Approver Kyle O'Farrell

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CONTENTS

1 EXECUTIVE SUMMARY

Previous national waste and recycling reports have noted a “lack of consistency between the material inclusions and definitions used for disposal and recycling in reports produced by different states/territories” (Waste and Recycling in Australia 2009, Hyder).

This is reflective of the different approaches of states and territories to collecting and reporting waste and recycling data. It is also reflective of the difficulty in defining what should be considered within the scope of waste and recycling reporting.

This report makes recommendations for a more consistent interpretation of these datasets for use in future national waste and recycling reporting (see Table 67). These recommendations deal with some fundamental principles of the scope of waste and recycling reporting, some known issues of difference, and some issues regarding the measurement and recording of waste and recycling. These recommendations were informed by an appraisal of the definitions of key terms used in waste and recycling reporting, and an assessment of waste and recycling datasets produced nationally.

This exercise is important for future national waste and recycling reporting in that it addresses the need to, and the reasons for, setting boundaries around national waste and recycling reporting. As is discussed at various points in this report, what constitutes a waste, and what should be considered to be within the scope of waste and recycling reporting is not clearly agreed and depends on the environmental, economic and social context.

Figure 31: Overview of the recommended scope of future national waste and recycling reporting

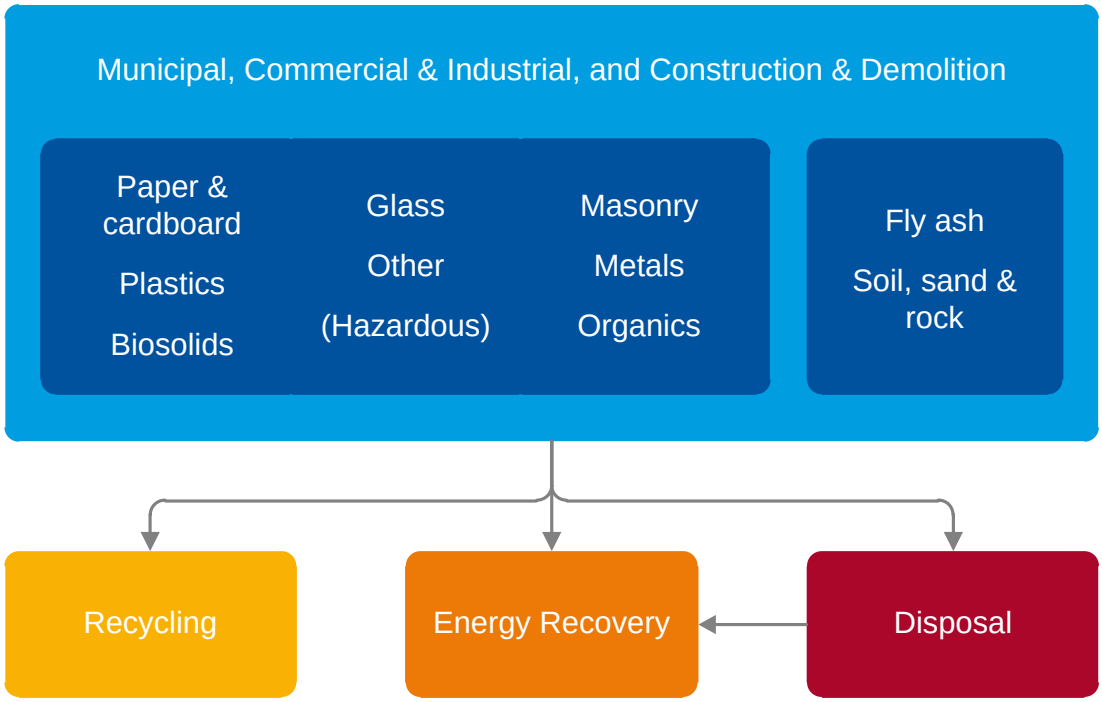


Table 67: Recommendations for a more uniform approach to data

Recommendation 1 (from the method report): the scope should be limited to waste material that is recycled, recovered for energy and disposed. Re-use is excluded from the scope.

Recommendation 2: Waste generation and waste disposal quantities should be reported, as well as recycling and recovery rates.

Recommendation 1: The scope should be limited to waste material that is collected for recycling, energy recovery and disposal, and re-use is excluded from the scope.

Recommendation 2: Waste generation and waste disposal should be considered a more useful indicator of environmental impact than recycling and recovery rates.

Recommendation 3: Liquid and gaseous wastes should be excluded from the scope at this stage.

Recommendation 4: Report waste generation data on a per capita basis using population figures that correspond to the reporting period.

Recommendation 5: Waste and recycling should be reported by weight.

Recommendation 6: Waste converted to energy should be counted as a separate disposal pathway to recycling and disposal.

Recommendation 7: The definitions in the *National Waste Report 2010* for the three major solid waste streams should be used.

Recommendation 8: Wastes generated by the core processes of primary production should be excluded from the scope.

Recommendation 9: Pre-consumer wastes that are recycled on-site as part of the manufacturing process should be excluded from the scope.

Recommendation 10: Bark and sawdust from forestry operations, and mining and mineral processing wastes should be excluded from the scope.

Recommendation 11: Agricultural wastes are excluded from the scope.

Recommendation 12: Soil, sand and rock should be included the scope, but be reported separately to the total of all other materials included within the scope.

Recommendation 13: Daily cover should be included in reporting on soil, sand and rock.

Recommendation 14: Fly ash should be included in the scope, but is reported separately to the total of all other materials included in the scope.

Recommendation 15: Bio-solids should be included in the scope.

Recommendation 16: Hazardous, prescribed or clinical wastes should be included in the scope.

Recommendation 17: Quarantine wastes from ships should be included in the scope.

Recommendation 18: A consistent set of materials should be used to report the composition of waste streams (see Table 3).

Recommendation 19: Waste should be counted by the stream that it is collected in unless data is readily available.

Recommendation 20: Standard conversion factors should be used except for where states or territories have justification to apply jurisdiction or site specific conversion factors.

Recommendation 21: Residual material from recycling operations should not be counted as recycled material.

Recommendation 22: Recycling should be counted by material input (less residual material).

Recommendation 23: Waste should be counted once at the point of generation.

Recommendation 24: Stockpiles of reprocessed product or material that has been actively recovered should be considered to be recycled.

Recommendation 25: Waste and recycling reporting should include both the most up to date data, and data from most recent time period reported on by all jurisdictions.

2 INTRODUCTION

The objective of this report is to collate a series of recommendations that will lead to a more uniform approach to interpreting waste and recycling data generated by Australian states and territories.

In 2006, Hyder Consulting (Hyder) produced a report for the (then) Department of the Environment and Heritage titled *Waste and Recycling in Australia*. This report aggregated previously released and unreleased data for 2002-03 and informed the Department's 2006 submission to the Productivity Commission's inquiry into waste generation and resource efficiency in Australia.

Hyder produced a report with the same title in 2008 for the (then) Department of the Environment, Water, Heritage and the Arts (DEWHA) collating data for the financial year 2006-07. The 2008 report updated and supplemented information contained in the 2006 report, and endeavoured to "provide the most up-to-date and comprehensive picture of waste and recycling activity in Australia" (Hyder, 2008c).

An amended version of the 2008 report was produced by Hyder in 2009 to incorporate 2006-07 data from states and territories. The amended version also included the latest data for some organic materials that had become available subsequent to the publication of the original report in 2008.

The Hyder (2009) report noted that:

> The data contained within the report should be used with caution as it has been drawn from a range of sources with varying data quality and methodologies.

In particular, the Hyder (2009) report stated that:

> There is a lack of consistency between the material inclusions and definitions used for disposal and recycling in reports produced by different states/territories.

Consequently, it has not always been possible to make accurate comparisons within or between datasets. The purpose of this study is to further assess the consistency of waste and recycling datasets nationally, and identify specific recommendations that will lead to a more uniform approach to data generated and collected for the purpose of future national reporting.

This objective aligns with the 'Providing the evidence' key direction of the National Waste Policy. The objective of this direction is to:

> Develop capacity to effectively collect consistent, accurate and meaningful national waste and resource recovery data to inform policy and decisions.

The direction also states that:

> Any improvements and streamlining that can be easily made in the short term will be identified and improvements undertaken where feasible.

The scope of previous national waste and recycling reporting has been the three major solid waste streams: municipal solid waste (municipal or MSW), commercial and industrial (C&I) and construction and demolition (C&D). The Hyder (2009) report was based on "data sourced through publicly available reports except where state agencies were able to provide unpublished data that was more up-to-date."

This study is based around these three major solid waste streams, and includes or excludes particular data and data sets with the aim of enabling more accurate comparisons of the

performance of different states and territories. In this way it aims to provide a “comprehensive and comparable picture of waste and recycling activity in Australia”.

In Hyder (2009), available data:

> ...was accessed through desktop research, industry knowledge and consultation with state agencies. Data was sourced through publicly available reports except where state agencies were able to provide unpublished data that was more up-to-date.

Hyder (2009) stated that:

> ...unless specifically stated within a particular report section, we have endeavoured to exclude the following waste streams/materials from the reported data: hazardous, prescribed or clinical wastes; contaminated soils; fly ash; mining and mineral processing wastes; quarantine waste from ships; other gaseous or liquid wastes and self-managed farm wastes.

Hyder (2009) also stated:

> Biosolids and bark and sawdust from forestry operations have been included within the report as it was not possible to exclude them from the data provided by all jurisdictions.

The 2009 report lists a number of ‘data gaps’ already identified in available data. These data sources were further assessed during the production of this report to identify any other variations or discrepancies in what is measured, how it is measured, the timeframe that is covered and the overall quality of the data. This assessment included an examination of:

- the points at which waste and recycling data are measured
- the timelines and timeframes for the collection of data
- the extent of the waste and recycling market that is covered
- the categorisation of product and/or materials
- the inclusion or exclusion of contaminate materials
- the inclusion or exclusion of material transported interstate for recycling
- the consideration of reprocessing losses, stockpiling and other reprocessing related issues
- the veracity of end-of-life and consumption data (where recycling for materials are reported)
- the inclusion or exclusion of imported materials into consumption data (where recycling for materials are reported)
- the definition of key concepts.

The development of a more uniform approach also took into account:

- the existence of any relevant standards and definitions
- the adherence to any relevant standards and definitions in data sources
- any conventions or common practices in data sources
- the accuracy and veracity of data sources.

Consultation was undertaken with state and territory governments to ascertain the potential impacts of any changes in the approach to data collection and reporting.

However, the participation of state and territory governments in the consultation process does not indicate the endorsement or otherwise of state and territory governments of this report or the recommendations contained within it.

3 DEFINITIONS

Consistent terminology and definitions are important requirements to underpin a commonly held understanding of the key concepts discussed in this report. The definitions applied to the main terms used in this report are outlined and justified (where required) below.

3.1.1 Consumption

According to the Australian Standard *Waste management - Glossary of terms* (AS/NZS 3831:1998) a consumer is "any organization or person purchasing or using materials, goods or services."

The definition of consumption provided in the Plastic and Chemical Industries Association (PACIA) *National Plastics Recycling Survey* (Hyder, 2008a) is:

> Consumption - Total use of product by ... industry and consumers. Includes locally made and used product, imported product and locally utilised recyclate. Does not include locally made product that is exported for use.

The key aspects of these definitions are that consumption of products and materials occurs at the point of use, and is distinct from the production of products and materials.

3.1.2 Re-use

The definition of re-use is well captured in Zero Waste SA's *Recycling Activity in South Australia* (Hyder, 2008b), where:

> Re-use involves recovering value from a discarded resource in its original state without reprocessing or remanufacture.

The Australian Standard (AS/NZS 3831:1998) definition is essentially the same, though it does explicitly mention the exclusion of reprocessing from the definition of re-use. The Australian Standard defines re-use as using a product again for the same or a different purpose, which is the equivalent to recovering value. It is important to note that within the Australian Standard AS/NZS 3831:1998) the terms re-use and recycle are clearly stated to not be synonyms.

3.1.3 End-of-life

The *Metropolitan Waste and Resource Recovery Strategic Plan* (Victorian Government, 2009) defines end-of-life waste as:

> Products such as cars that have reached the end of their useful life and become waste. This term is often used in the context of the product stewardship responsibilities of manufacturers and brand-owners for wastes discarded by consumers.

The use of the term "useful life" implies a product has passed through its intended application, reached the end of its serviceability, and has no further re-use value.

3.1.4 Recovery

Recovery is used to refer to both resource recovery and energy recovery.

Resource recovery is a broader term that includes recycling and energy recovery. The Australian Standard (AS/NZS 3831:1998) defines resource recovery as a "process that extracts material or energy from the waste stream."

The *National Waste Report 2010* expands the definition of resource recovery to be:

> The process of extracting materials or energy from a waste stream through re-use (using the product for the same or a different purpose without further production), recycling or recovering energy from waste.

Recovery can also refer to products or materials collected for recycling and/or energy recovery. In some cases, the amount of products or materials 'recovered' is the gross amount collected, and does not exclude contamination or unwanted components (see 0).

For the purposes of this report, the term 'recovery' is used to refer to those products and materials collected for resource recovery (excluding contamination or unwanted components).

3.1.5 Recycling

The definitions given in the Australian Standard (AS/NZS 3831:1998) and the *National Waste Report 2010* provide a clear definition of recycling. The Australian Standard definition of recycling is:

> [A] Set of processes (including biological) for converting recovered materials that would otherwise be disposed of as waste, into useful materials and or products. The following definitions apply: a) *Closed loop recycling* - recycling process in which the reclaimed output is used as an input to the same product system. b) *Open loop recycling* - recycling process in which the reclaimed output is used as an input into another product system.

The Australian Standard defines something as recyclable if it is:

> ...able to be recovered, processed and used as a raw material for the manufacture of a useful new product through a commercial process.

The *National Waste Report 2010* definition is simpler, and places recycling as a subset of resource recovery. Recycling is:

> A resource recovery method involving the collection and processing of waste for use as a raw material in the manufacture of the same or similar non-waste product.

The *National Waste Report 2010* defines a recyclate as:

> Material able to be processed for recycling in a facility. Sometimes only to refer to materials actually recovered from recycling, excluding residual wastes.

Recycling Activities in South Australia (Hyder, 2008c) was careful to exclude:

> ...waste materials that are reclaimed and reutilised within the same manufacturing processes that generated it as a matter of course to the efficient operation of the site...

It is important to note the inclusion of biological process in the Australian Standard definition of recycling. In some cases, composting is seen as being distinct from the definition of recycling. For example, the Victorian *Metropolitan Waste and Resource Recovery Strategic Plan* (2009) in defining "recyclables" states that:

> While this term strictly applies to all materials that may be recycled, in this document the term is generally used to refer to the recyclable containers and paper/cardboard component of kerbside waste, i.e. it excludes garden organics.

However, for the purposes of the purposes of waste and recycling reporting, composting should be considered to be recycling.

3.1.6 Energy recovery

The *National Waste Report 2010* defines energy recovery as:

> Processes or opportunities to recover energy from waste materials, usually through thermal processes.

Most other definitions of energy recovery have a similar meaning, although the WA Waste Authority *Draft Waste Strategy 2009* added reprocessing to the list of means of extracting materials or energy.

For the purposes of this report, waste to energy is used to describe the mass of product or material that can be said to have been recovered for energy (see 0).

3.1.7 Landfill

The Australian Standard (AS/NZS 3831:1998) definition for landfill is:

> Waste disposal site used for the controlled deposit of solid waste onto or into land.

This is much more formal than other definitions of landfills. The Victorian *Metropolitan Waste and Resource Recovery Strategic Plan* (2009) defines landfill as "a site for the disposal of waste to land". The ACT's *No Waste by 2010* strategy defines landfill as "a site where waste materials are buried."

3.1.8 Disposal

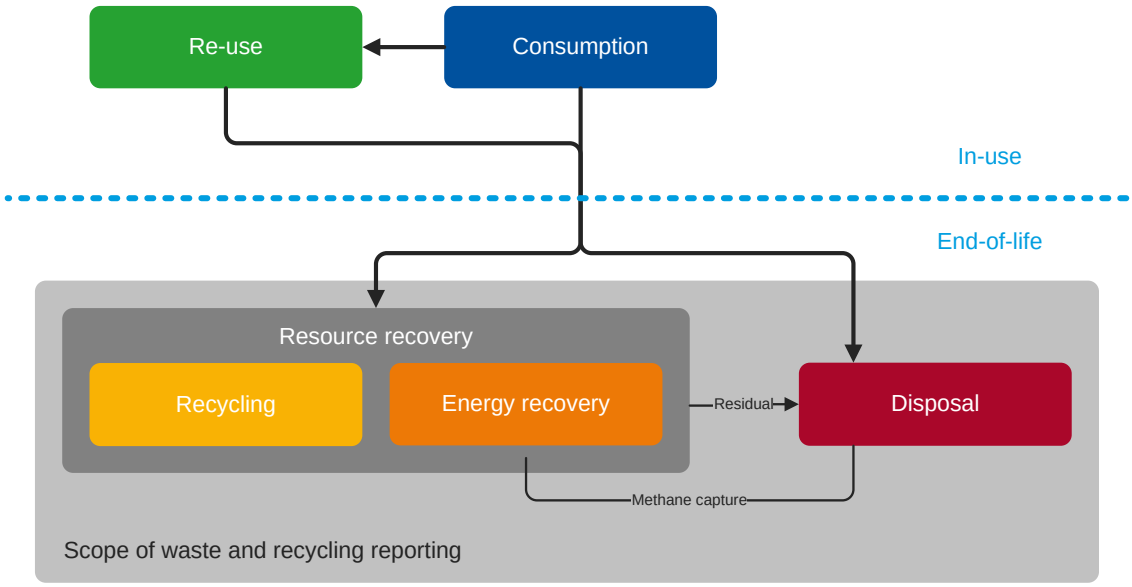
The Australian Standard (AS/NZS 3831:1998) defines disposal as the "final stage in the management of the waste stream." In this sense, disposal can used to describe any end-of-life product or material that is discarded regardless of whether it is recycling, energy recovery or landfill.

However, waste reported as having been "disposed" usually refers specifically to material that is disposed of to landfill.

Yet, incineration of solid waste that does not include energy recovery can similarly be considered to be a final disposal. Incineration is often coupled with landfill in the definition of "disposal" at the bottom rung of the waste hierarchy.

For the purposes of this report, products and materials that are reported as having been "disposed" refers to those which are landfilled or incinerated without energy recovery.

Figure 32: Key terms in waste and recycling reporting



3.1.9 Recycling rate and recovery rate

There is a degree of inconsistency in the use of the terms recycling rate and recovery rate.

The United States Environment Protection Agency cites the municipal recycling rate as being waste recycled as a percentage of waste generated. Although not providing a definition of the recycling rate, the *National Waste Report 2010* also uses material collected for recycling as a percentage of material disposed to generate reported recycling rates.

However, the Australian Standard (AS/NZS 3831:1998) states that:

> The term recycling rate has been omitted from this Standard because it is ambiguous.

The Australian Standard does define the recovery rate, being:

> The amount of material recovered from a product group as a percentage of overall consumption.

But this is different to the definition in *Victorian Recycling Industry Annual Survey* (Sustainability Victoria, 2008), which states:

> The recovery rate is the percentage of materials recovered for reprocessing from the total quantity of waste generated.

The major difference in the definitions of the recycling rate or the recovery rate is the use of consumption or waste generation as the denominator. Consumption tends to be used as the denominator in instances where consumption figures are more readily attainable and/or where a product has a short life span (for example, newspapers). In such cases there is no significant difference between the use of consumption or waste generation as the denominator.

However, where a product or material has a longer life span, or where the consumption rate of a product or material has changed significantly over time, the use of consumption as the denominator can lead to perverse results. For example, given that the number of cathode ray tubes (CRTs) currently recycled is greater than the number of CRTs currently consumed, using consumption as the denominator to calculate the recycling rate of CRTs would generate a rate greater than 100%.

As such, and for the purposes of this report, the recycling rate refers to the amount of product or material (excluding contamination or unwanted components) recycled as a proportion of total amount of end-of-life product or material waste generated. That is, the recycling rate is the amount recycled divided by that amount of waste generated.

Similarly, the recovery rate refers to the amount of product and/or material (excluding contamination or unwanted components) recycled and recovered for energy as a proportion of total amount of end-of-life product or material disposed of.

Defined in this way, the recovery rate is also often called the diversion rate, which refers to that proportion of waste generated which diverted from landfill.

3.1.10 Solid waste

There is no standard definition of ‘solid waste’. For example, materials such as sludge and slurries can equally be defined as a liquid or solid waste. A practical definition is to define a solid waste as anything that is ‘spadeable’, i.e. can be picked up with a spade.

In the ACT solid waste is defined as municipal waste and biosolids, while in Victoria the *Metropolitan Waste and Resource Recovery Strategic Plan* (2009) defines solid waste as composed of “non-hazardous, non-prescribed, solid waste materials ranging from municipal garbage to industrial waste.”

4 A MORE UNIFORM APPROACH TO DATA

This section details the consideration of the main issues for a more uniform approach to data. It also contains recommendations for the scope of, and approach to, national waste and recycling reporting.

For the purposes of this exercise, it is necessary to establish boundaries for the reporting of national waste and recycling data. This section seeks to do that by establishing some principles for general consideration, by addressing areas that are difficult to define within the three major waste streams and by suggestion a common approach to the measurement of data.

4.1 General considerations

There is not clear agreement on the exact scope of waste. What is waste is sometimes subjective, and often reflects the economic value of products and materials within a particular society. The *National Waste Policy Regulatory Impact Statement* (RIS) states that:

> Defining waste is not simple and there is no single domestic or international definition. This is due to the complex nature of waste, and the fact that the nature of waste is changing rapidly, involving more diverse materials and products as well as new processing and management technologies.

The *National Waste Report 2010* includes the following definition of waste:

> Any discarded, rejected, unwanted, surplus or abandoned matter; discarded, rejected, unwanted, surplus or abandoned matter intended for recycling, reprocessing, recovery, re-use or purification by a separate operation from that which produced the matter, or for sale, whether of any value or not.

4.1.1 Re-use

The consideration of re-use is often the cause of uncertainty as to what constitutes waste. Disregarding any market failures, perverse incentives or information asymmetries that may exist, re-use can be seen as being proof that a product has not reached end-of-life, that it is still being consumed and that it is not a waste. However, whether re-use occurs or not is often a reflection of the value of products or materials within a particular setting or community. Accordingly, patterns of re-use can vary markedly from place to place, as can the consideration of the waste flows of particular products and materials.

Previous national waste and recycling reporting have compiled figures for waste recycled and waste disposed, with some accommodation of energy recovery from waste; but has not included data on re-use.

No jurisdictions provide comprehensive reporting on the re-use of products and materials. The notable exception is earthen materials (see 4.2.5).

Recommendation 3: The scope should be limited to waste material that is collected for recycling, energy recovery and disposal, and re-use is excluded from the scope.

4.1.2 Waste generation and disposal

Putting aside the operational efficiency of a product or material, re-use is a more favourable environmental outcome than recycling, energy recovery or disposal. The waste hierarchy reflects this order of merit.

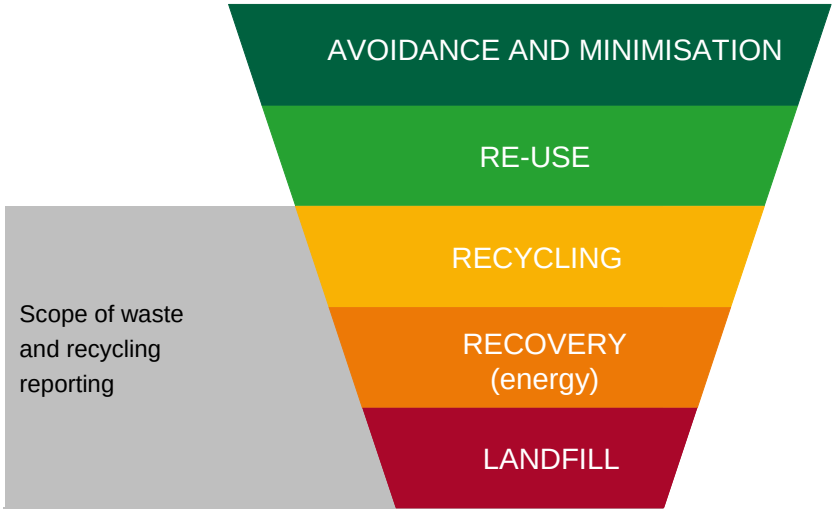
Re-use prolongs the life of the energy and water that is embodied in a product or material. Re-use also prolongs the life of a material in its current physical state. In doing so, re-use offsets the use of further energy, water or materials to produce new products.

Recycling does not fully recover the embodied energy and water in a product or material. Recycling also often reduces the physical quality of a material. For example, polymers often lose material properties in the process of recycling.

Energy recovery only captures the calorific value of the raw material, and destroys the physical value of a material. Energy recovery does not recover the embodied energy and water required to refine a material or to make a product.

With the exception of methane gas capture, landfilling a product or material represents a complete loss of a resource, and the embodied energy and water within it.

Figure 33: Waste hierarchy[29] and scope



The exclusion of re-use from the scope of waste and recycling reporting raises an important issue in respect to the key indicators reported, in particular the recycling and recovery rate. If re-use is excluded from the scope of waste and recycling reporting, then the benefit of re-use is not counted in the recycling or recovery rate. In this case, the recycling or recovery rate and the amount of material being disposed can increase simultaneously. This is demonstrative of the fact that recycling and recovery rates do not usually give an indication of the overall consumption of resources.

The quantity of waste generation and waste disposal is more closely aligned with the actual life cycle environmental impacts of waste.

Recommendation 4: Waste generation and waste disposal should be considered a more useful indicator of environmental impact than recycling and recovery rates.

Having excluded re-use from the scope of waste and recycling reporting, it follows that waste generation should be considered the total of products and materials collected for recycling, energy recovery or disposal.

[29] As shown in: Department of the Environment, Water, Heritage and the Arts, *National Waste Report 2010*.

4.1.3 Liquid and gaseous wastes

The scope of the Hyder (2009) report was:

> ... the three major solid waste streams: municipal solid waste (municipal or MSW), commercial and industrial (C&I), and construction and demolition (C&D).

This is narrower than the scope of the National Waste Policy, which:

> ...encompasses wastes, including hazardous wastes and substances, in the municipal, commercial and industrial, construction and demolition waste streams, and covers gaseous, liquid and solid wastes. Radioactive waste is excluded.

However, the focus of the key directions and strategies, and the implementation plan of the National Waste Policy, is on solid waste. The National Waste Policy RIS, while acknowledging the scope defined above, also restricts its analysis to the three major solid waste streams.

State and territory government reporting of waste is generally constrained to solid waste. Queensland does include liquid wastes within its *State of Waste and Recycling* reports, but these are listed separately.

Recommendation 5: Liquid and gaseous wastes should be excluded from the scope at this stage.

As previously discussed, there is a degree of ambiguity as to what is considered a solid for the purposes of waste definitions. Where data exists, waste to landfill figures may need to be adjusted to take account of the small proportion of viscous liquids contributing to solid waste figures.

Liquid wastes cannot be disposed directly to landfill in any jurisdiction. Liquid wastes that are not readily reused or recycled are often solidified to enable their disposal to landfill, usually as a hazardous solid waste. As a result, it is important to note that reported amount of waste disposed to landfill usually includes solidified liquid wastes. Solidified liquid wastes may be a significant proportion of hazardous wastes. However, solidified liquid wastes are likely to be a small percentage of total solid waste.

4.1.4 Waste generation data reporting on a per capita basis

Variation in overall waste generation data for each state is expected given the population size of the different states/territories. This is corrected for by presenting the data on waste on a per capita basis. When presenting data on a per capita basis, the population of the relevant time period (as reported by the Australian Bureau of Statistics) needs to be used to ensure that population growth does not distort the per capita generation rates of the time.

Recommendation 6: Report waste generation data on a per capita basis using population figures that correspond to the reporting period.

4.1.5 Reporting by weight

The approach of previous reports, and that of most states and territories, is to report waste and recycling by weight.

Recommendation 7: Waste and recycling should be reported by weight.

It should be noted that mass alone does not provide a complete representation of the relative benefits of recycling or disposing collected materials. For example, from the perspective of resource recovery, in particular embodied energy, the diversion of a tonne of aluminium is more

important than the diversion of a tonne of timber. Aggregating the disposal of materials by mass does not highlight this important environmental aspect of material disposal.

The full life cycle impacts of the disposal of materials require a more detailed analysis of the embodied resources with a material, the relative benefits of recovering these resources, and any pollution or toxic impact associated with the extraction or recycling of a material. The availability of a raw material is also important to understanding the full benefits of recycling, recovering energy from, or disposal of that material.

However, the weight of end-of-life products and materials that is disposed is critical to understanding the impacts of waste and recycling, and is a very useful first step towards better management and use of materials and resources. It is also the most practical and universal way to measure waste and recycling.

4.1.6 Waste to energy

Energy recovery from solid waste can occur through the conversion of material with a useful energy value directly into a combustible fuel, or through the collection and combustion of methane generated through the anaerobic decomposition of organic material.

Previous national waste and recycling reporting has not separated energy recovery from recycling. This reflects the approach of most states and territories. However, given the increase in the attention on, and quantification of, waste to energy, particularly methane capture, energy recovery should be separated out from waste and recycling.

Recommendation 8: Waste converted to energy should be counted as a separate disposal pathway to recycling and disposal.

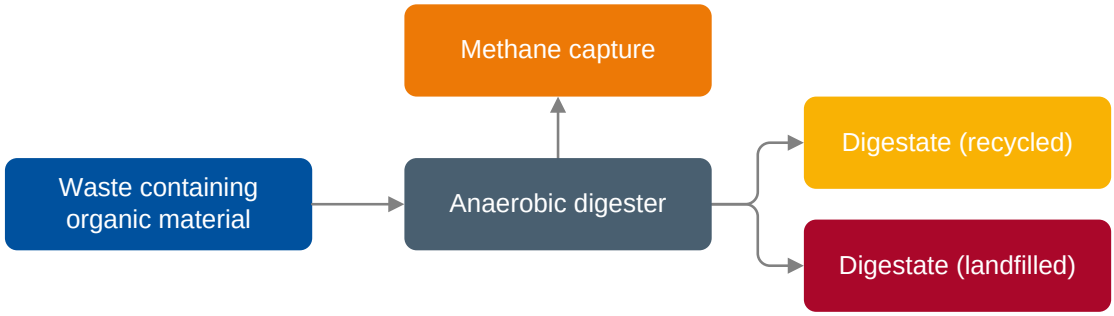
Energy recovered from waste is often measured as a unit of energy or a unit of electricity. This presents an issue for the reporting on that component of solid waste – measured by weight – that is converted to energy.

When energy is recovered from the conversion of material into a fuel, the weight of waste to energy can be relatively easily isolated from material that is recycled or disposed. The weight of material converted to energy is the balance of the weight of residual materials from this process.

N.B. Energy recovery from the conversion of material into a fuel for a defined purpose is distinct from the incineration of material that does not involve the use – recovery – of that energy (see section 0). In Australia, incineration is mainly confined to the treatment of biosolids, hazardous and/or quarantine wastes.

More difficult in a waste accounting sense is the recovery of energy from the decomposition of organic material. Methane collected in an anaerobic digester – either mixed waste or organics only – can be reasonably easily accounted for. Assuming that the amount of digestate is recorded at the end of the anaerobic digestion process, the material mass related to energy recovery can be said to be the total material received, less digestate.

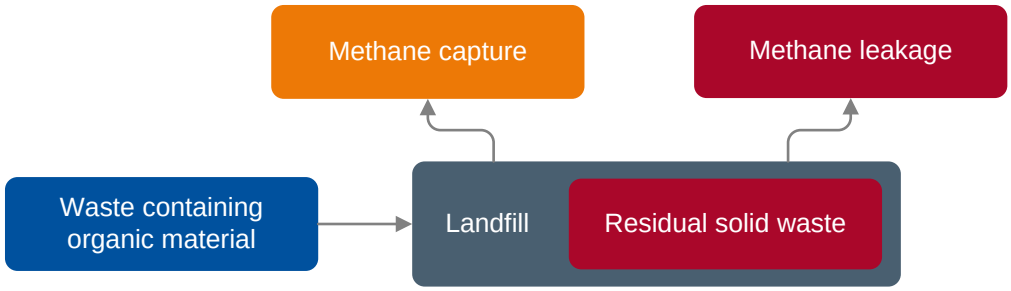
Figure 34: Mass flow of organic material in an anaerobic digester



The accounting of energy recovered from landfill is less straightforward. The mass of material that is disposed of to landfill is recorded regardless of any energy recovery that subsequently occurs. In the case where energy recovery occurs and is recorded, the mass of material that is converted into energy is counted twice. A mass conversion factor could be applied, using the amount of energy produced on-site as the input data, to determine what mass of material disposed to landfill has been converted to energy. This mass of methane captured could be converted back into an equivalent mass of organic material, subtracted from the reported mass landfilled and recorded as mass related to energy recovery.

For the purposes of the national waste and recycling reporting, methane that is created in landfill but migrates from the site (methane leakage) should be still be counted as waste to landfill.

Figure 35: Mass flow of organic material in landfill



This method provides some representation of the relative merits of methane collection from landfill. In some cases (using best practice landfill design and management), landfill can be an efficient means of capturing methane from the decomposition of degradable organic carbon. However, the disposal of this material usually means a loss of the organic resource for any other purposes, in particular as a compost or fertiliser.

States and territories have a variety of approaches to the reporting of energy recovered from waste.

NSW does not report on energy recovered. Material collected at AWTs is reported as a mass balance excluding energy recovered.

Victoria includes energy recovery from rubber (by weight) in its recycling figures.

Queensland typically counts energy recovery within, but not distinct from, its recycling amounts.

South Australia records timber used in cement kilns (by weight) as an energy source distinct from other recorded material.

4.2 Waste streams

Waste streams are useful in providing an indication of the source of waste material. However, from the perspective of trying to understand the environmental and resource consumption impact of waste and recycling, making a distinction between the points of generation of waste is less important than understanding the composition of waste.

Nonetheless, taking account of material collected by waste stream is important in actually establishing the composition of waste collected. This is particularly so for the C&D waste stream, which is defined principally by its material type, as opposed to the municipal and C&I waste streams which are defined by their source.

Information on waste and recycling by waste streams also helps inform investment and infrastructure decisions made by industry and state, territory and local governments regarding collection and treatment facilities.

The *National Waste Report 2010* provides the following definitions as a guide for the three major solid waste streams:

- Municipal solid waste (MSW): waste produced primarily by households and council facilities, including biodegradable material, recyclable materials such as bottles, paper, cardboard and aluminium cans, and a wide range of non-degradable material including paint, appliances, old furniture and household lighting.
- Commercial and industrial (C&I) waste: waste that is produced by institutions and businesses; includes waste from schools, restaurants, offices, retail and wholesale businesses, and industries including manufacturing.
- Construction and demolition (C&D) waste: refers to waste produced by demolition and building activities, including road and rail construction and maintenance and excavation of land associated with construction activities. The C&D waste stream usually covers only some of the generation, disposal and recycling of C&D wastes, as these materials can also be found in the MSW and C&I streams, or as hazardous wastes.

Recommendation 9: The definitions in the *National Waste Report 2010* for the three major solid waste streams should be used.

4.2.1 Primary production wastes

Primary production is defined here as the conversion of natural resources into primary products, usually for use as raw materials by other industries. Although primary production is considered an industrial activity, the C&I waste stream includes only wastes from the secondary, tertiary and quaternary industrial sectors; wastes from the primary sector don't fall within the definition of C&I waste.

Furthermore, the 'disposal' pathway of primary production waste is often analogous to, or chemically indistinguishable from natural processes. For example, sawdust created during the felling of trees is difficult to distinguish from the natural decomposition of trees and tree limbs in a forest. As a result, primary production wastes are often disposed of on-site, and often don't follow the same disposal routes for the three major solid waste streams.

The consideration of wastes from primary production is also important from the perspective of making meaningful comparisons between different states and territories. The amount of primary production and primary production waste varies markedly between different jurisdictions, principally because of the different natural resource conditions in states and territories.

Recommendation 10: Wastes generated by the core processes of primary production should be excluded from the scope.

Core processes refers to waste from the primary production process itself, rather than wastes ancillary to primary production. For example, end-of-life mining equipment should be considered to be C&I waste and not be considered primary production waste.

4.2.2 Pre-consumer wastes

Pre-consumer waste typically refers to the scrap from manufacturing inefficiencies or malfunctions. Pre-consumer wastes are part of the industrial process and could be considered within the definition of C&I waste. However, pre-consumer wastes are usually only considered in waste and recycling reporting when they are disposed of offsite.

Where pre-consumer wastes are fed back into the manufacturing process this is what is referred to in the Australian Standard (AS/NZS 3831:1998) as “closed loop recycling”. ‘Mill broke’ generated during the production of paper that is fed back into the manufacturing process is an example of closed loop recycling.

Closed loop recycling is usually excluded from waste and recycling reporting, and is sometimes excluded from the definition of recycling (see 0). Closed loop recycling can be considered to be something that is done “as a matter of course to the efficient operation of the site” (Hyder, 2008c).

Conversely, the generation of waste during an industrial process can be considered to be the result of inefficient operation of the site, either by design or by malfunction. If closed loop recycling was to be included in waste and recycling reporting, then an increase in the inefficiencies of the industrial processes would be represented as an increase in recycling.[30]

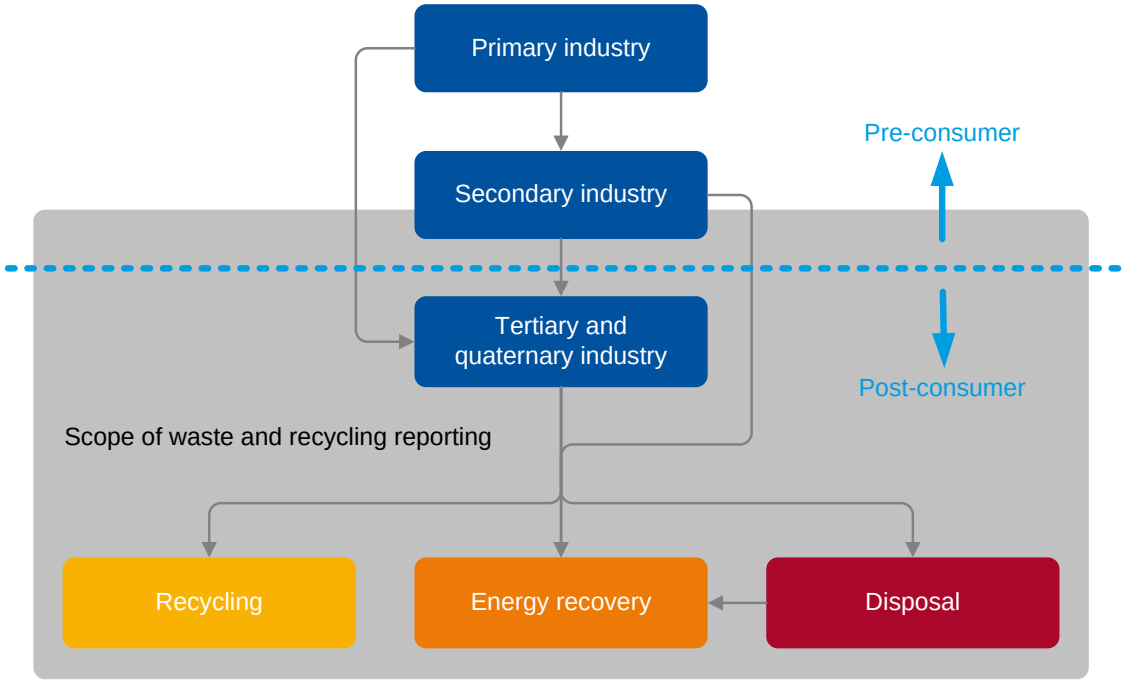
Recommendation 11: Pre-consumer wastes that are recycled on-site as part of the manufacturing process should be excluded from the scope.

By contrast, post-consumer wastes are clearly within the scope of waste and recycling reporting. Most products and materials that enter the municipal waste stream are clearly post-consumer wastes and are relatively easy to define within this stream.

Most products and materials in the C&D waste stream are also clearly post-consumer wastes, although there are a number of raw materials in the C&D stream, most notably earthen materials, which are more difficult to define (see 4.2.5).

[30] As is noted in section an increase in the inefficiencies of consumption can also lead to an increase in recycling.

Figure 36: Scope of national waste and recycling reporting by production stage



The scope of waste and recycling reporting can also be approximately defined by the point of disposal for wastes. Products and materials included within the scope of waste and recycling are usually those disposed of offsite, from non-primary production sources. Conversely, materials excluded from the scope are usually primary production or pre-consumer wastes that are close to their raw form and that are disposed of on-site.

4.2.3 Bark and sawdust from forestry operations, and mining and mineral processing wastes

Bark and sawdust from forestry operations, and mining wastes are all primary production wastes. Bark and sawdust generated from forestry operations is distinct from those generated in secondary industrial processes, such as timber mills.

Recommendation 12: Bark and sawdust from forestry operations, and mining and mineral processing wastes should be excluded from the scope.

No states or territories treat the disposal of bark and sawdust to landfill any differently to other landfilled material. However, many do account for the recycling of bark and sawdust from forestry separately. A number of these jurisdictions use Organics Recycling in Australia – Industry Statistics compiled by Compost Australia to generate the breakdown of organic material. This report lists sawdust and barks from forestry residuals as a separate item.

NSW reports bark and sawdust from forestry residuals as distinct items in reporting on recycled organic material.

Victoria reports sawdust & other forestry residuals, but does not distinguish the origin of the material. Bark and sawdust is reported separately from other materials regardless of where it comes from.

Western Australia records and reports on forestry waste collected for reprocessing but does not include it in its reported organic materials collected for reprocessing.

South Australia reports barks and sawdust from forestry residuals in combination with all other timber wastes.

4.2.4 Agricultural wastes

Agricultural wastes are generated through primary production activities. For the purposes of waste and recycling reporting, agricultural waste should not include waste material ancillary to the core primary production. For example, fencing wire should be considered C&I waste, and not agricultural waste.

Recommendation 13: Agricultural wastes are excluded from the scope.

Agricultural wastes are likely to be subject to different treatments depending on where the industry is located. Agricultural wastes generated in more remote areas are likely to be disposed of on-site and are unlikely to be recorded. Conversely, agricultural waste generated adjacent to more highly populated areas are more likely to be disposed of at specific organic waste treatment facilities and are more likely to be recorded in recycling activity.

In all states, agricultural waste that is disposed of to landfill is not reported on separately. Jurisdictions that do report on agricultural wastes do so only for reprocessing.

NSW reports agricultural waste received for reprocessing as a component of its organic stream.

Queensland reports manure and other agricultural wastes recovered.

Western Australia reports agricultural waste, excluding manures, collected for reprocessing.

South Australia includes waste from agricultural processes collected for reprocessing in the 'other organics' category.

4.2.5 Soil, sand and rock

Soil, sand and rock, can be considered a primary product. Soil, sand and rock also have the capacity to be re-used on-site, although this is limited in many circumstances. By this account, they should be considered for exclusion from the scope of waste and recycling reporting.

However, soil, sand and rock are an anomaly in one important respect. While still in their raw state, soil, sand and rock are earthen materials. And putting soil, sand or rock in landfill can be considered a re-use of materials.

As such, soil can either be included or excluded from the landfill ledger, but cannot be included in the recycling ledger; when soil, sand and rock is used as fill it is a re-use of the material, but it is not recycling.

Excluding soil entirely from the scope would also present a practical issue. Data on soil disposed to landfill is often not separated from other materials. Furthermore, given that there is usually demand for clean fill, it can be reasonably postulated that much of the soil that is disposed of to landfill is not clean fill, and is likely to contain other C&D waste.

Recommendation 14: Soil, sand and rock should be included the scope, but be reported separately to the total of all other materials included within the scope.

For the purposes of waste and recycling reporting, soil sand and rock refers to earthen material in its raw or unrefined state, and that is not mixed with another material.

4.2.6 Daily and intermediate landfill cover

Daily and intermediate landfill cover refers to soil or other inert material used to temporarily cover contained cells in modern landfills. Where landfills use daily cover, the soil, sand and rock that is disposed of at the landfill is likely to be used for this purpose.

The inclusion of daily cover in landfill figures is an anomaly for the same reasons that the inclusion of soil is an anomaly. The consistent approach would be to treat daily cover as a component of soil, sand and rock.

Recommendation 15: Daily cover should be included in reporting on soil, sand and rock.

In some jurisdictions, the amount of material disposed to landfill is adjusted downward to account for daily cover, irrespective of whether that daily cover is generated on-site. Accounting for daily cover in the recommended way would better account for the disposal of daily cover generated on-site.

Most states and territories list soil or daily cover as a separate material, though the way it is accounted for varies greatly between jurisdictions. Daily cover practices also differ between jurisdictions, at different landfill types and under different conditions.

NSW counts soil, including daily cover, as waste disposed to landfill. Earth based material is reported as a particular material in the domestic waste stream. Soil is not reported separately from other C&D waste.

In Victoria, landfill operators are granted a fixed rebate equal to 15% of all “waste deposited onto land at the premises” to allow for daily cover. As a result, the data reported on waste disposed of to landfill is less than the actual amount disposed to landfill. The shortfall is equal to the amount equal to 15% of all waste disposed to landfill. Victoria also reports soil and sand as a material recovered for reprocessing.

Queensland reports clean fill disposed to landfill as a discrete item. Queensland previously made allowances for daily cover, but no longer does so.

Western Australia provides separate data on “sand, soil, clean fill and rubble” in its materials recovery reporting. In calculating the landfill levy, some landfill sites are able to make an allowance for daily cover up to 8% of the waste received.

South Australia reports soil in combination with brick, tile and rubble. Clean fill is exempt from the landfill levy and is reported separately in the landfill levy accounts. No special accounting is made for daily cover.

Tasmania excludes clean fill from landfill reporting and does not make any allowance for daily cover.

4.2.7 Fly ash

Fly ash is a pre-consumer waste generated during the combustion of material, most usually coal for electricity generation. It is sometimes classified as a hazardous or regulated waste.

Fly ash is unusual in that that where it is not recycled, it is usually disposed of into ‘ash dams’ located adjacent to mines and power stations. In this respect, fly ash can be considered to be disposed of on-site.

However, unlike primary production and pre-consumer wastes disposed of on-site, fly ash is clearly a solid industrial waste that should be disposed of in a controlled way. The on-site disposal of fly ash is more by virtue of the fact that it is generated adjacent to a site which is

available for disposal. But for this, it is likely that fly ash would be subject to stringent requirements for disposal through routes for conventional or hazardous wastes.

Recommendation 16: Fly ash should be included in the scope, but is reported separately to the total of all other materials included in the scope.

Most states and territories do not record fly ash separately as part of solid waste data.

Queensland lists fly ash as a separate item in the reporting of waste from industrial facilities.

South Australia also reports on fly ash separately to other materials, and records it as a specific waste type in the composition of recycled materials.

4.2.8 Biosolids

Biosolids are the residual material from sewage treatment plants and industrial wastewater treatment. Biosolids are clearly a post-consumer waste.

Although biosolids are often kept in storage cells on-site, this is not usually the final point of disposal for biosolids. It is perhaps for this reason, and for its extraction from a liquid waste, that biosolids are not always included in waste and recycling reporting.

Recommendation 17: Bio-solids should be included in the scope.

In some states and territories, biosolids are landfilled or incinerated, but not are specifically identified or reported separately. However, in many instances, accurate data can be garnered from hazardous or controlled waste reporting, and/or from wastewater treatment facilities.

NSW reports biosolids, grit and screenings as a distinct material type in the composition of organic material received for reprocessing.

Victoria measures biosolids separately from other wastes, and reports on it separately to reports on recycling and landfilling activity.

Queensland reports biosolids separately both in terms of material landfilled and material recovered. In recording biosolids, an attempt is made to measure the dry weight of the material, where possible.

Western Australia records biosolids that are collected for reprocessing, but reports them separately to other organic wastes.

South Australia excludes biosolids from its reported recycling.

4.2.9 Hazardous, prescribed or clinical wastes

Hazardous, prescribed or clinical wastes have been excluded from previous national waste and recycling reports, which reflect the reporting approach of most states and territories. However, this exclusion raises a number of issues.

Hazardous wastes often refer to the state of a particular product or material, rather than a distinct product or material type. In such instances, non-hazardous quantities of these products or materials are counted as waste. For example, contaminated steel and plastic containers may be excluded from solid waste data, but clean containers are included in both recycling and landfilling figures.

Secondly, different jurisdictions have different classifications for hazardous, prescribed or clinical wastes. Instances may arise where materials are included in solid waste data in one

jurisdiction but excluded in another on the basis of different classification methods for hazardous wastes.

Recommendation 18: Hazardous, prescribed or clinical wastes should be included in the scope.

Hazardous wastes that fall into any other category that is recommended for exclusion from the scope elsewhere in this report, in particular liquid wastes, should also be excluded. Accordingly, contaminated soil should also be treated in the same way as other soil, sand and rock. In most cases, data is available from jurisdictions on the amount of hazardous material that is soil.

Where hazardous wastes are clearly reported as a particular product or material that is within the scope of this report, data should be recorded along with other waste and recycling of that particular product or material. Any remaining, unallocated hazardous waste should be recorded as a generalised hazardous waste (see 0).

Most jurisdictions keep separate databases for hazardous, prescribed or clinical wastes, or are in the process of developing them. The National Pollutant Inventory also provides a point of consolidated information on particular pollutants and their transportation.

NSW reports hazardous waste as a component of domestic waste and includes it within its reports.

Victoria has accurate data for prescribed industrial waste disposed of to landfill, but data on this waste is reported separately to data on municipal and industrial waste.

Queensland reports regulated wastes separately. This data is generated from the movement of hazardous waste, not disposal, which may result in some double counting.

In Tasmania, data is gathered for hazardous waste. However, most hazardous waste is pre-treated for use as clean fill. Any remaining hazardous waste that does go to landfill is not distinguished from all other material going to landfill.

Hazardous waste from the ACT goes to NSW, and is not counted in that territory's data.

4.2.10 Quarantine waste from ships

Quarantine waste from ships can be considered similarly to hazardous waste; it is the regulatory state of the waste that is its defining characteristic more than the material type.

Non-quarantine products or materials that enter the country by ship, or by air, are not distinguished from other products or materials if they end up in the waste stream. For example, non-quarantine waste collected at international airports is not considered differently to other C&I waste.

Therefore, it follows that quarantine (solid) waste from ships should be considered similarly to non-quarantine waste from ships, or quarantine and non-quarantine that enter the country by other means.

Recommendation 19: Quarantine wastes from ships should be included in the scope.

NSW and Queensland are aware that quarantine waste from ships is included in recorded waste figures.

Tasmania sends quarantine waste from ships – principally from Antarctica – to a specific landfill, and excludes this from non-quarantine landfill data.

Table 68: Approximate grouping of issues by production stage for solid waste streams

Waste stream	Primary production	Pre-consumer	Post-consumer
Municipal			▪ Biosolids ▪ C&I waste collected by Councils
C&I	▪ Bark and sawdust from forestry operations ▪ Mining and mineral processing wastes ▪ Agricultural wastes	▪ Fly ash	
C&D	▪ Soil, sand and rock ▪ Daily and intermediate landfill cover		▪ C&D waste collected in municipal or C&I waste streams
Key:	*Included in the scope, but reported separately*		*Included in the scope*

Hazardous waste arises at multiple points in the production stage, and in multiple waste streams, and has subsequently been excluded from inclusion in this table.

N.B. The recommended exclusion or separate treatment of any particular wastes for waste and recycling reporting should not be seen as a suggestion that these wastes should be exempt from, or eligible for discounted fees or charges relating to the disposal of waste, in particular landfill levies. To the contrary, there is often good reason to maintain consistent landfill levies on all wastes disposed to landfill so as to discourage or prevent dishonest disclosure regarding the composition of waste.

4.3 Measurement

Data on products and materials within the scope of national waste and recycling reporting should be given for each of the following measurement parameters:

- Destination (recycling, energy recovery or disposal)
- Waste stream (Municipal, C&I or C&D)
- Material composition (see breakdown provided in 0)
- State or territory of origin (in both total weight and on a per capita basis).

Tables should be generated that present combinations of these measurement parameters.

Tables should also be generated to show for each of the measurement parameters:

- Total weight of material disposed
- Recycling rate (recycling as a function of total weight of material disposed)
- Recovery rate (recycling and energy recovery as a function of total weight of material disposed).

4.3.1 Composition of waste streams

As noted in 4.2, establishing the composition of waste steams is important in gaining a more detailed understanding of the environmental and resource consumption impacts of waste generation, and recycling, energy recovery and disposal. Establishing the composition of waste streams also helps inform government and industry of products and materials that might be targeted for greater resource recovery, or where investment might be needed.

Recommendation 20: A consistent set of materials should be used to report the composition of waste streams (see Table 69).

Some states and territories report on the composition of waste, though the practice is not widespread or consistent. Those jurisdictions that do report on the composition of waste use a similar set of materials. Where there are differences, they are usually with respect to:

- the grouping or separation of plastic polymer types
- the grouping or separation of organic materials, particularly whether food is identified separately
- the grouping or separation of C&D materials, particularly whether soil is reported separately.

Those jurisdictions that do report on waste composition usually use the breakdown of waste streams, in combination with audits, to refine the overall product and material composition of waste and recycling.

NSW councils are funded to undertake audits of municipal waste, and many do so, providing composition data on that stream. NSW undertakes audits of the C&I stream to obtain compositional data, and obtain good data on C&D material composition from source separated loads.

Victoria also uses municipal audits as the principal source of data on the composition of municipal loads. Victoria also undertakes audits of landfills approximately every five years, during which a visual assessment is made of municipal, C&I and C&D loads to obtain compositional information. However, no attempt is made to assess the contents of closed bags in the C&I and MSW streams.

It is unknown if any compositional studies have been undertaken in Queensland.

Western Australia undertook its last compositional audit in 2005.

South Australia undertook compositional audits in 2008.

ACT undertakes regular compositional audits of waste to landfill, and undertakes audits of kerbside waste on an annual basis. However, recycling disposal is not audited and the ACT does not provide a sector breakdown for recycling activity.

Table 69: Recommended set of materials used to report the composition of waste streams

Material category	Material
Masonry materials	Asphalt
	Bricks
	Concrete
	Clay, fines, rubble & soil
Metals	Steel
	Aluminium
	Non-ferrous metals (excluding Aluminium)
Organics	Food organics
	Garden organics
	Timber
	Organics - other
Paper & cardboard	Cardboard & waxed cardboard
	Liquid paperboard (LPB)
	Magazines
	Newsprint
	Phonebooks
	Printing & writing papers
Plastics	Polyethylene terephthalate (PET)
	High density polyethylene (HDPE)
	Polyvinyl chloride (PVC)
	Low density polyethylene (LDPE)
	Polypropylene (PP)
	Polystyrene (PS)
	Other plastics
Glass	Glass
Other	Foundry sands
	Leather & textiles
	Tyres & other rubber
	Biosolids
	Hazardous* (not able to be classified in another material category)
	Quarantine
Anomalies	Soil, sand and rock (including daily cover)
	Fly ash

* The total amount of hazardous waste, irrespective of classification in a material category or not, should be provided in waste and recycling reporting.

There are also a number of industry surveys that are regularly used in waste and recycling reporting to assist in the compositional breakdown of recycling.

The Recycled Organics Unit compiles *Organics Recycling in Australia – Industry Statistics* which is commonly used to provide a breakdown of organic material.

The National Packaging Covenant (NPC) (now the Australian Packaging Covenant) has generated a number of reports that include data on packaging composition. Additionally, a

number of materials recycling activity reports are used to either inform the NPC, or jurisdictional recycling activity for packaging materials. These include the:

- annual PACIA National Plastics Recycling Survey
- annual NPC Steel Can Recycling Survey
- annual Aluminium Can Group data
- annual Industry Edge data on newspaper recycling.

4.3.2 Waste collected in a different stream to the source

Waste that is defined as originating from a particular source is sometimes collected, and identified as being part of another waste stream. There are a number of instances where this happens on a regular basis.

Some councils offer a kerbside waste and/or a recycling collection service to local small businesses. Waste and recycling collected from these businesses is usually not recorded separately to that collected from households. In this case, a small proportion of waste that is recorded as municipal waste is actually C&I waste. Conversely, some municipal waste collected in mixed use buildings is can be counted as being C&I waste.

C&D waste from home renovations, shop fit-outs, and other minor building activities can be disposed of through Council or privately sourced waste collection systems that would ordinarily be considered part of the municipal or C&I waste stream. For example, a trailer load of C&D waste taken to a transfer station or landfill by a home renovator is likely to be considered municipal waste.

In these instances, the data collected usually makes it difficult to distinguish between the source of the waste and the stream that it is collected in. Most waste and recycling reporting does not attempt to separate that out component of a waste stream that is collected from another source.

Recommendation 21: Waste should be counted by the stream that it is collected in unless data is readily available.

4.3.3 Conversion factors

Some landfills, particularly smaller facilities, and those in rural areas, operate without weighbridges. In these instances, conversion factors are used to convert data on the volume of material collected into an estimate of the weight of material collected. Conversion factors are also often used to convert the volume of organic material collected into a weight.

The density of loads disposed to landfill or organic recyclers can vary markedly between jurisdictions, and between landfills within jurisdictions. Accordingly, conversion factors can vary between jurisdictions, and between landfills within jurisdictions.

Recommendation 22: Standard conversion factors should be used except for where states or territories have justification to apply jurisdiction or site specific conversion factors.

For open truck loads, NSW applies a different conversion factor to municipal and C&I waste, to C&D waste and to “excavated natural materials”. For closed truck loads a single conversion factor is applied.

Victoria uses a standard conversion factor for landfills that collect volumetric data. However, provision is made for landfills to establish and apply a site specific density. Victoria also uses a conversion factor to determine the weight of organic material recycled.

Queensland uses conversion factors from California to convert volumes to weight.

4.3.4 Residual material

Residual material refers to the contaminants in, or unwanted components of, products and materials collected for recycling. These materials are extracted either prior to or during reprocessing operations, or the conversion of waste to energy. Residual material usually accounts for any discrepancies between the materials reported as having been recovered for recycling, and that which is actually recycled.

Recommendation 23: Residual material from recycling operations should not be counted as recycled material.

Difficulties in measuring and comparing the amount of residual material can arise depending on the point in the recycling process at which data collection occurs. If the amount of recycled material is measured at the point of input into a recycling process, the reported amount will include any waste material separated during reprocessing. In this case, the residual material would be counted twice: once as a component of material made available for recycling, and again when it is disposed to landfill.

This difficultly also occurs when measuring material that is collected for recycling overseas. However, it is less likely to be an issue in this instance given that there is usually an economic imperative to ship recyclate material with as little residual material as possible.

Most states and territories make attempts to record the amount of material after reprocessing.

NSW reports on material received for reprocessing, and records details on contamination losses where they occur.

Victoria also records material recovered for reprocessing, and asks recyclers to provide data on the “amount of material disposed to landfill due to contamination or as processing waste.”

Queensland asks Councils to provide details on “materials collected for recycling disposed to landfill due to contamination.”

Western Australia provides details of recyclable and non-recyclable reprocessing losses.

South Australia excludes reprocessing losses from the quantity of material recovered for recycling.

In the ACT, recycling is generally measured as ‘out-the-gate’, with the exception being green-waste, which is measured using a conversion factor.

4.3.5 Input or output

Another issue in the accounting of recycling can be whether to record the weight of material input or material output, even after accounting for contamination or unwanted components. This is a particular issue in the composting of organic wastes, where chemical processes occur which reduce the mass of the compost significantly from that of the organic material coming in the gate.

Given that organic waste disposal to landfill is recorded as a waste input, it stands to reason that organic waste recycling (less residual material) should be accounted for similarly.

Recommendation 24: Recycling should be counted by material input (less residual material).

4.3.6 Interstate and international movement

The movement of waste and recyclate between states and territories sometimes leads to the double counting of material. For example, one state might record material collected for recycling within its borders, and another state that receives this material might also record this material in its recycling figures.

Recommendation 25: Waste should be counted once at the point of generation.

The accurate accounting of waste that is transported interstate can become difficult with respect to residual material. When material collected for recycling crosses state or territory borders, it is usually counted by gross weight in the state of origin. The residual material from recycling operations in the destination state is also likely to be counted as landfilled waste. In this case, care needs to be taken that the residual material from recycling is not double counted. Residual material from reprocessing that is collected in a different jurisdiction to that where it is landfilled should be attributed to the point of generation.

The double counting of material collected for landfilling is less likely. However, given that most jurisdictions record landfill data at the gate, material that is transported interstate to be landfilled is usually recorded at the point of disposal.

Significant quantities of recyclate materials (both before and after reprocessing) are exported from Australia. This occurs across many material types, including; steel, non-ferrous metals, paper and cardboard, and plastics (predominately packaging). While reasonably good data is often available on the material types of exported recyclate, the state of origin of the material can be uncertain as materials are sometimes transported interstate prior to export.

NSW records data on recycling at the point of collection. That is, material that is imported into the state is not reported, but material that is collected and exported from the state is. However, landfill data is measured only as what comes through the gate, irrespective of origin.

Victoria provides details on material imported and exported interstate in its survey of recycling activities. However there is no tracking of the interstate movement of non-hazardous waste to landfill.

Conversely, in Queensland, landfills are asked to provide state of origin, but no tracking is undertaken for recycling.

The ACT only reports recycling originating in that territory. They receive a clearly identified quantity of material from Queanbeyan (NSW) which is excluded from the ACT's reported data.

No waste materials are known to be imported into Australia for disposal to landfill. Small quantities of some recyclate materials (e.g. glass) are occasionally imported into Australia for reprocessing. In relation to Australia, this material is effectively 'consumption', and should not be considered as recycling.

4.3.7 Stockpiling

Materials collected for recycling are often stockpiled subsequent to reprocessing. This can create the potential for double counting of material stored over more than one reporting period.

Recommendation 26: Stockpiles of reprocessed product or material that has been actively recovered should be considered to be recycled.

NSW records only that material that is reprocessed, and is confident that stockpiling is not leading to any double counting.

Victoria records how material is being stockpiled each year to ensure there is no double counting of material.

Queensland is aware of the possibility that stockpiles in that state are being double counted.

South Australia has a process that accounts for stockpiling of reprocessing.

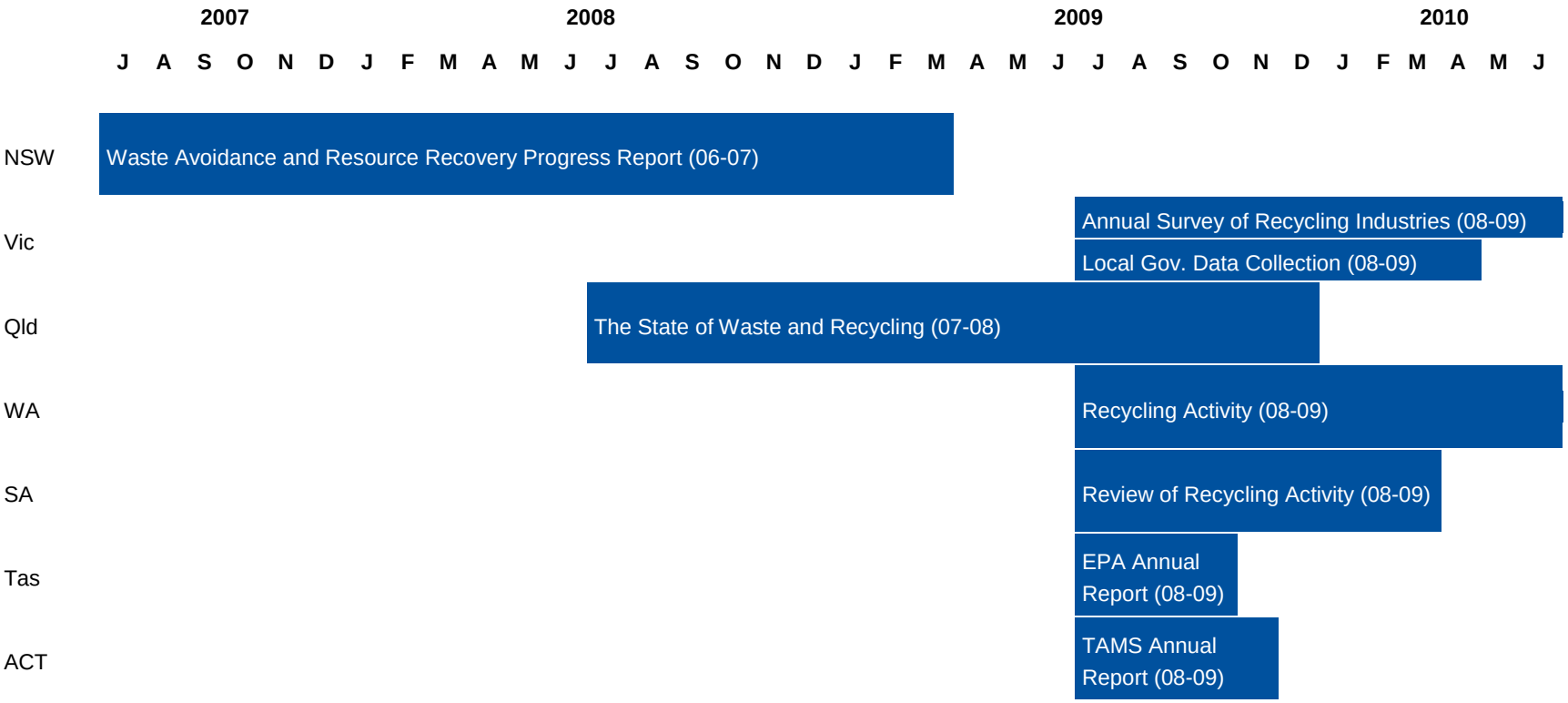
4.3.8 Reporting delay

The delay in publishing waste and recycling data varies between states and territories. This can sometimes make it difficult to make accurate comparisons between data from states and territories while also using the most up-to-date waste and recycling data.

Recommendation 27: Waste and recycling reporting should include both the most up to date data, and data from most recent time period reported on by all jurisdictions.

Table 70 details the delay in publishing the most recent waste and recycling reports by states and territories.

Table 70: Delay in waste and recycling reporting by states and territories



The time period highlighted represents the period of delay between the reporting period and the publication of the report.
The reporting period is the 12 month period before the time period highlighted.

APPENDIX 1: DATA SOURCES

The tables shown below show the data sets used to report on waste generation for each state and territory in *Waste and Recycling in Australia* (2009). This includes those data sets generated by the state and territories, and, in some cases, those generated by industry groups.

Table 71: New South Wales

Destination	**Recycled**			**Disposal**		
Amount	DECC - Waste Avoidance and Resource Recovery Progress Report					Landfill levy data
Stream	**Municipal**	**C&I**	**C&D**	**Municipal**	**C&I**	**C&D**
Amount	DECC - Waste Avoidance and Resource Recovery Progress Report					
Composition	Resource Recovery Industries Survey NEPC - Used Packaging Materials NEPM (2007) PACIA - Plastics Recycling Activity Study (2006) WMAA - Resource Recovery Industry Survey (2008)			Audits by DECC on the composition of disposal to landfill.		DECC - Report into the C&D Waste Stream - Sydney Metropolitan Area

Table 72: Victoria

Destination	**Recycled**			**Disposal**		
Amount	SV waste model					
	SV - Victorian Recycling Industries Annual Survey	SV - Victorian Local Government Survey				EPA - Landfill levy data
Stream	**Municipal**	**C&I**	**C&D**	**Municipal**	**C&I**	**C&D**
Amount	SV waste model					
Composition						

Table 73: Queensland

Destination	Recycled			Disposal		
Amount	EPA - The state of waste and recycling					
Stream	**Municipal**	**C&I**	**C&D**	**Municipal**	**C&I**	**C&D**
Amount	EPA - The state of waste and recycling					
	PACIA - Plastics Recycling Activity Study (2006)					
	ROU - Organics Recycling in Australia					
Composition	PACIA - Plastics Recycling Activity Study (2006)					
	PACIA - Plastics Recycling Activity Study (2006)	ROU - Organics Recycling in Australia				

Table 74: Western Australia

Destination	Recycled			Disposal		
Amount	Cardno BSD - Review of total recycling activity in Western Australia			www.zerowastewa.com.au extrapolation		
Stream	**Municipal**	**C&I**	**C&D**	**Municipal**	**C&I**	**C&D**
Amount	Cardno BSD - Review of total recycling activity in Western Australia ROU - Organics Recycling in Australia			DEC - Zero Waste Plan Development Scheme	www.zerowastewa.com.au	
Composition	Cardno BSD - Review of total recycling activity in Western Australia			Murdoch University - City of Stirling	Audits by Waste Audit and Consultancy Services for DEC	

Table 75: South Australia

Destination	**Recycled**			**Disposal**		
Amount	ZWSA - Recycling Activity in SA			EPA - Landfill data		
Stream	**Municipal**	**C&I**	**C&D**	**Municipal**	**C&I**	**C&D**
Amount	ZWSA - Recycling Activity in SA			Waste Audit and Consultancy Services - Disposal based survey		
Composition				EPA - State of the Environment Report	Waste Audit and Consultancy Services - Disposal based survey	

Table 76: Tasmania

Destination	**Recycled**			**Disposal**		
Amount	DPIPWE					
Stream	**Municipal**	**C&I**	**C&D**	**Municipal**	**C&I**	**C&D**
Amount	DPIPWE			Landfill operators		
Composition						

Table 77: Australian Capital Territory

Destination	**Recycled**			**Disposal**		
Amount	www.tams.act.gov.au					
Stream	**Municipal**	**C&I**	**C&D**	**Municipal**	**C&I**	**C&D**
Amount	NEPC Annual Report	www.tams.act.gov.au ROU - Organics Recycling in Australia				
Composition	PACIA - Plastics Recycling Activity Study (2006)				ACT NoWaste	ACT Waste Inventory

Table 78: Northern Territory

Destination	**Recycled**			**Disposal**		
Amount	NEPC Annual Report Darwin City Council			Darwin City Council		
Stream	**Municipal**	**C&I**	**C&D**	**Municipal**	**C&I**	**C&D**
Amount						
Composition						

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