Cooperative Research Centre for **Contamination Assessment and Remediation of the Environment**

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Landfill futures

National guideline document

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CRC for Contamination Assessment and Remediation of the Environment

Technical Report no. 30

Landfill futures

December 2014

Executive summary

There is a continued imbalance between the stated policy preference for avoidance or reuse, the proportion of the waste stream which is reused or recycled and the efforts made in avoidance through alternate models of resource use. The initial findings of this test case application of the integrated resource planning (IRP) model to waste suggest that disposal to landfill is an expensive option for waste compared to many others.

Once a full suite of costs and benefits of mitigation options are considered, it appears that landfill may be an expensive and less preferred option compared to others, in many cases, but still have a role to play in specific contexts where the costs of other options are higher.

However the current pricing structures for disposal to landfills do not reflect the full costs borne by society of this disposal mechanism, so these costs are not reflected in the price signal to consumers.

In addition, as landfills near their end of life around Australia, the social costs of landfills are reflected in difficulties siting new facilities, and start-up costs will be reflected in the overall cost of this disposal method. That is, while Australia is not short of space it is becoming increasingly difficult to site landfills in metropolitan areas and hence extended travel distances for disposal will become the norm. The per unit disposal cost will also increase (and charges will need to increase, as costs increase) as facilities reach end of life capacity and need to be either extended or new facilities established, and old sites remediated.

While landfill may have a role to play in the future of waste management and mitigation in future, it should not be assumed that this technology, nor any other particular technology, will continue to provide a cost effective pathway to meeting the agreed objectives for managing / mitigating waste and creating efficient use of resources. An important direction for the future of waste will be the uncoupling of industry interests from the provision of information to decision makers about options. Another important direction will be the even handed consideration of technology and policy options across a broad range of scales (not just large scale projects but also small local initiatives) and taking a range of formats (considering both soft systems practice change approaches and infrastructure approaches alongside each other for example).

Increasing professionalisation of the waste management sector will be an important foundational element for the changes we describe. If the sector were to reflect on and reach consensus on the range of key skill sets required for waste managers (in both strategic and operational roles), and support this with both formal accredited training and accredited industry membership, this would provide a platform for integrating decision making processes and the use of tools such as IRP.

In terms of decision making about options, it is critical that a full range of options be considered, including options that have typically been beyond the scope of waste managers to affect change or implement directly (e.g. options for waste avoidance or re-use). To make these assessments there could be better connection between those involved in industrial design processes, minerals and other resource processing, and

those considering waste mitigation and management options once products have been obtained and used and used by consumers. A larger systems approach to resource management which reconnects the decision makers across traditional management domains with each other, and to better articulated estimates of costs and benefits of different approaches is needed.

Another key strand of work for the future is better defining the objectives for waste management and mitigation activities, and acknowledging that these differ for different localities and stakeholders. Involving citizens and aligned stakeholder groups in decision making is an area for further thought and innovative design in waste management. An IRP process is a tool for distinguishing between options based on cost, against a stated set of objectives. Without clear objectives, the process is not useful. Devising robust and transparent decision making processes in which citizens are involved, and where involvement is deliberative and goes beyond large stakeholders will be an important factor in ensuring broad community support and social licence for decisions around waste options such as technologies and programs.

The current policy landscape demonstrates a growing commitment to strategic approaches to waste management and mitigation in Australia. Discussions with stakeholders reveal that while the national framework is welcome, old patterns of distrust surround protracted problems that have not yet been resourced or solved – such as the coordination of data across scales of government, consistency in its use or consistency in auditing methodologies. That said, this situation should not be taken as a rationale for continuing the status quo in terms of approaches to waste management, or for not considering new options. Instead the approach of IRP encourages continued monitoring and evaluation across the life of a set of options being implemented, so that the data on actual performance can be refined over time and fed into the model for future decision making. Similarly, the lack of perfect data need not delay the application of a process such as IRP – as demonstrated in the worked example the differences in costs between options are often so large that even if some volumes were approximated within 50%, this would not change overall conclusions about the relative cost-effectiveness of options.

This research takes into account the significant historical role of landfills as the predominant waste management measure, and the changing cost of landfill, relative to other options for waste management or mitigation. There is an extensive body of literature on the direct (or tangible) costs and particular technological challenges of minimising local landfill impacts on the environment – specifically through containment of contamination and then remediation. These costs are increasing, as landfills in close proximity to urban centres become constrained and land use pressures limit options for new landfill sites, and as the costs of increased regulation, including carbon pricing, are felt.

The complexity of future waste management requires a new approach beyond cost benefit analysis and the waste hierarchy. By using the Strategic Sustainable Development Framework, the role which integrated resources planning can play as a process to select and connect actions to objectives was identified. The steps in IRP were outlined and key stages were discussed through an illustrative worked example for Canberra.

Good-quality, robust and relevant information is needed to help the sector make decisions concerning these emerging challenges. Furthermore, such data must be coupled with an effectively deliberative process of stakeholder engagement to support adaptive decision making for the long term. IRP can fulfil this role.

IRP has been successfully applied in water and energy sectors, but IRP has not yet been applied in systems with the variety of materials currently involved in the waste system. Additional complexity comes from the different health and environmental impacts associated with each of these materials. Developing agreement about clear and achievable objectives in such circumstances will require significant mapping of issues, implications, barriers, incentives, in addition to the processes and technologies that might be used to achieve objectives.

IRP offers strong potential to handle the complexity of today's waste paradigm, both in terms of the number of relationships and interactions between different stakeholders, and with respect to the nature of the materials being addressed, IRP's focus on objectives and its support for exploring a wide range of alternatives simultaneously, may be very useful in resolving issues between more numerous and diverse stakeholder groups.

Glossary

Avoidance/waste avoidance	waste avoidance (also known as waste minimisation) is the reduction of waste through education and improved production process rather than increased or improved treatment technology – it is focused on maximising the efficiency of resource use
Clean fill/fill material	material that will have no harmful effects on the environment and which consists of soil (being clay, silt and/or sand), gravel and rock of naturally occurring materials, arising from the excavation of undisturbed material
Composting	the biological decomposition of organic materials such as leaves, grass clippings, brush, and food waste into a soil amendment – composting is a form of recycling
Construction and demolition waste	materials in the waste stream which arise from construction, refurbishment or demolition activities
Disposal	removal and containment of waste for public health and amenity benefits; despite a move towards the recovery of resources from waste, disposal is still the most common final destination for many types of waste, including municipal waste; two main categories of disposal are burial (landfilling) or burning (incineration); the line between disposal and resource recovery is sometimes blurred by the fact that both landfills and incinerators can be established or modified to enable at least the recovery of energy (and potentially the recovery of materials)
Instrument/policy instrument	economic, communicative, structural or regulatory interventions made to work towards a stated goal or desired outcome
Integrated resource planning	a strategy that addresses the entire production life-cycle (beyond post-consumption), includes all key stakeholders, all sustainability costs and benefits, material flows, and other key sustainability aspects of waste and resource management
Landfill	a site licensed under the relevant jurisdiction used for disposal of solid material (i.e. is spadeable) by burial in the ground
Measure	waste management/mitigation measures include specific resource recovery, avoidance, AWT technologies and initiatives suitable to meet strategic objectives

Municipal solid waste	is made up of: • household domestic waste set aside for kerbside collection or delivered by the householder directly to the waste facility • other types of domestic waste (e.g. domestic clean-up, furniture and residential garden waste); • local council generated waste (e.g. waste from street sweeping, litter bins and parks), and • commercial waste generated from food preparation premises or supermarkets.
Option	option is a combination of a particular measure and instrument (as defined above)
Post-generation/ consumption waste	any product which has served its intended use by a business or a consumer and has been disposed of
Production and consumption system	the physical, social and economic system/s which produce goods and services for human use and purchase; the associated social and economic factors which affect the demand, use and disposal of these goods (and services)
Putrescible	component of the waste stream likely to become putrid; liable to decay – food and garden waste from various sources
Pyrolysis	chemical decomposition of organic materials
Recycling	using waste as material to manufacture a new product – recycling involves altering the physical form of an object or material and making a new object from the altered material
Reuse	recovering value from a discarded item without reprocessing or remanufacture; that is, using an object or material again, either for its original purpose or for a similar purpose, without significantly altering the physical form of the object or material – reuse includes selling/buying, donating, or exchanging used items
Treatment	physical, chemical or biological processing of a waste for disposal or reuse

Waste	waste may mean one or more of the following: • any substance that is discarded, emitted or deposited in the environment in such volume, constituency or manner as to cause an alteration in the environment • any discarded, rejected, unwanted, surplus or abandoned substance • objects or materials for which no use or reuse is intended • any otherwise discarded, rejected, unwanted, surplus or abandoned substance intended for sale or for recycling, reprocessing, recovery, or purification by a separate operation from that which produced the substance, and/or • any substance described in environmental regulations as waste. In this project, waste is defined as all waste that is or would otherwise be sent to landfills. This focuses on municipal solid waste (MSW), commercial and industrial waste, and construction and demolition waste. Hazardous waste is included to the extent that it relates to landfill as a disposal option. Mining, agricultural and other rural wastes that are typically managed onsite or via other means than landfilling are excluded from the scope of this project. Liquid waste is also excluded, unless explicitly stated otherwise.
Waste hierarchy	an ordered list of approaches to deal with MSW, which ranks the options according to their environmental acceptability, with waste reduction the most preferred, and landfill disposal the least preferred
Waste management and mitigation	for the purpose of this report, 'waste management and mitigation' refers to the suite of all measures or options to better treat, recycle, minimise or avoid waste

Acronyms

ACT	Australian Capital Territory
ALGA	Australian local government association
AWT	Alternative waste treatment technologies
C&D	Construction and demolition waste
C&I	Commercial and industrial waste
CBA	Cost-benefit analysis
CDL	Container deposit legislation
COAG	Council of Australian Governments
CRC CARE	Cooperative Research Centre for Contamination Assessment and Remediation of the Environment
EPA	Environmental Protection Authority
EPR	Extended producer responsibility
EU	European Union
GHG	Greenhouse gas
IRP	Integrated resource planning
ISF	Institute for Sustainable Futures
IWM	Integrated waste management
LCA	Life cycle assessment
LGA	Local government area
MRF	Materials recovery facility
MSW	Municipal solid waste
NEPM	National Environmental Protection Measure
NSW	New South Wales
NT	Northern Territory

PS	Product stewardship
QLD	Queensland
SA	South Australia
SSD	Strategic sustainable development
TAS	Tasmania
VIC	Victoria

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1. Introduction

The Cooperative Research Centre for Contamination Assessment and Remediation of the Environment (CRC CARE) has an interest in land and water contamination from various land uses including landfill. The Institute of Sustainable Futures (ISF) provided expertise from its 15 years of experience with systems, futures, and decision making frameworks such as integrated resource planning (IRP), as well as a broad view of sustainability, gained from working across industry sectors on sustainability approaches. This project focused on landfill in the broader context of waste management and mitigation options – recognising that significant technical research is being carried out on how to reduce the impacts of existing and decommissioned landfills, but less in relation to how to choose whether landfill is the appropriate approach to waste management in a particular context.

This work is sought to bring greater insights into decision making using a broad sustainability framework to bear on resource decision making.

1.1 Scope, objectives and methodology

The role of landfill in the future of waste management is controversial. Some see landfill as the antithesis of resource efficiency and a symbol of a culture which values neither scarce resources (such as minerals), nor minimises social and environmental impacts of consumption. Others maintain that well designed and managed landfill is a reasonable and necessary response to residual waste, and even a sound basis for future mining of resources.

This research accepts as a premise that landfill has a role to play in the current waste management and mitigation landscape. The role of the IRP decision making tool will be investigated, and all forms of waste mitigation and management are included in terms of analyses. This research seeks to provide support for improved decision making at the levels of government which have jurisdiction over waste.

1.2 Structure of report

This report comprises six parts and is focused upon the full sustainability costs of waste management and mitigation in Australia. The next five parts are:

- Section 2 *Sustainability costs and challenges of waste management and mitigation in Australia* discusses the full range of costs associated with landfills as well as outlining various decision making frameworks for distinguishing between waste options.
- Section 3 *Understanding the future of landfills: Waste management policy in Australia* considers the policy landscape in Australia, in relation to key challenges and opportunities for the future of waste policy. This section was informed by a review of both industry reports and documents and academic texts.

- Section 4 *Integrated resource planning for waste* considers in more detail the idea of IRP as a decision-making tool. This section contains a worked example of components of IRP for waste management and mitigation in Canberra.
- Section 5 *Waste futures: Workshop report* outlines the results of a stakeholder workshop held on 23 November 2011 in Sydney.
- Section 6 *Landfill futures: Stakeholder interview summary report* discusses results of the eleven semi-structured telephone interviews and one face-to-face interview, which were carried out in August–September 2011.

1.3 Research and potential applications

This research explores a new decision making framework for waste, identifying ways it can assist to overcome the challenges of existing processes. These challenges include consideration of the full range of options for waste management and mitigation (avoidance, reuse, recycling, resource recovery and disposal); assessment of the entire chain of production and consumption; consideration of the full range of costs, including environmental and social externalities and the need for rigorous engagement processes.

This research could be applied at either a state or local government level for prioritising policy and infrastructure interventions for waste reduction. The research has provided an introduction and proof of concept, with opportunities now for application of this approach in specific jurisdictions. This would generate detailed implementation data which would help refine the model.

2. Sustainability costs and challenges of waste management and mitigation in Australia

Historically in Australia, disposal to landfill has been the dominant means for managing waste. However, intervention points can occur at all stages of the production and consumption chain, and there are a variety of disposal, recovery, re-use or avoidance measures in use worldwide.

This section comprises part of a research project examining the way that costs, policy and stakeholder preferences are shaping waste management responses in Australia. The aim of this project is to undertake detailed analysis of the role of landfills in Australia, in relation to other waste mitigation approaches. The research draws on issue identification, situation analysis, review of existing literature, policy mapping, and participatory stakeholder engagement methods (see appendices A and B for details). The project seeks to provide support for improved decision making for Australia's three tiers of government, all of which are involved in waste management. It will also present policy options related to the decision-making processes that are currently in use.

This project has deliberately taken a broad perspective on managing waste and resources, in line with international best practice. That is, the system boundary explicitly includes the whole production and consumption value chain, rather than just post-consumption waste.

The research reported in this section draws on a literature review and stakeholder interviews (see appendix B). This report uses the term waste management and mitigation to describe the objective, or overall purpose, of various options, rather than the terms waste management or landfill avoidance. Where these terms are used, they represent usage in the original interview or document.

2.1 Background

There is a considerable body of academic and industry literature on the issue of waste management in Australia. The *National waste report 2010* (EPHC 2010a), *Beyond recycling* (ISF 2004a) and many others provided the basis for understanding and critiquing waste management in Australia today, and the impacts and opportunities. The research reported here sets up the case for a comprehensive framework for decision making in the waste area, allowing the lowest cost options to the whole of society for waste management to be determined, based on an adaptation of the principles and processes that have been applied in other infrastructure areas such as energy and water (Fane et al. 2011).

This project takes a purposefully broad perspective on managing waste and resources, in line with international best practice. That is, the system boundary explicitly includes the whole production and consumption value chain, rather than just post-consumption waste. Historically in Australia, disposal to landfill has been the dominant means for managing waste, however today there is a variety of measures in use that can be

classified variously as disposal, recovery, reuse or avoidance measures. Intervention points can occur at all stages of the production and consumption chain.

The role of landfill in the future of waste management is controversial. Some see landfill as the antithesis of resource efficiency and a symbol of a culture which neither values scarce resources (such as minerals), nor minimises social and environmental impacts of consumption. Others maintain that well designed and managed landfill is a reasonable and necessary response to residual waste, and even a sound basis for future mining of resources.

This project takes a futures perspective (i.e. by asking how do we want to manage resources in the future), while acknowledging the change that has occurred within the industry, as well as the inertia of the past and challenges associated with the current context (such as sunk costs associated with existing landfill infrastructure). Finally, the project considers the current and future roles and responsibilities of all stakeholders. This framework expands the focus of current waste management thinking in at least three dimensions – sustainability costs, responsibility and time (Figure 1). The project considers all sustainability costs (economic, social, environmental) both tangible and intangible; takes a whole-of-community approach to waste disposal and mitigation options and their impacts, while allowing long- and near-term sustainability issues to be considered.

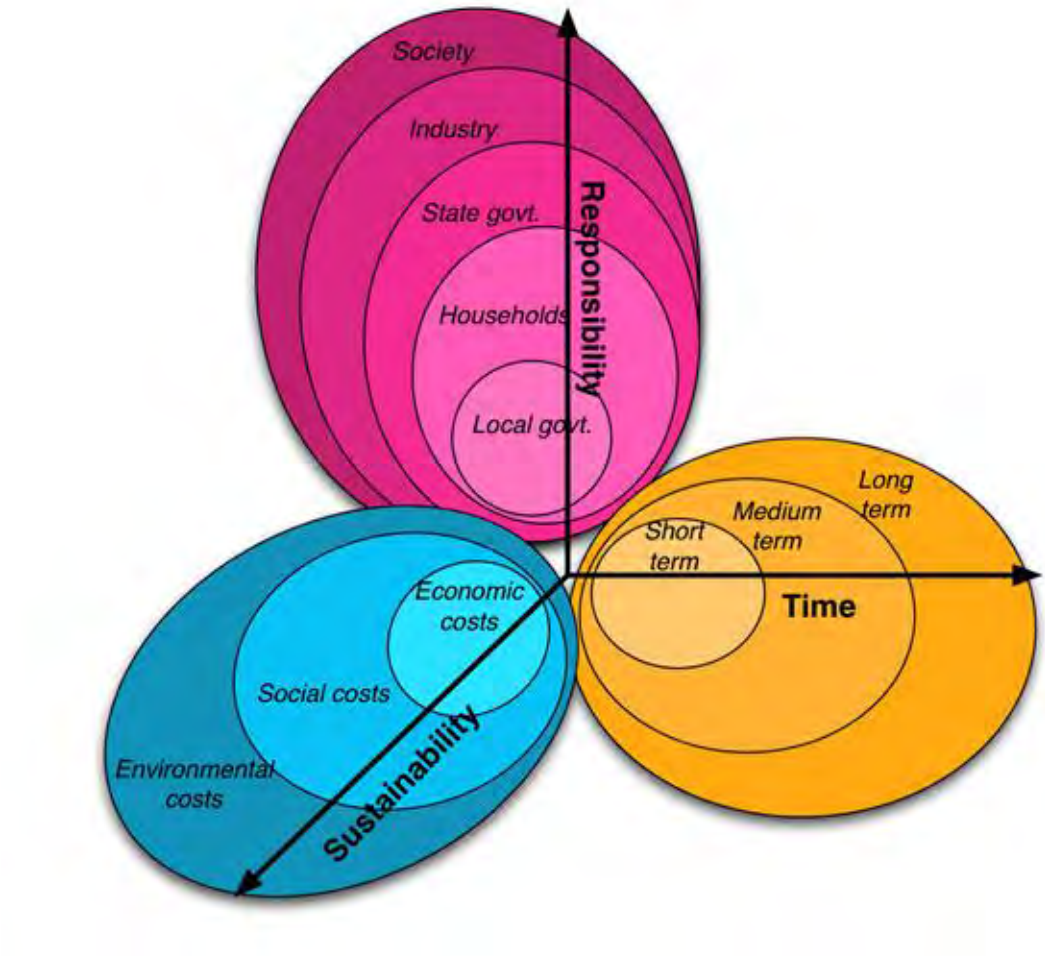

Figure 1. Broadening the dimensions of sustainable waste management to account for the long-term, whole-of-society and true sustainability costs.

The waste hierarchy, first developed in the 1970s, sets out a priority of actions from avoidance and minimisation, to reuse and recovery and finally disposal. While the hierarchy presents a rule-of-thumb based on environmental impacts and efficiencies that have been adopted extensively in waste policy around the world, it is often not explicitly tested and examined for specific contexts. This project examines all possible waste and resource management options (from avoidance through to landfilling) and generates a framework for assessing which are the lowest cost options in a given context and in what priority order investment might occur. Such an integrated decision-making framework based on the relative cost-effectiveness of the full range of options (avoidance, reuse, recycling, resource recovery, disposal, production and consumption) is rarely used in the waste and resources sector. Rather, decisions are often made on a project-by-project basis. This proposed framework will help waste planners make better, more informed decisions about how to manage waste and resources both in the near- and long-term future.

2.2 Waste management: drivers, role and capacity

Historically, the use of landfills has been the dominant form of managing waste. Whilst landfill design and management has evolved to more sophisticated levels, and other waste management measures (such as resource recovery) have emerged, landfilling remains the dominant form of waste management in Australia today.

2.2.1 Historical drivers and current pressures

The coordinated use of simple, small-scale local landfills to stockpile community waste was the first form of deliberate solid waste management. Prior to the industrial revolution (and in pre-colonial Australia), many materials used in products were natural and either biodegradable or inert, hence could be readily disposed of to the environment (e.g. buried, burned or reused). However, because of unsanitary waste disposal methods and increasingly complex products – containing potentially harmful and persistent chemicals and materials – there was a need to separate waste from human settlements to minimise health risks. The industrial revolution also introduced the throw-away culture, where mass produced items could be used once and thrown away. This dramatically increased the volume and changed the nature of waste being generated, particularly in the latter half of the 20th century. Landfills have been used for many decades by Australian municipalities in an attempt to manage the health and amenity risks associated with solid waste (WMAA 2008; EPHC 2010a). For a long time, landfills were considered a relatively cheap and simple waste management and health protection response (WMAA 2008; EPHC 2010a).

However in the past few decades there has been increased awareness of some of the social and environmental challenges associated with landfill – including greenhouse gas emissions and toxic leachate (Scott et al. 2005). This is in part due to the changing nature of the waste stream – with increasingly complex and hazardous waste products emerging in recent times. Population growth and increased per capita consumption of material goods has increased the volumes of waste being generated (hence the size of landfill space required), and simultaneously resulted in expansion of residential land use. Reduced landfill capacity and competing land-use issues have also placed pressure on landfills (Xu et al.1999; Wright 2009).

In response to these pressures, there has been deliberate consolidation of landfills to help raise environmental standards and introduce economies of scale, however many of these consolidated landfills will also reach capacity in the near- to medium-term (DPIWE TAS 2004, Wright 2009). Finding space for siting new landfills which meet planning constraints is therefore an emerging challenge, as are the potential increased transport costs and concerns about traffic congestion associated with disposal to fewer sites (Benns 2010, EPA Vic 2010). Increasingly, local communities are becoming concerned about living near landfill sites and possible property value impacts for people living adjacent to these sites (Nelson et al. 1992; Lim & Missios 2007). There is also ongoing concern about the consequence of disposing some specific wastes such as e-waste to landfill because of the valuable metals they contain and about who is responsible for providing alternative collections/recycling facilities for this waste (i.e. extended producer responsibility) (Davis & Herat 2009).

2.2.2 Role of landfills in Australia

While historically landfills may have been seen as the most appropriate way of managing society's solid waste, new local and global pressures on waste and materials management, in addition to the changing nature of waste itself, means we may need to rethink the role of landfills in Australia. The nature of the pressures (and responses) differs in different parts of the developed world.

In many European countries, incineration and resource recovery measures are often the dominant form of waste management due to serious land space constraints and environmental policies. For example, in 2007, Germany sent just 1% of solid municipal waste to landfill – the remainder was either composted/recycled (64%) or incinerated in waste-to-energy plants (35%) (Worldwatch Institute 2011). However like landfills, incineration plants (including waste-to-energy facilities) are also not without their challenges and costs (see example in section 5). There is likely no silver bullet to managing waste – rather, there is a need to investigate the most appropriate selection of measures in a given country or local context.

A broader question around waste and the future role of landfills is the potential to avoid materials going to landfill, emerging out of lifecycle and cradle to cradle thinking (ACOR 2006). Currently landfills play a significant role in the management of waste within Australia – during 2006–07 around 48% of Australia's waste was disposed to landfill (EPHC 2010a). However, waste is increasingly being seen as a resource – containing minerals and elements that are finite and useful for production – hence the trend towards resource recovery which we see emerging in the recent language of waste policy and strategy. Many regard the ultimate vision to be a material efficient, closed loop economy where the amount of waste created would be minimised in design, production processes, and through designing for easy upgrade and repair rather than product obsolescence (Howlett 2003). Different waste management technologies generate different by-products, and there is debate within the sector as to which combination of technologies produce the maximum benefit (environmental and/or economic) for least cost (GHD 2009; EPHC 2010a).

It has also been suggested that landfills should be considered an appropriate long-term option for waste management, based on cost and the potential for improved landfill design and operation and the potential for future mining of landfill sites for commodities (Barrett & Lawlor 1997). The existence of a debate surrounding the appropriate role of landfills as a waste disposal option, and the changing use of language around waste management, emphasises the need for the development of a conceptual framework that allows comparison of all options on the basis of total economic, social and environmental cost to society.

2.2.3 Data on landfill capacity

There are around 655 operating landfills across Australia today, receiving over 20 million tonnes of waste a year (see EPHC 2010a for state by state estimates). Publicly available data on landfills in Australia is limited due to commercial confidentiality. However, WMAA (2009) has undertaken a detailed review of landfills by contacting

every operating landfill in Australia, asking questions regarding size, siting, annual tonnage, waste types and typical features of a modern landfill site. While responses were voluntary, a large percentage of landfills were covered – >95% of landfills in NSW, QLD, VIC, SA and WA, and 50% in TAS. The figures for ACT are for 2003–04, and those for the NT are an estimate.

However in terms of greater levels of detail regarding the characteristics of these landfills, there are no comprehensive jurisdictional or national requirements for the public disclosure of landfill volumes, capacity, type, risk or operating performance and only a small number of Australian landfill sites report to the National Pollutant Inventory. In relation to future capacity, a 2009 modelling study in Australia found no evidence of an immediate critical shortage of physical landfill capacity at any of the major population centres (Hyder 2009a). Most of the population centres were found to have sufficient approved physical landfill capacity to last many years, and those with only a few years of approved physical capacity have plans to expand that capacity. The study found that future landfill capacity was constrained most strongly by social, environmental and political factors rather than limitations on actual physical capacity.

However, there has been a need identified for additional landfill capacity in areas of NSW (WCS 2009). In particular, landfills in metropolitan Sydney and the adjoining regions are identified as limited in capacity, with some major landfills at or near capacity. For example, Eastern Creek and Lucas Heights have only four to six years of active life for general putrescible waste (WCS 2009).

Similarly, existing landfill airspace at Whytes Gully Resource Recovery Park in Wollongong was projected to expire in late 2013, with a proposal to extend the site's current landfill capacity by up to 50 years within the addition of a new cell (Golder Associates 2011). If capacity is not increased, Whytes Gully Resource Recovery Park would no longer be able to accept municipal solid waste and result in the Wollongong Local Government Area (LGA) requiring an additional facility to accept municipal solid waste. It is reported that there are currently no suitable existing landfill sites to accept municipal solid waste within the Wollongong LGA (Golder Associates 2011).

In addition to exacerbating the identified landfill capacity constraints, the environmental, economic and social cost of transporting waste to alternate landfill sites outside the waste producing area is considered to be high and consequently not in the interest of stakeholders within the surrounding areas. In Melbourne, Victoria, the cost of transferring waste from Casey to the Bacchus March landfill site instead of the nearby Cranbourne area site is estimated to be $26–$35 per tonne greater (State of Victoria 2009).

In terms of waste going to landfill, Australia has an increasing annual production of waste, in absolute terms (Hyder 2009a; EPHC 2010a). Reported waste generation has increased from 32.4 million tonnes in 2002–03 to 43.8 million tonnes in 2006–07, of which 17.4 million tonnes and 21.1 million tonnes were disposed of to landfill respectively (Hyder 2009a). While there has been an evolution over the last few decades from smaller, local landfills to consolidated landfills that are better designed and operated to deal with local environmental challenges, this has resulted in increased costs to build and operate landfills and, in particular, higher transport costs because they are located on the periphery of cities.

2.3 The true cost of landfill

Australia and other countries are facing increasing economic, social and environmental costs of dealing with the current and future generation of waste, especially technological wastes (comprising hazardous industrial wastes and e-waste). While this report argues the importance of determining the true sustainability costs of all potential waste management and mitigation measures, so that they may be compared on an equal basis for a given region, this section focuses on the true cost of landfill by way of example.

There have been a number of recent studies on the costs of landfill disposal in Australia which quantify the tangible financial costs and attempt to quantify some environmental and social costs (Productivity Commission 2006; BDA Group 2009). Some estimates of the tangible financial costs range between $42 and $102 per tonne in urban areas and between $41 and $101 per tonne in rural areas (BDA Group 2009). However most tangible financial cost estimates include operating costs and do not include the marginal capacity cost associated with future augmentation of landfill capacity or end-of-life costs (Pickin & Wardle 2009; Hyder 2009a). Table 1 shows Sydney-wide fixed and variable (transport related) disposal costs according to Wright (2009). The table indicates that while the fixed component of landfill cost for the Sydney region ($57 per tonne) is expected to remain fairly constant in the future, the current marginal transport costs ($15 per tonne[1]) is expected to increase in the future to $43 per tonne as new landfills will be located further from Sydney.[2]

Table 1: Sydney wide fixed and variable (transport related) disposal costs (data extracted from White et al. 2001a).

	Fixed costs per tonne	Transport (marginal) costs per tonne	Proportion of total costs
Current	$57	$15	21%
Future	$57	$43	43%

While it is relatively straightforward to calculate the tangible financial costs (associated with land, infrastructure, operational and maintenance costs of landfills), it is more difficult to calculate the indirect, or intangible costs associated with environmental and social impacts due to the uncertainties involved with measuring external costs (Rabl et al. 2008; EPHC 2010a).These costs will likely be site specific, and therefore not easily transferable from one context to another. Calculating or estimating the true cost of landfill – or any waste mitigation measure – is essential for making more informed decisions regarding the most appropriate measures for a given context.

[1] While the marginal transport costs vary throughout the Sydney region, Wright (2009) estimated that the current Sydney average transfer and transport cost is $15 per tonne.
[2] Although this is a 2000 study, the conclusions are still valid in that transport costs are likely to increase significantly in the future.

Calculating the true sustainability costs of landfill or other waste mitigation measures ideally needs to consider:

- tangible financial costs (e.g. operating costs of a facility)
- intangible costs (e.g. reduced property value of residents near a landfill, incinerator or materials recovery facility (MRF))
- externalities (environmental and social costs such as odour or CO_2 emissions)
- avoided costs (e.g. avoided cost of sending waste to landfill)
- long-term costs (e.g. landfill closure and rehabilitation)
- costs across the whole production and consumption chain costs (e.g. consumption of virgin materials used to produce a product), and
- whole-of-society costs (e.g. costs to all stakeholders).

Figure 2 conceptualises this as a spectrum of costs for any waste management or mitigation measure. On the left side of the figure are the tangible costs, or costs that lend themselves to being quantified. The first tangible cost is the option cost, which refers to the actual costs associated with implementing a particular measure (e.g. capital and operating costs associated with a landfill, incinerator, MRF or resource recovery facility). The avoided costs include those costs that are tangible, but can be avoided by investing in the measure. For example, investment in resource recovery facility might avoid sending waste to landfill and avoid some energy use associated with landfills. The avoided costs are typically a net benefit. On the other side of the barrier are intangible costs. These are predominantly externalities. They can be actual or avoidance costs. For example, the labour cost of householders separating waste for kerbside recycling is an actual intangible cost, while the avoided cost of mining non-renewable resources due to investment in resource recovery is an avoided intangible cost. Ideally, both tangible and intangible costs should be considered when assessing and comparing sustainable waste mitigation options.

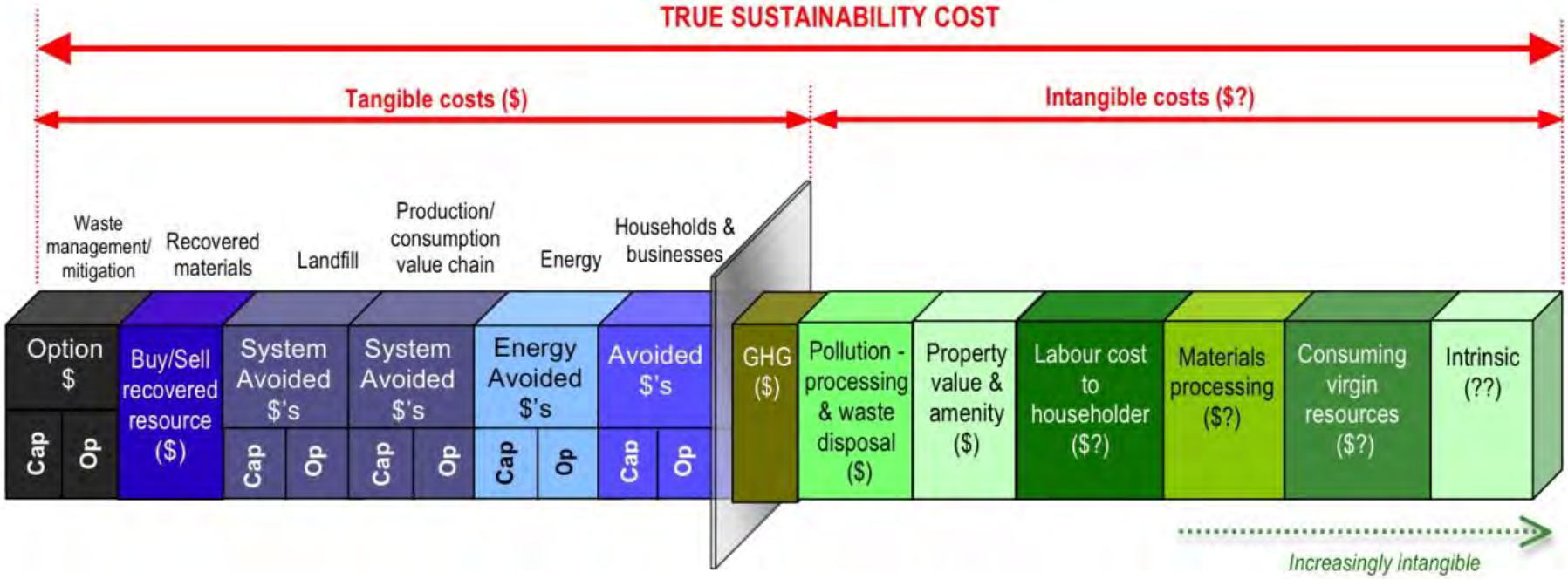

Figure 2. The sustainability costs of waste management or mitigation: including tangible costs (left side of spectrum) and intangible costs (right side of spectrum).

2.3.1 Reflections from sector stakeholders

Participant interviews included topics such as costs and pricing (see appendix B for more information on interview methodology). A question on the costs and impacts of landfill and waste management prompted responses that varied across sectors and jurisdictions. Costs and impacts of landfills were also brought up throughout the interviews and a thematic illustration (Figure 3) provides an overview of additional themes emerging from the discussion of costs and impacts.

Discussion of costs, especially in relation to question B3 ('What do you see as the main costs and impacts associated with landfill, and with waste management?') revealed that most respondents thought of economic and financial costs as the main costs associated with landfills and waste management. Several respondents acknowledged environmental costs, noting that the impacts of landfill on the environment had greatly improved over time, as illustrated by this comment from one respondent from the recycling sector:

> 'The costs are environmental and financial, but these days environmental impacts have been reduced using technology in landfill design.'

Several respondents noted the changing landscape regarding costs, for example the increasing landfill levy across several jurisdictions, increasing compliance requirements and the need for industry to employ stakeholder engagement officers in response to community demands. Hidden costs were also raised, for example from an NGO representative:

> 'We [society] don't pay the real price for anything… it's the same with landfills – the true cost is not charged.'

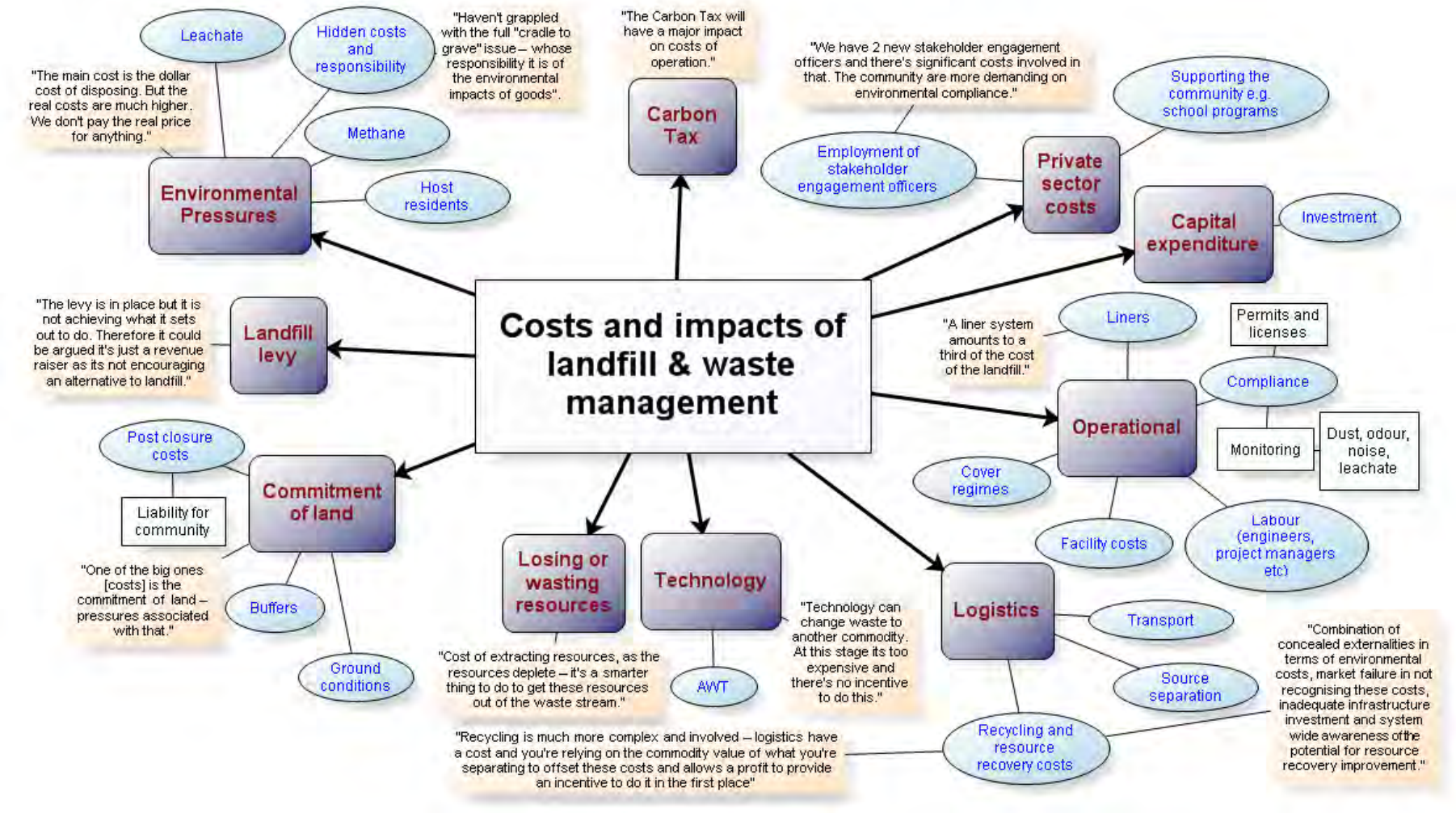

Figure 3. Costs and impacts of landfills and waste management – themes and specific issues raised by interview participants.

Concern was raised around some specific aspects of costs – in particular the carbon tax, with seven interviewees raising this as a concern. One commented:

> 'The carbon prices will double the cost of landfill before the levy. This is going to happen in nine months' time and not a lot of people understand what's going to happen and what it's going to do to the industry.'

Lack of markets was raised as an important factor in determining the costs of some options. For example:

> 'In WA, there's no doubt about it, the issue is markets – we are consumers of products from elsewhere. These end products have to be sent elsewhere to be reprocessed e.g. most glass goes to Adelaide. This is costly and not sustainable.'

Prices of disposing to landfill were seen to be influenced by both increasing operating costs and political considerations of the impact of increased prices. One interviewee considered that:

> 'Governments are sensitive to increasing the charges therefore very wary of this and the impact on business and industry which causes a big impact.' Another noted the 'economic imperative that is imposed by the levy and the ever increasing costs of landfill. Also the costs of environmental compliance of the landfills – it's more expensive to run a landfill and this must be passed on as a gate charge.'

Various state landfill levies were discussed as options for driving diversion of waste away from landfill, however there was concern expressed about re-investing revenue appropriately, or driving up costs of disposal to landfill without offering feasible alternatives. For example:

> 'At the moment local government don't want to pay, and landfill is too cheap. The levy will keep going up at least for the next 3–4 years but it will still be too cheap… It needs to be about $180/tonne to incentivise alternatives.'

Most respondents agreed that South Australia had the most effective financial incentives, partly due to the ability to receive rebates on the levy and revenue being reinvested appropriately in waste management and avoidance projects.

2.3.2 Reflections from the literature

As mentioned previously, while this report argues the importance of determining the true sustainability costs of all potential waste management and mitigation measures, this section focuses on the true costs of landfills. This is important because of their historical and predominate role in Australia.

Landfills can pose a range of potential environmental and amenity issues, which include groundwater contamination via leachate, greenhouse gas emissions (and other air pollutants), and social impacts on the local community such as odour (Xu et al. 1995; Scott et al. 2005; Hyder 2009a; GHD 2009; EPHC 2010a; EPA Vic 2010).

Historically, many argue, these impacts have been undervalued and not adequately reflected in disposal pricing to landfill, which may act as a deterrent to other resource recovery initiatives, may fail to act as an effective price signal to encourage waste minimisation, and may have resulted in less investment in environmental protection associated with landfills (Xu et al.1995; Howlett 2003).

Table 2 provides a typology of sustainability costs of waste management and mitigation (based on the literature review and stakeholder interviews). In this case, examples of tangible and intangible costs of landfills are identified, including type of sustainability cost (economic, environmental or social), scale of the cost (local or global), and the stakeholders affected by the cost (local council, residents, government or society as a whole). Note some examples appear twice because they have both a tangible and intangible component. For example, leachate may have a tangible mitigation cost (e.g. landfill lining), however it may also have an intangible environmental cost associated with potential pollution. What this matrix provides is a systematic means of detailing the spread of sustainability costs documented in the literature and capturing them across the different dimensions mentioned in Figure 3. What is often seen are reports, frameworks or calculators for landfill costs that quantify, or attempt to quantify, the actual tangible and intangible costs associated with landfills (and external costs to some degree), but do not attempt to describe and analyse the longer-term, avoided tangible and intangible costs, identify the stakeholders affected or the scale at which these costs can be felt.

Table 2. Typology of sustainability costs: tangible and intangible costs of landfills, indicating type (economic, environmental or social), scale (local or global), and relevant stakeholders (local council, residents, government or society in general).

Sustainability costs	Type			Scale		Stakeholder affected			
	Economic	Environmental	Social	Local	Global	Local council	Residents	Governments	Society
TANGIBLE COSTS									
Capital:									
Design and planning*	x			x		x	x		
Construction*	x			x		x	x		
Land acquisition*	x			x		x	x		
Approval process*	x			x		x	x	x	
Vehicle acquisition	x			x		x			
Operational costs:									
Fuel/electricity*	x			x		x			x
Road repair/upkeep*	x			x		x			
Licence fees*	x			x		x	x		
Staff labour, administrative, engineers, project managers)*	x			x		x			
Compliance costs*	x			x		x			
Monitoring and environmental licence compliance	x	x		x		x	x	x	
Monitoring groundwater quality	x	x		x		x	x	x	
Monitoring methane and other GHG emissions	x	x		x	x	x	x	x	x
Maintenance costs:	x					x			
Vehicle maintenance*	x			x		x			
Road repair/upkeep*	x			x		x	x		
Asset replacement	x			x		x			
Environmental protection costs:									
Leachate collection and treatment*	x	x		x			x	x	x
Toxic and hazardous substances/contamination	x	x		x			x	x	x
Landfill gas emissions and associated controls	x	x		x			x	x	x
Preventing contaminating water, soil, and nearby water catchments	x	x		x			x	x	x
Reaching capacity (marginal costs increase)	x			x	x	x			
Post-closure costs:	x					x			
Remediation	x	x		x		x	x		
Management and monitoring until landfill stability is achieved	x	x		x		x	x		
INTANGIBLE COSTS									
Climate change (methane (CH_4) and carbon dioxide (CO_2))	x	x	x		x	x		x	x
Consuming critical global virgin resources:									
Energy scarcity	x	x	x		x			x	x
Peak phosphorus	x	x	x		x			x	x
Mineral (other) scarcity	x	x	x		x			x	x
Environmental and resource cost of replacing the resources being buried	x	x			x			x	x
Potential habitat loss due to continued use of virgin material (impact level depending on avoidance and resource recovery approaches implemented)		x	x		x			x	x
Production chain costs (pre-waste-generation):									
Materials processing	x	x			x			x	x
Energy cost of processing and transporting materials, by products and intermediates	x	x			x			x	x
Pollution associated with processing materials	x	x	x		x			x	x

Sustainability costs	Type			Scale		Stakeholder affected			
	Economic	Environmental	Social	Local	Global	Local council	Residents	Government	Society
INTANGIBLE COSTS									
Local/regional social and environmental costs:									
Leachate		x	x	x		x	x		
Toxic and hazardous substances/contamination		x	x	x		x	x		
Reduced amenity			x	x		x	x		
Wind-blown litter		x	x	x		x	x		
Vermin (e.g. rodents, flies and carrion birds)		x	x	x		x	x		
Noise (collection and disposal)			x	x		x	x		
Traffic/congestion			x	x		x	x		
Visual intrusion			x	x		x	x		
Risk of fires and explosions		x	x	x		x	x		
Odour			x	x		x	x		
Dust			x	x		x	x		
Illegal dumping		x	x	x		x	x	x	
Local air pollutants (e.g. sulphur dioxide (SO_2), nitrogen oxides (NOx), particulates (TSP, PM10) and volatile organic compounds (VOCs)		x	x	x	x	x	x	x	
Community anxiety/worry about impacts of landfills			x	x	x	x	x		x
Land-use costs:									
Reduced real estate value	x		x	x		x	x		
Use and cost of land (inability to use for other purposes) (e.g. buffer zones)	x		x	x		x	x		
Post closure costs (inability to use contaminated land)	x		x	x		x	x		

* indicates costs where quantifications are typically included in cost assessments of landfills.

As mentioned earlier, one example of an externality is the environmental cost associated with the generation in landfill of leachate – a liquid that occurs in landfills and results from precipitation and surface water combining with the biochemical and physical breakdown of waste. Leachate may contain metals, organic and inorganic compounds. It is well documented that surface waters and groundwater can be polluted by leachate from landfill sites, and that leachate may cause serious water pollution if it not properly managed. The costs associated with leachate are often evaluated by seeking to directly measure damage costs (or the community willingness to pay to avoid impacts) or other measures such as preventative expenditures (i.e. landfill lining). A number of studies do not place a value on intangible leachate costs at all, mainly because they assume adherence to strict landfill regulations (Rabl et al. 2008; Gorecki et al. 2010). What is not clearly measured or researched thoroughly is the extent to which the costs are felt across stakeholders when occurrences of contamination do occur, or the effects of leachate and its transmission from landfills to the environment (e.g. habitat loss and effects on biodiversity). Despite these uncertainties, most studies have tried to come up with a cash value for the intangible costs of leachate, estimating the costs per tonne of waste as zero for a modern lined landfill to €1.5 for an unlined site (European Commission 2000). More research needs to be undertaken to further elicit costings for leachate in order for them to properly acknowledge the full costs identified above.

A tangible cost, often not included in estimating costs of landfill is the capacity cost associated with the finite life of a landfill facility. As a landfill approaches the end of its capacity, the marginal cost ($/tonne) increases due to the need for new capital expenditure to provide alternative means of disposal. The relative contribution of this capacity cost to the marginal cost of landfill is a function of the size of the capital expenditure required, and how soon the expenditure is required. Essentially it represents the deferral value of avoiding a tonne of waste being disposed of to the current landfill.

The tangible and intangible costs of greenhouse gas emissions (GHG) from landfills span over all sustainability costs, have an impact at the global scale (e.g. climate change), affect all stakeholders (e.g. direct costs to rate payers and local government to pay for GHG catching technologies, and indirect costs to whole of society due to the impacts of climate change), and have a temporal element (e.g. emissions often continue long after landfill sites actually stop taking waste). In their current form, landfills readily produce GHG through the natural process of anaerobic bacterial decomposition of organic waste.[3] Landfill methane is a potent heat-trapping gas that has a global warming potential estimated to be 21 times greater than that of the same volume of carbon dioxide (IPCC 1996). According to the US EPA (2006) global landfills represent over 12 percent of total global methane emissions (and expected to rise by nine percent between 2005 and 2020). Many modern studies of landfill costs actively try to calculate some of the external costs of landfill gas mentioned above and include the cost into landfill pricing arrangements[4] (RPM et al. 2001; DEFRA 2003; BDA Group 2009). However, these are usually highly variable and estimates at best. The UK Government has recommended the use of an estimated price for the social costs of carbon at £70/tonne of carbon, within a range of £35 to £140 (rising at £1 per tonne of carbon per year from the year 2000) (GES 2002). In Australia a similar plan to internalise the costs of GHG emissions will be met through the proposed introduction of a carbon pricing scheme (GHD 2009; EPHC 2010a). While a cash value has been developed for GHG emissions which can be divided between rate payers, GHG and their climate impacts are independent of the source of emissions, and therefore the whole of society pays for these impacts in both tangible and intangible costs.

Other intangible costs which have not been readily quantified relating to GHG emissions are vegetation dieback due to uncontrolled migration of landfill gas to the root zone of plants, the explosion risk of methane and if not used, the waste of a viable fuel source.

While not readily quantifiable, community concerns represent one intangible cost that has only recently had a cost indicator identified. Community Engagement Officers have been employed by landfills to liaise with communities and to discuss their concerns and anxieties. While the cost associated with community concern and anxiety is a quantifiable cost (i.e. staff time), it is important to understand that the costs of community anxiety span across the dimensions identified previously.

[3] Landfill gas is made up of approximately 50% methane (CH_4), with the remaining 50% being carbon dioxide (CO_2) mixed with small quantities of other gases.
[4] Previously GHG emissions were not factored into costs and funds have not been set aside to cover potential future obligations for GHG emissions (RPM et al. 2001).

At the global level, there is also increasing awareness and concern regarding the intangible cost of consuming many of the world's finite resources, particularly as global demand for these critical resources increases exponentially while the cheap and readily accessible stocks are in decline. This is not only the case for oil and other fossil fuel resources, but also for many other strategic and scarce mineral and metals, such lithium (required for rechargeable batteries), phosphorus (essential for food production) and rare earth elements (used in catalytic convertors, electric vehicles, LEDs, etc.) (Cordell 2010; Giurco et al. 2010). Geopolitical factors further complicate quantifying this cost; for example, China alone produces over 85% of the world's rare earth elements and in recent years has imposed export tariffs on these and other major export mineral commodities. While difficult to quantify, the consumption of such critical resources is a serious sustainability cost of waste management.

Overall, there is reasonable confidence in the tangible costs of landfill management, depending on a range of factors, such as size of landfill and equipment used. However, according to the literature, lesser-known information such as the environmental burden created by waste disposed to landfill, and the difficulty of monetary valuation of intangible costs introduces uncertainty to landfill cost calculations. Long term costs such as capacity costs and the impact of using non-renewable resources and processing virgin materials must also be considered. As discussed earlier, full costs are need to make informed decisions, and while some intangible items may be quantifiable to an extent (e.g. GHG), others such as community concerns may require the use of deliberative processes.

2.4 Sustainability frameworks for waste management

Over the past few decades, numerous frameworks for managing waste in a sustainable and integrated way have emerged internationally (Graedel 1996; UNEP 2000; Makela 2009). Importantly, these extend the focus of waste management from post-generation, to the entire production and consumption value chain. The focus then becomes on sustainable materials management, rather than solely waste management. The term waste management and mitigation to captures this more holistic view. Important criteria for waste management and mitigation, or to use a more complex term, sustainable materials management include:

- integrated systems or life-cycle thinking (i.e. the entire production-consumption system)
- energy consumption (direct and indirect use)
- pollution and toxicity (of air, water, land)
- sustainability costs (not just financial)
- long-term thinking (in addition to short- and medium-term constraints)
- multi-scale analysis (from local to global impacts), and
- responsibility of all stakeholders (not just those involved in post-consumption waste management).

Table 3 indicates the focus of a number of such international sustainability frameworks and which parts of the product life-cycle phase they address. Specific examples or case studies of how such frameworks have been applied in Australia and internationally are provided.

Table 3. Sustainable/integrated waste management frameworks, indicating which phase of the product life-cycle they address, and which sustainability aspects they predominantly focus on.

Sustainable/integrated waste management frameworks	Product life-cycle phase				Sustainability focus		
	Design	Manufacture and sale	Consumption	Post-consumption	Responsibility	Energy, materials & toxicity	Costs
Life cycle analysis/assessment (LCA)	x	x	x	x		x	x
Material flows analysis	x	x	x	x		x	
Cradle-to-cradle	x	x	x	x		x	
Extended producer responsibility (EPR)	x	x	x	x	x		x
Polluter pays principle				x	x		x
Cost-benefit analysis (CBA)			x	x		x	x
Resource recovery				x		x	
Waste minimisation		x	x			x	
Waste avoidance	x	x	x		x		
Sustainable procurement		x			x	x	
Design for the environment	x			x		x	
Design for deconstruction	x			x	x	x	

Integrated waste management (IWM) emerged as a leading concept in sustainable solid waste management (McDougall et al. 2001) as a result of environmental concerns regarding waste generation. The broader concept implies that decisions on waste handling should take into account environmental, social and institutional dimensions. The integrative aspect of IWM lies in the attempt to reconcile an assumed trade-off between these dimensions (McDougall et al. 2001).

Among the key elements of the IWM approach is the waste hierarchy. The waste hierarchy is an ordered list of approaches to deal with municipal solid waste (MSW), which ranks the options according to their environmental acceptability, with waste

reduction the most preferred, and landfill disposal the least preferred (Figure 4). However, there is a school of thought that despite being generally accepted, the rigid use of the hierarchy will not always lead to environmentally and economically sustainable systems, and it ignores the costs of the different options in different contexts (Barrett & Lawlor 1997; Environmental Assessment Institute 2005; Schmidt et al. 2007). The result of this perspective is a proposal for a holistic approach that recognises that all options may have a role to play in waste management, furthering the argument for the development of a new framework based on IRP.

While managing pollution and toxicity associated with waste generation has long been an important goal of waste management, more and more sustainability frameworks today focus on assessing energy and material flows through the whole life cycle from production through to consumption, such as life-cycle assessment (LCA), material flows analysis and cradle-to-cradle thinking (UNEP 2000; McDonough & Braungart 2002; Brunner & Rechberge 2004). However conducting a full LCA for example, can be costly and resource intensive for waste planners. Further, data on energy is not always available or reliable. Kaufman et al. (2010) suggest the use of life cycle thinking (rather than conducting a complete LCA). They propose a life cycle metric that enables more appropriate and efficient benchmarking of different waste management systems (rather than the more common recycling rate metric).

Other frameworks, such as extended producer responsibility (EPR) and polluter pays principle, focus more explicitly on redistributing responsibility among stakeholders. EPR focuses on extending responsibility for managing (and financing) up the value chain. That is, from consumers and waste managers at the post-generation end of the value chain (typically rate payers and local government in Australia) to those stakeholders at the production end of the chain, such as designers, producers, distributors and wholesale or retailers (OECD 1996; White et al. 2001a). Product stewardship is a similar notion, however this tends to focus on voluntary schemes which often make it a weaker cousin to EPR schemes. White (2001c) provides a comprehensive review of EPR schemes and potential application in Australia.

Other frameworks also focus on assessing the broader cost of waste or waste management options. Examples include CBA, cost-effectiveness analysis, full cost accounting and least cost planning (Moutavtchi et al. 2010). CBA in waste management typically seeks to identify the net cost of a waste management option, by quantifying all costs and benefits, while cost-effectiveness analysis allows the *relative* merits of various options to be compared (White et al. 2001a). Moutavtchi et al. (2010) assess a number of different integrated waste management models that incorporate CBA, addressing some of their benefits and short-comings. The US EPA has promoted the use of full cost accounting tools for waste planning. Such an approach includes accounting for all costs (including hidden, past and future, overhead, and indirect costs) associated with waste management (from generation to final point of disposal or processing (Tellus Institute 1998). For example, the software WastePlan was developed for FCA and has been applied in numerous cities and other contexts. However an important limitation of this use of full cost accounting (and indeed the application of many other costing approaches) is that they do not consider the pre-consumption part of the production and consumption system, thereby excluding the costing of avoidance/minimisation measures.

Another important feature of sustainable management is taking a long-term perspective, rather than addressing current and medium-term costs and challenges. Two frameworks which seek to incorporate long-term planning horizons with respect to the product life-cycle are design for deconstruction (or more broadly, design for the environment) and cradle-to-cradle thinking. These frameworks explicitly include the end-of-life consequences of a product in the product's design (McDonough & Braungart 2002; Chien 2011). That is, design for deconstruction implies that the product is designed in a way that the product components (or the product itself) can be more easily recovered or reused. Typically, this means minimising the use of toxic chemicals and physically designing components so they can be readily disassembled.

Scale and context are also important aspects. Waste management options need to be evaluated at different scales (such as local government, regional or even national levels) and account for local and global impacts. Kijak and Moy (2004) sought to develop a flexible tool that is applicable at multiple scales. Kaufman et al. (2010) demonstrated with their life cycle metric that 'there is no one size fits all solution' (p.5953), for waste management in different cities, in part because cities and their infrastructure are generally at different stages of development.

Each frameworks has benefits and limitations. The appropriateness of each also depends largely on the objective of waste management and local context. However few frameworks comprehensively address all sustainability criteria and all parts of the production life-cycle. Further, many of these frameworks have been developed and applied in Europe and North America, and have thus not been tested or adapted for the unique context in Australia.

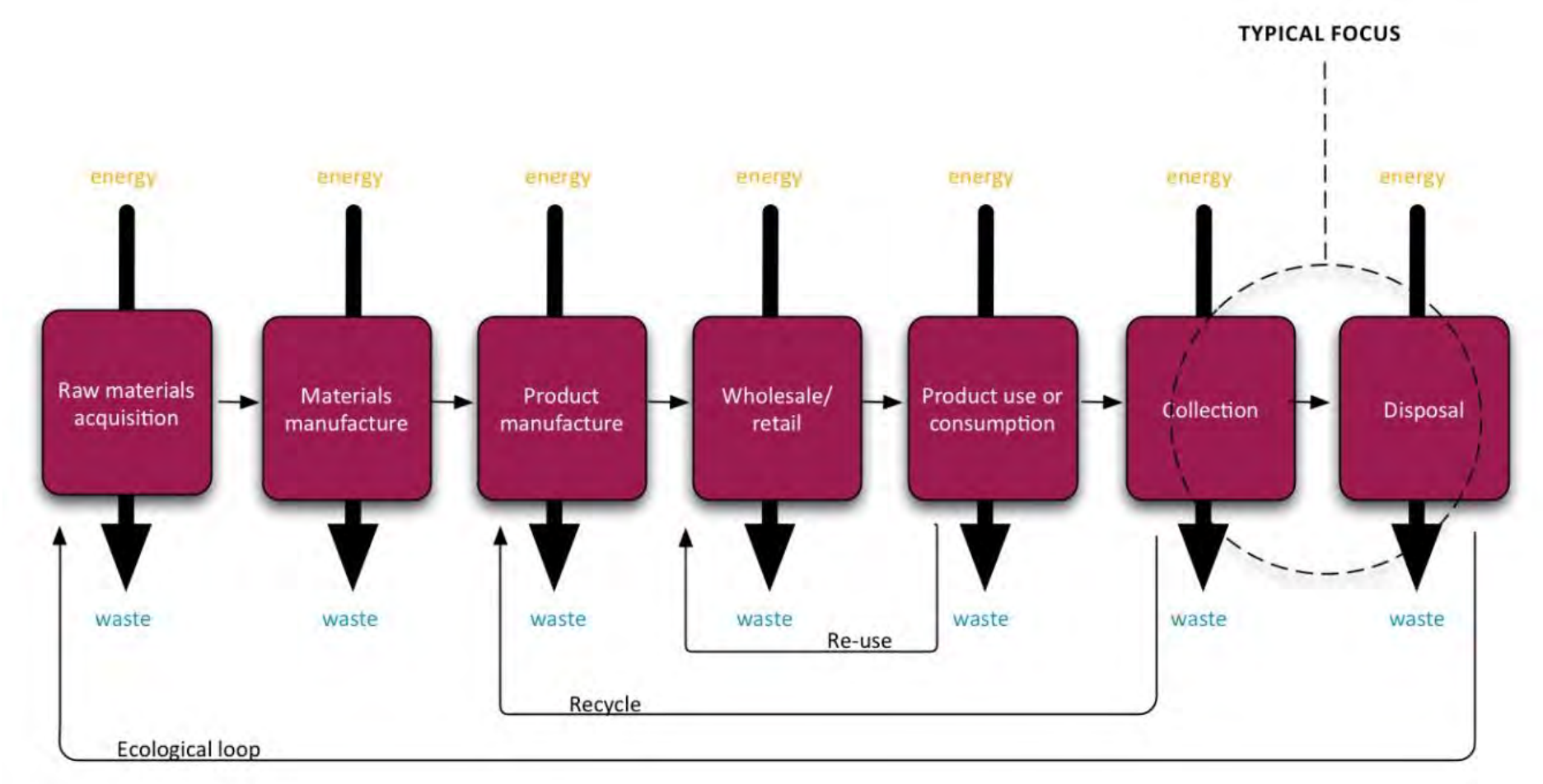

Figure 4. Typical focus within the pre- and post-consumption parts of the material production and consumption system.

2.5 Sustainable initiatives for waste management and mitigation

This section is based on the well-known waste hierarchy. While there are many variations to the waste hierarchy, they all have a focus on minimising the impacts of waste (Franchetti 2009; EPHC 2010a; European Commission 2010). Figure 5 shows the waste hierarchy represented as a priority of actions along a spectrum.

The measures at the top of the hierarchy (or to the left in Figure 5) are considered preferable due to their preventative and/or ameliorative nature (Franchetti 2009; EPHC 2010a; European Commission 2010). In general, these measures include (in order of priority):

1. Avoidance – waste minimisation initiatives to help businesses and households reduce the amount of waste they create in the first place
2. Reuse – reuse materials and thus avoid energy consuming reprocessing
3. Recycling – reprocess waste for further use
4. Other recovery – generating usable energy and materials from waste using a variety of technologies, and
5. Disposal – depositing waste in landfill sites.

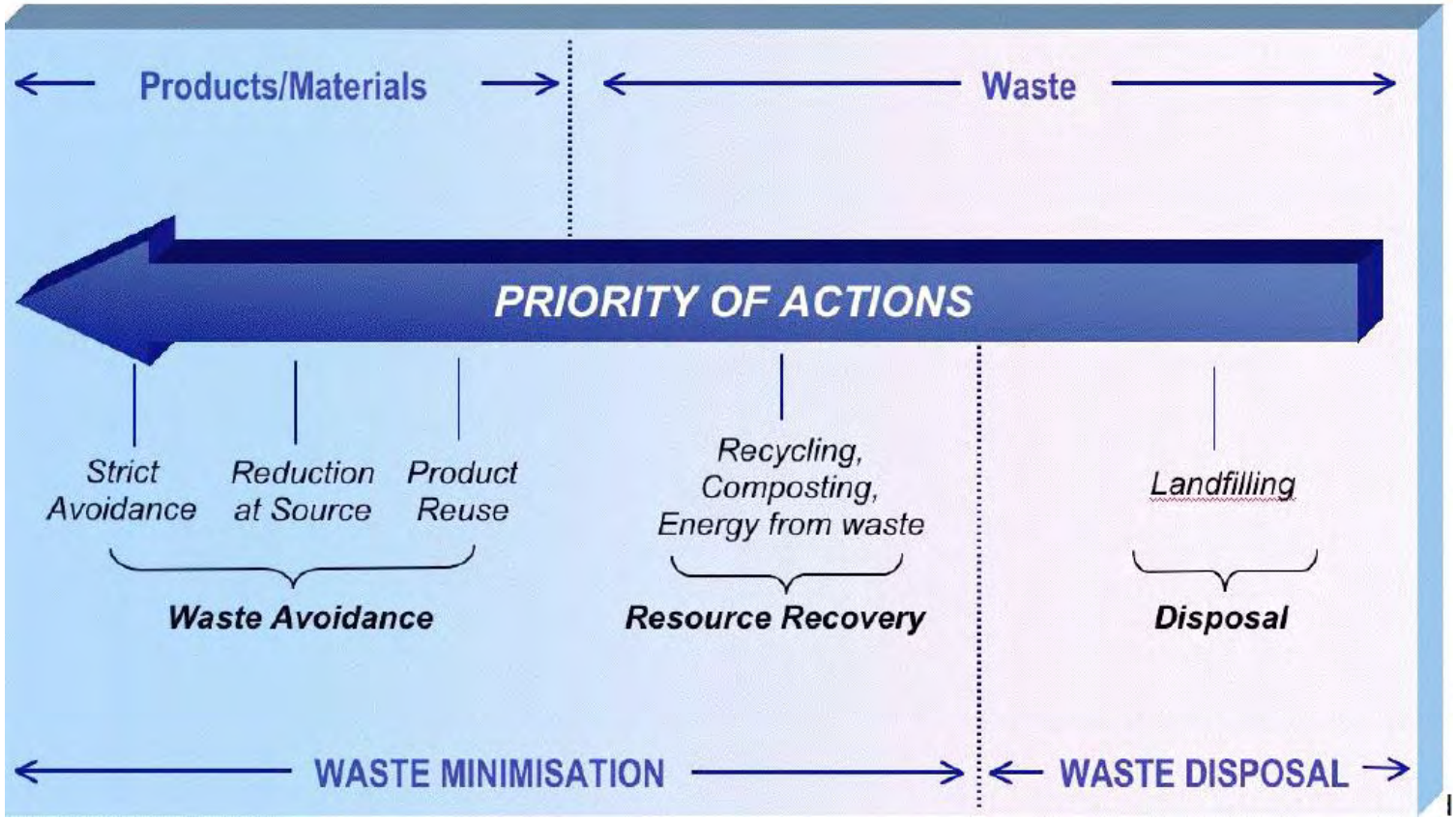

Figure 5. Waste avoidance, resource recovery and disposal in context of the waste hierarchy, based on NSW Waste Avoidance and Resource Recovery Strategy 2013–21.

Avoidance refers to the prevention of waste and/or materials generation. By preventing the creation of waste before it enters the waste stream we are intervening at the source of the problem. Avoiding the creation of waste generally remains the best strategy for dealing with the true sustainability costs that resource consumption and waste generation create. The European Union's *Waste Framework Directive* (the foundation of EU waste policy) for example prioritises waste prevention and includes targets for EU Member states to recycle 50% of MSW and 70% of construction and demolition (C&D) waste by 2020 (European Commission 2010). Avoidance can include purchasing fewer items; reducing process waste (that is, waste generated throughout the production and consumption chain); or using less material per unit in design and manufacture. Better product design and manufacturing processes in some cases can reduce both the amount of energy and resources required to manufacture a product, and also the amount of waste produced pre- and post-product consumption (Hischhorn et al. 1993: Gertsakis & Lewis 2003). This approach can often result in reduced sustainability costs (or greatest benefits), especially in the case of using smaller amounts of virgin resources and life cycle energy costs. Table 4 indicates the relative benefits of avoidance compared to other measures in the waste hierarchy.

Examples of waste avoidance initiatives include educational campaigns to help businesses and households reduce the amount of waste they create. The UK based Love Food Hate Waste campaign is one such initiative aimed towards food waste avoidance at the household level (WRAP 2011). It aims to raise awareness of the need to reduce food waste, and the benefits of less waste for the environment and household budgets. For example, Zero Waste SA (2010) suggests that better food planning and higher awareness of food waste can lead to significant household savings. According to The Australia Institute (2009), Australian households throw out more than $5 billion worth of food each year. Other examples of avoidance include avoidance of packaging waste, that is, unnecessary or overuse of packing materials – such as individual wrapped items in a large package where the wrapping does not contribute to significant hygiene or longevity (Zero Waste SA 2011). Public education plays an important part in the process of any waste resource mitigation program – whether it be an avoidance initiative or a recycling program. According to Zero Waste (2011), the challenges such education programs often face are maintaining program participation, providing adequate funding, and successfully delivering educational messages.

Table 4. The potential benefits of the different measures in the waste hierarchy, indicating avoidance generally has the highest benefits, and disposal the least.

Waste hierarchy	Benefits of waste management and mitigation measures							
	Avoid virgin material extraction	Avoid process energy (whole production-consumption chain)	Minimise process energy (whole production-consumption chain)	Avoid materials processing	Minimise materials processing	Avoid generation of waste	Divert waste from landfill	Minimise methane emissions to atmosphere
Avoidance	✓	✓	✓	✓	✓	✓	✓	✓
Reuse	✓		✓		✓	✓	✓	✓
Recycling			✓				✓	✓
Other recovery							✓	✓
Disposal*								✓

* advanced landfills including lining and capping to prevent leachate and methane emissions respectively

Unlike avoidance initiatives, which are purely preventative, reuse, recycling and other recovery initiatives are predominantly ameliorative, or can only ever minimise or shrink the true costs of waste management. Reuse and recycling result in material being returned to production processes, either in closed loop processes (where the material is made into the same, or similar product from which the material arose) or in processes where the waste material is fashioned into something completely different (upcycled or downcycled).[5] This means that, for society as a whole, there is a reduced need for primary extraction, and hence a reduction in the sustainability costs from the production, processing and transport of the raw material (ISF 2004b).

Reuse includes selling/buying, donating, or exchanging used items. Events such as the Bondi Garage Sale Trail, which is now part of the national Garage Sale Trail are community initiatives that have taken reuse to the household level. Reusing decreases the amount of waste that is thrown away, which in turn decreases the volume of waste destined for landfill. According to Sydney Lord Mayor Clover Moore (2011), the Bondi Garage Sale Trail redistributed 15 shipping containers worth of unwanted items from people's homes in 2011, potentially preventing it going to landfills. While the costs associated with initiatives such as these (time/labour, creation and maintenance of a website, etc.) are typically quantified and costed, they are often seen as minute in relation to the sustainability benefits they bring to the whole of society. Challenges associated with such initiatives are again usually in relation to stakeholder engagement and funding.

Recycling can mean turning waste into a new substance or product. When manufacturers use recycled materials to make a new product, they typically use fewer natural resources and less energy than if they had used virgin or raw materials.

[5] Upcycling refers to recycling used materials into new commodities of higher value (e.g. recycling PET plastic containers into fleece outdoor clothing), while downcycling refers to recycling used materials into commodities of lower value (e.g. recycling old car tyres into floor mat underlays).

Recycling, similar to reuse, prevents valuable materials being sent to landfill. In the EU, it is estimated that the commercial value of materials currently sent to landfill could be in the order of €5.25 billion (European Commission 2010). In Australia, recycling programs recovered 52% of the waste generated in 2006/07 (EPHC 2010a), and a 2001 independent assessment of kerbside recycling in Australia concluded that the current system in metropolitan and regional centres provide a total net benefit to Australian communities (Nolan-ITU 2001). While such council kerbside recycling programs have clear benefits, they also have drawbacks, such as the infrastructure, transport, and energy and labour costs required to collect, handle, transport and process the materials (White et al. 2001b). The cost of such schemes are relatively high, and they only address certain materials in household waste, excluding the bulk of waste generation in Australia – such as construction and demolition waste (C&D) and much commercial and industrial waste (C&I) waste (ISF 2004a; ISF 2004b).

Metal recycling in Japan is another example of advanced and integrated recycling, where rare and precious metals (such as platinum, palladium, copper, gold and silver) in end-of-life electronic products (such as cars, refrigerators, mobile phones and computers) are collected, separated from via incineration, crushing and separation and sold for upcycling as new products. While the technological and logistical systems in place are advanced and costly, there is an economy of scale in Japan because the nation is a significant importer and producer of electronic products (compared to say Australia, which is a significant exporter of unprocessed/raw minerals) (Hayashi 2009).

The Waste Exchange Database, developed by EPA VIC and the Victorian Waste Management Association, is another example of recycling and reuse. In the spirit of eco-industrial parks promoted under the theory of industrial ecology, the database brings waste generators and potential waste receivers together to find reuse and recycling options for waste that otherwise would be disposed to landfill. The database allows one to browse for wastes that are wanted or available for reuse or recycling. The drawbacks of this open system are that logistical (handling and transport) issues are not necessarily regulated and there is often a lack of physical and institutional infrastructure to support and facilitate such an initiative (such as depots and promotion/advertising).

Resource recovery generally refers to the recovery of valuable commodities from used products. Commodities might include energy (fuels, heat and power) or materials (such as metals, nutrients and other materials). Technical processes for recovering such materials for resale include biological processes such as anaerobic digestion and composting; thermal processes such as gasification, incineration with energy recovery facility and pyrolysis (for more in-depth detail on technologies see ASK Waste Management 2010). These systems generally fall under the title alternative waste treatment technologies (AWT), and there are many configurations. Within a single AWT facility there are sometimes a number of technologies combined. Another example includes the recovery of the valuable nutrient phosphorus from sewage sludge incinerator ash. Phosphorus is an essential element for plant growth (and hence critical in food production), however the world's main source (finite phosphate rock reserves) are becoming increasingly scarce and expensive, making phosphorus recovery from waste essential. While phosphorus can be recovered from all organic waste sources for reuse, this particular recovery technique yields high-value elemental phosphorus that

can be sold to food producers or pharmaceutical companies. However the process is energy- and capital-intensive and can result in sunk infrastructure costs associated with inefficient centralised wastewater treatment systems (Cordell et al. 2011).

Disposal includes landfilling and incineration (without energy recovery). Both landfilling and incineration have a spectrum of low tech to high tech approaches. High-tech approaches such as lined and capped landfills, or sophisticated incinerators generally have a higher standard of environmental protection (UK Parliament 1998). For example, lined and capped landfills prevent leaching of toxic material from the landfill to groundwater and prevent methane emissions, while sophisticated incinerators can prevent the incomplete combustion of waste (which can otherwise result in the release of toxic gases such as dioxins and acid gases which have adverse environmental and health affects) (European Commission 2010). However this also results in higher costs associated with investment in expensive infrastructure and higher running costs (such ensuring sufficiently high temperatures in the case of incinerators).

Table 5 demonstrates the full spectrum of waste management and mitigation measures, indicating a diverse range of examples, from disposal to avoidance and high-tech to low-tech.

Table 5. Waste mitigation measures, indicating a palette of measures spanning the waste hierarchy, from high-tech to low-tech. *Note: measures are by way of example, rather than a complete set.*

Waste management & mitigation measures	High-tech ←				→ Low-tech
Disposal		Incineration*	Lined and capped landfill		Burning refuse
Resource recovery	Phosphorus recovery from incinerator flyash	Waste to energy schemes	Anaerobic digestion of organic waste		Home composting
Recycling				MRF	Waste exchange database
Reuse				EPR schemes for reuse of car components	National Garage Sale Trail
Avoidance			Selling service instead of product, carpet leasing		Educational campaigns

* excluding energy recovery facility

2.5.1 Reflections from the sector

In a stakeholder workshop (held in November 2011), participants raised the issue of an infrastructure gap across all types of waste related processing infrastructure – including large scale composting for food recycling. This highlights the importance of having sound decision making frameworks in place to weigh up different options, before large investments are made in new infrastructure.

Interviews with stakeholders highlighted issues associated with lack of independent information about the full suite of waste management and mitigation measures, with reports that industry lobbying on large scale high-tech options often constitutes a key source of information for decision makers.

2.5.2 Discussion

While the waste hierarchy has been adopted extensively in waste policies of the world's governments, community organisations, business and the scientific community, there are still several shortcomings in practice. Firstly, there appears to be a disconnect between the espoused theory and practice, while avoidance/prevention are the highest priority in theory, they are often the least practised, perhaps because they can involve greater effort and longer-term planning. The higher rungs of the waste hierarchy are often more difficult to incorporate into practice. Pre-generation measures can require more complex strategies, involving more stakeholders in the production and consumption value chain. Another shortcoming or critique of the waste hierarchy is that the order of priority of actions may not necessarily be applicable in all contexts. Finally, the terms reuse, recovery and recycling are often used interchangeably, while in fact they often have different meanings to different groups or individuals and different implications. Further, the very term waste management often has differing connotations. While some may interpret this as the complete set of options for managing waste (e.g. those exemplified in the matrix in Table 5), others may implicitly assume this only refers to managing post-generation waste, which excludes interventions higher up in the production and consumption chain.

2.6 Integrated resource planning: A new approach for sustainable waste mitigation

While there are numerous frameworks designed to more sustainably manage materials and the production and consumption chain, few frameworks provide an overall high-level integrative decision-making framework. This section introduces IRP as a new integrative strategy that seeks to fill such a gap. That is, a strategy that addresses the entire production life-cycle (beyond post-consumption), includes all key stakeholders, all sustainability costs and benefits, material flows, and other key sustainability aspects of waste and resource management.

The IRP framework enables the lowest-cost options for the whole of society to be determined and a prioritised strategy developed. This has been used extensively and successfully in the water and energy sectors both in Australia and internationally (Fane

et al. 2011). Importantly, the IRP framework allows for both resource recovery options and waste avoidance options to be assessed in the same framework. Further, the strategy can be applied to context-specific situations (thereby addressing local costs and drivers) and be applied at different scales (e.g. from country level to local government level).

Key steps involved in the IRP framework include:

1. Identify key drivers: what are the key local and global pressures? This might be transport distances to landfill, landfills reaching capacity, global resource scarcity. From this, define key objectives/goals (e.g. reduce generation of waste, minimise waste to landfill) and an appropriate metric for measuring progress towards the goal.
2. Define system boundary in terms of space: e.g. city, region, LGA, and in terms of a long-term planning horizon (e.g. 20 years, 50 years) (Box 1). This should take into account the whole production and consumption system where possible.
3. Identify and engage stakeholders: who are the key stakeholders in the system boundary? What are their current roles and responsibilities? What institutional structures (such as policies, guidelines and legislations) are relevant to the system boundary? What are the perceptions of stakeholders and the community regarding waste, materials management, and their own role and those of other stakeholders in the system?
4. Analyse size and nature of waste and material flows through the system: e.g. in tonnes/year. This should include both pre- and post-consumption waste and materials and include quantities between and within different sectors. Material accounting tools such as substance flows analysis can aid such analysis (Brunner & Rechberge 2004).
5. Identify potential waste management/mitigation measures: e.g. specific resource recovery, avoidance, AWT technologies and initiatives suitable to meet the strategy objectives identified in step 1. Identify possible policy instruments (e.g. economic, communicative, structural or regulatory instruments) that could be used to implement these measures.
6. Analyse the waste reduction potential for each option: i.e. combination of measure and instrument using the metric defined in step 1.
7. Estimate total life-cycle costs for each option, including real and avoided; economic, environmental and social costs; costs to all stakeholders; present and future costs.
8. Determine unit cost for each option so these can be compared and supply curves developed from lowest to highest unit cost and the least cost options identified.
9. Redistribute costs equitably between stakeholders (e.g. through transfer payment).

The above steps are iterative, rather than linear. For example, stakeholder and community consultation may occur at repeated steps. This IRP framework will be developed (and applied) in the following stages of this project.

Box 1: Designing long-term future waste management and mitigation scenarios

Planning for the long-term future of waste and materials management cannot ignore the current or past constraints. In order to understand and proceed towards a desired sustainable resource future (defined as aspirations in Figure 6), the inertia of existing physical and institutional infrastructure (weights of the past) and important factors that cannot be avoided, and must be responded to, such as climate change (future pushes) must be first identified and analysed (Inayatullah 1998). Figure 6 provides a preliminary map of such aspirations, pushes and weights drawing from responses to the stakeholder interviews and the literature review undertaken for this report.

For example, a weight of the past includes the complex and fragmented decision making arrangements in Australia (ACOR 2006; EPHC 2010a). There is a lack of coordination between different tiers of government and a lack of consistency in the regulatory framework and institutional arrangements between State jurisdictions. This is despite ambitious waste reduction targets. There is also a rapidly developing technology and policy environment, and strong community interest in the issues of waste. Another weight of the past includes sunk infrastructure costs associated with current disposal facilities, such as landfills and the familiarity and experience of waste service providers with associated technologies. Sustainable future pathways will need to therefore address the question of how we get from where we are now, to where we want to go.

An example of a push or driver includes the variety of policy and pricing measures that many state and local governments are currently using to discourage disposal to landfill such as increasing gate fees or waste levies (BDA Group & McLennan 2003). The rising costs (tangible and intangible) of transport fuel is another push driving waste management and mitigation measures to reduce transport required. That is, future waste management and mitigation planning and decision-making cannot be undertaken in isolation from other important pushes, whether they be specifically waste related, or global in nature.

While the waste hierarchy is often put forward as the way of the future for waste management and mitigation, a more explicit and deliberative conversation with key stakeholders is required regarding future goals in Australia. The subsequent phase of this project will bring together key stakeholders to discuss such pertinent questions through an interactive stakeholder future scenarios workshop.

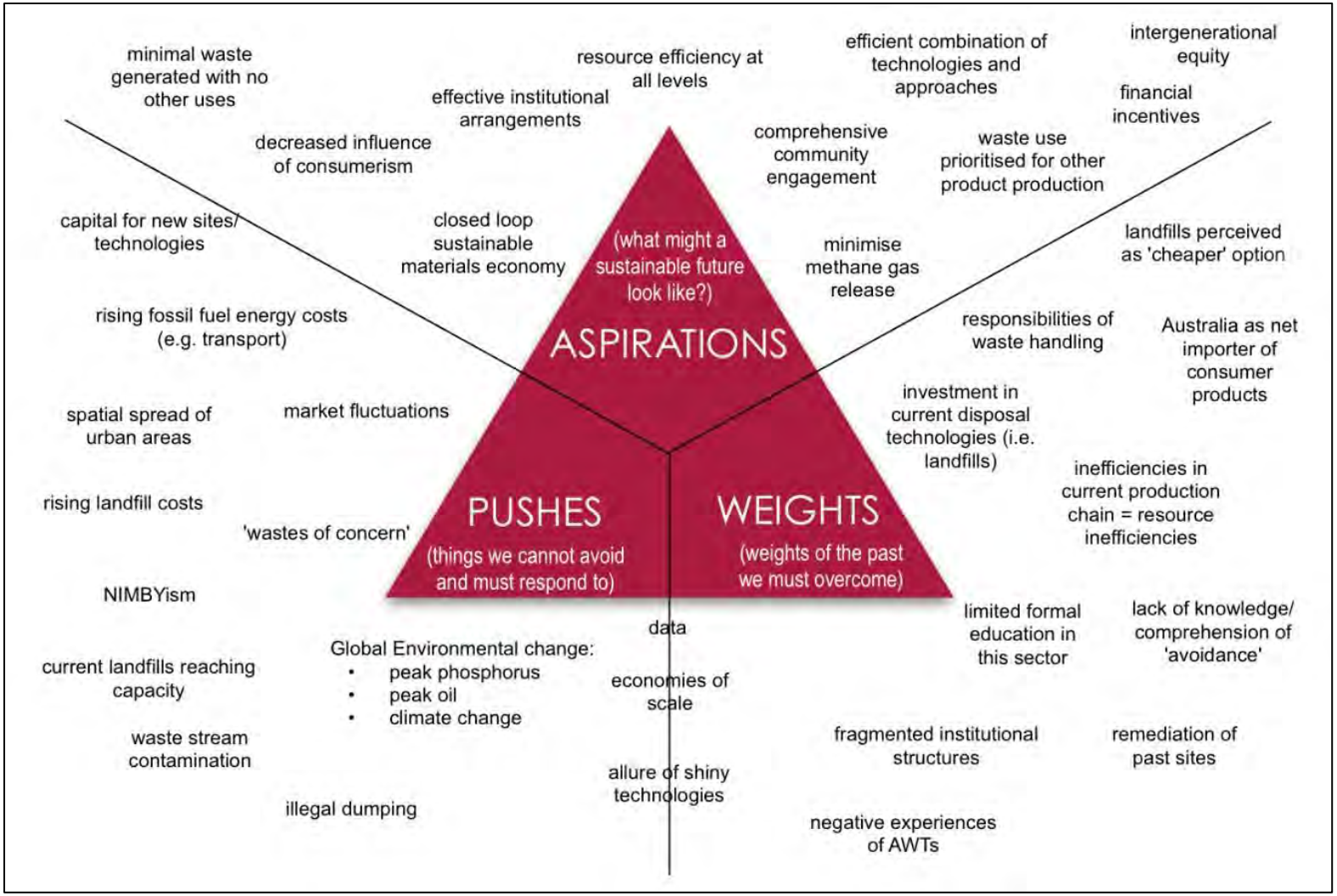

Figure 6. Moving towards a sustainable resource future for Australia must address weights of the past (inertia), pushes (drivers) and aspirations (future visions). Note, this is not a complete map, rather a first version.

2.7 Discussion and conclusions

In response to the increasing pressures on current waste management systems in Australia and other parts of the world (such as the rising costs of transport, land-use conflicts and increased scarcity of minerals and metals), there has been increasing numbers of studies assessing the costs of landfills and other waste management measures. However many of these detailed analyses of landfill use a narrower framework and/or focus on specific technologies, rather than considering the full suite of measures and policy instruments available – including waste reduction measures. Additionally, various environmental and social costs are often excluded from analyses due to the difficulty in quantifying these intangible costs. If all tangible and intangible costs are included and the whole production and consumption chain is examined, within a consistent and systematic framework, then lower costs options that achieve the greatest sustainability outcome can be determined. Understanding the true cost to the community of waste disposal and identifying who pays allows the wide range of waste management options available – from AWTs to investment in waste avoidance – to be compared on an equal basis. Further costs can be redistributed to ensure more equitable financial responsibility, consistent with the principles of extended producer responsibility.

There is currently a substantial gap in baseline data regarding the true sustainability costs of waste management and mitigation including landfills, but also incineration, resource recovery and avoidance measures. There is also a gap in decision-support tools that can aid local councils, state and Commonwealth government departments in making more informed and long-term decisions about sustainable management and mitigation of waste. While this report suggests a new framework to fill such a gap (i.e. IRP), it is also recognised that local data will be needed in order to apply the framework to a specific context. For example, the transport costs associated with landfill or a resource recovery measure will vary greatly from one context to another.

The IRP approach has been undertaken in the water and energy sectors respectively with win-win results for industry, service providers and the community. By analysing the entire production and consumption chain in consultation with all key stakeholders, more informed, appropriate and effective decisions can be made to better manage waste in Australia.

While the waste hierarchy has been used extensively as a guiding framework, the most sustainable and appropriate priority of actions may vary from region to region in practice, because of heterogeneity of municipal solid waste, logistics, local pressures, different stages of infrastructure development and different regional economic issues. There is likely no silver bullet to address Australia's waste problem. This means that avoidance, reuse, recycling, incineration and landfilling may all play a role to various extents in the future. The key challenge will be to determine their respective roles and priorities in different contexts.

3. Understanding the future of landfills: Waste management policy in Australia

Waste management in Australia is a complex and dynamic landscape, featuring a large, varied group of stakeholders who are required to navigate a range of policies, regulations and legislative instruments from the national to the local level. Much has been written on these broad issues of waste management (ISF 2004a; Hyder 2009b; WCS 2008; EPHC 2010a).

This section explores the existing policy landscape across different jurisdictions in Australia, and the views of a range of key stakeholders with an aim to:

- provide an analysis of the current waste management policy landscape in Australia
- identify how changes to this landscape are likely to affect the future of waste management and mitigation options, including landfill
- review existing waste management policy, from the national to the local scale, in order to evaluate the future potential of landfill as a waste management and mitigation measure, and
- draw upon stakeholder interviews with key representatives from government, non-government organisations and the waste industry, as a means of grounding the research in the different perspectives that each brings to waste management.

An introduction to the current waste policy landscape in Australia, in Section 3, is followed by three case studies in Section 4, each of which illustrates a number of these issues in practice. Case Study 1 describes and analyses the high performance of South Australia's waste management system, and how the approach taken in SA has differed from that taken by other states and territories. Case Study 2 describes and analyses the distinctive waste policy approach taken by the ACT government, which serves as an illustration of how the integration of policy development and implementation can significantly improve the reliability of target setting and reduce uncertainty regarding investment in particular technologies. Case Study 3 describes the local government perspective and provides insight into the disconnection between local governments' roles/responsibilities and their capacity to confidently assess options in the face of changing technologies, and reconcile the expectations of different stakeholders (federal and state/territory government as well as community). The case studies are followed by a discussion of the main drivers, challenges and gaps that have been observed in the course of the research (Section 5). Finally, Section 6 provides recommendations for future policy development, including a new approach to waste management and mitigation that centres on IRP, and which allows for improved decision making.

The research reported here draws on a literature review, stakeholder interviews and a stakeholder workshop (Appendix B and C).

Despite limited project resources to undertake a systematic and formal review process with all jurisdictions, earlier drafts of this report were made available to key waste and

resource recovery stakeholders for comment. Specifically the report was circulated in November 2011 to the Project Reference Group for this project and offered to participants of a stakeholder workshop which had representatives from industry, Government and research (Appendix C). The report was subsequently distributed in revised form to participants at two meetings held in Victoria in February 2012 – firstly, a meeting of the National Waste Policy Landfills Working Group hosted at EPA Victoria, and secondly a meeting with invited staff from several Victorian state government agencies at EPA Victoria. As a result, one set of comments was received, and has been incorporated into this report.

3.1 Background

The National Waste Policy was approved by the Environment Protection and Heritage Council (EPHC) in November 2009. The continued refinement of the Policy is ongoing and is guided by the principles of the waste management hierarchy and ecologically sustainable development (EPHC 2010a). The National Waste Policy is explicit in its aim to avoid the generation of waste, manage waste as a resource and contribute to the reduction of greenhouse gas emissions (EPHC 2010a). The National Waste Policy may represent a significant milestone in Australian waste policy, in that its expressed intention is to address what many have referred to as the fragmentation of the waste management systems and regulations across state and territory jurisdictions. This fragmentation is perceived as problematic because it creates an inconsistent regulatory environment for waste producers and processors, mitigating against national markets and waste minimisation solutions, and causing confusion for consumers. The objectives of the National Waste Policy, and the wide range of considerations that are raised in the documents and processes that preceded its release, present a clear imperative for those involved in the current systems of waste management and disposal to review current assumptions, practices and business models. Our intention is therefore to assess how various stakeholders operating in and across Australian states and local governments are responding to the National Waste Policy in practice. This assessment considers the challenges, gaps and opportunities that may arise as the push towards waste avoidance and managing waste as a resource takes shape.

3.2 The Australian waste policy landscape

Individual state and territory jurisdictions are the primary administrators of waste and resource recovery. It is their role to establish and manage policies and legislation, with local government having the primary responsibility for delivering services to the residential community, and in some cases commercial enterprises (WME 2011). Both local government organisations and private companies own and run waste infrastructure and provide waste collection and transport services.

The Australian waste policy landscape comprises many elements aside from legislation and strategies and is a reflection of the history and geography that is unique to Australia.

This section describes what we believe are the major factors affecting the waste policy landscape, including:

- the history of waste management and mitigation
- the existing state and territory policy instruments, and
- the physical and social landscape in which our policy discussion is set.

3.2.1 History of waste management

Historically, landfill has been the preferred means of disposing of waste in Australia (WMAA 2008; EPHC 2010a). This has largely been justified on the basis that it has a low financial cost, fewer impacts on urban amenity than incineration, and that there is no scarcity of land in Australia.

Currently landfills play a significant role in the management of waste within Australia with 48% of Australia's waste disposed to landfill during 2006–07 (EPHC 2010a).[6] Australia currently disposes of an estimated 20 million tonnes of waste to around 655 landfills (EPHC 2010a; WMAA 2009).

Figure 7 provides a summary of key developments in Australian waste disposal and management since European settlement.

[6] This compares with 70% in the United States (approximately 16% is incinerated) and 4% in Sweden (where 47% is incinerated) (Batten 2002; Worldwatch Institute 2011).

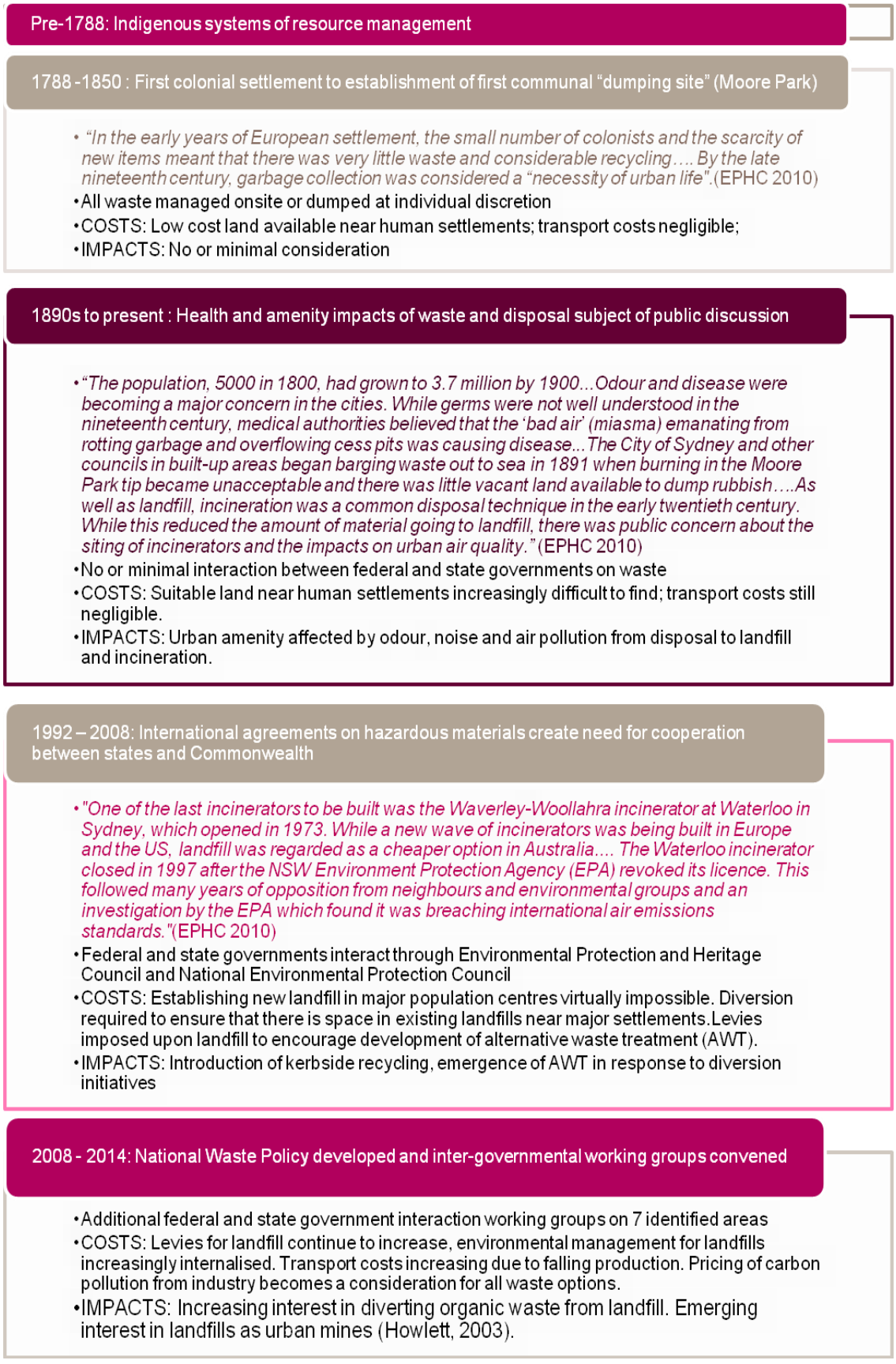

Figure 7. Changes to waste policy in Australia including perceptions of waste costs and impacts. (Excerpts from the National Waste Report 2010 (EPHC 2010a: 210–216))

Figure 7 provides an outline of the different phases in waste management and disposal policy, and shows the gradual but increasing understanding of costs and impacts of landfill. It documents changes in waste disposal and management since the first settlement in the late 1700s, and illustrates the growing impact of waste generation and disposal methods on public health, urban amenity and, in later years, environmental health. The figure relates these developments to increasing integration of waste policy objectives across Australian states and territories in response to increasing costs and impacts and external commitments, such as the Basel and Stockholm Conventions on the transport of hazardous waste across national borders.[7]

This figure also illustrates the impacts of persistent public concerns about odour, pests, and health-affecting emissions. These have resulted in a gradual move towards alternatives to disposal as it became increasingly difficult to site new landfills or incineration facilities near major settlements. This review of current national, state and territory waste strategy documents indicates that while existing levels of waste generation could be accommodated by existing landfills, growth in population and consumption per head may make established landfills inadequate to future needs (WCS 2010; DERM 2010; DECCEW 2010; WA Waste Authority 2010).

Perhaps most importantly, there is also broad recognition of the difficulties of managing increased waste generation using existing landfill systems. The historical, and in some cases, contemporary view that there is no lack of land to fill is increasingly challenged by developments in the social and physical landscape. These developments include:

- Increasing population coupled with increasing consumption per head of population leads to rapidly filling landfills. This view is supported by waste strategy commentary and interviews, for example one interview respondent stated, '[I am] not convinced that the volume of waste going to landfill is going to decline due to greater population growth.'
- Increasing proximity of settlements to landfills coupled with an increasing understanding of the social, economic and environmental impacts of landfill as a waste management technology led to a difficulty in creating new landfills near large population centres. This too is supported by waste strategy commentary and interviews, for example, 'Hallam Road is established since 1997 – change over time has been huge. Tens of thousands of new neighbours within 1 km radius. No protection of buffers – not in Planning or Environmental Protection Acts.'

Responses to these changes in human geography have included the development of policy that acts to:

- conserve space in existing landfills
- limit the impact of landfill on human settlements
- limit the impact of landfill on the natural environment
- assist in the development and dissemination of alternatives to landfill, and

[7] A more comprehensive view of these periods can be found in Section 4.1 of the *National Waste Report 2010* (EPHC 2010a).

- reduce the cost incentive to dispose of waste materials to landfill through the imposition of waste levies in different states and territories.

Waste management in Australia has been treading this path since 1992, when it was agreed that greater coordination between the federal and state governments would be required to meet new commitments to international conventions related to waste (EPHC 2010a). This occurred via the Council of Australian Government's (COAG) National Strategy for Ecologically Sustainable Development and many of the subsequent national, state and territory waste policies made reference to the waste hierarchy (EPHC 2010a).

Since this time, an increasingly uniform policy approach of diverting waste from landfill has created distinct waste streams[8] and specific policies for reducing the amount of material that is generated within these streams. However, there are legitimate questions about the extent to which national waste policies aimed at diverting waste from landfill can significantly improve performance against the criteria of waste reduction and avoidance.

Changes to historical policy have tended to address economic, social and environmental impacts in jurisdictions where there is clear public support for change, and it becomes cheap enough to do so. The circumstances of different settlements will determine what these impacts are, how they might be reduced or eliminated, and how much this will cost.

Policy context – issues from the past and present:

- Decreasing availability of sufficient land near human settlements
- Increasing generation of waste
- Rising costs for all forms of waste disposal and management
- Rising costs for transporting waste
- Increasing awareness of the environmental impacts of landfill
- Costs being attributed to previously externalised environmental impacts (e.g. carbon price)
- Historical practices and investment in current disposal technologies
- Belief that there is no lack of land to fill, and
- Absence of policies that consider the production consumption and disposal cycle to achieve avoidance objectives.

3.2.2 Current national, state and territory policy instruments

In Australia, there is currently the National Waste Policy and a strategy or policy in each state and territory (Table 6). In addition, some national and state legislation relate

[8] This refers to the development of sector specific streams (MSW, C&I, C&D), rather than the separation or commingling of waste types within a particular sectoral stream.

to aspects of waste management such as landfill planning and approvals, transportation of waste, community engagement, and disposal of hazardous or clinical waste.

Many existing state and territory waste strategies appear to be in draft form in anticipation of developments associated with the progress of the National Waste Policy.

Table 6 outlines, by jurisdiction, the waste policy documents included in this review. Previous strategies are included to highlight their development time.

More detail is provided below about the instruments and the support for them, and a discussion of similarities and differences of emphasis between jurisdictions (with a focus on states and territories).

Table 6. Australian states and territory waste legislation and strategies.

Jurisdiction	Waste legislation	Waste strategy
NSW	Protection of the Environment Operations Act 1997 (amended in 2008) Protection of the Environment Operations (Waste) Regulation 2005 Waste Avoidance and Resource Recovery Act 2001	**Waste Avoidance and Resource Recovery Strategy (WARR) 2007** *NSW Waste Avoidance and Resource Recovery Strategy 2003*
VIC	Environment Protection Act 1970 Environment Protection (Amendment) Act 2006 Environment Protection (Distribution of Landfill Levy) Regulations 2002 Sustainability Victoria Act 2006 Environment Protection (Industrial Waste Resource) Regulations 2009	**Metropolitan Waste and Resource Recovery Strategic Plan (2009)** **Towards Zero Waste Strategy 2005**
QLD	Environmental Protection Act 1994 Environmental Protection Regulation 2008 Environmental Protection (Waste Management) Policy 2000 Environmental Protection (Waste Management) Regulation 2000	**Queensland's Waste Reduction and Recycling Strategy 2010–2020** *Let's Not Waste our Future – Queensland Waste Strategy (draft)*
WA	Environmental Protection Act 1986 Waste Avoidance and Resource Recovery Act 2007 Waste Avoidance and Resource Recovery Levy Act 2007 Waste Avoidance and Resource Recovery Regulations 2008 Environmental Protection (Controlled Waste) Regulations 2001 Environmental Protection (Rural Landfill) Regulations 2002	**Waste Strategy for Western Australia (Draft 2) released 03/2010** *2005 Extended Producer Responsibility Policy Statement* *2004 Statement of Strategic Direction for Waste Management in WA* *2001 Towards Zero Waste action plan*
SA	Environment Protection Act 1993 Zero Waste SA Act 2004 Plastic Shopping Bags (Waste Avoidance) Act 2008	**Draft South Australia's Waste Strategy 2010–2015 released 08/2010** *South Australia's Waste Strategy 2005–2010*
TAS	Environmental Management and Pollution Control Act 1994	**Tasmanian Waste and Resource Management Strategy released 06/2009**
ACT	Environment Protection Act 1997 Waste Minimisation Act 2001	**Draft ACT Sustainable Waste Strategy 2010-2025 released 2010** *2004 Turning Waste into Resources – No Waste Strategy Action Plan 2004–2007* *2002The Waste Pricing Strategy for the ACT* *2000 The Next Step in the No Waste Strategy – No Waste Strategy implementation 2000–2003* *1996 Waste Management Strategy for Canberra*
Commonwealth	Hazardous Waste (Regulation of Exports and Imports) Act 1989 Industrial Chemicals (Notification and Assessment) Act 1989 Agricultural and Veterinary Chemicals Act 1994 Environment Protection (Sea Dumping) Act 1981 Protection of the Sea (Prevention of Pollution from Ships) Act 1983 Environment Protection and Biodiversity Conservation Act 1999 Ozone Protection and Synthetic Greenhouse Gas Management Act 1989	**National Waste Policy: Less Waste, More Resources**

(For more information, see EPHC 2010a) Current waste strategy is bold, previous waste strategy is italic.

National Waste Policy: Less waste, more resources

This is the new waste strategy for Australia for the next ten years, launched in November 2009 through the Environment Protection and Heritage Council. The Commonwealth Government's *National Waste Policy* aims to avoid generation and reduce the amount of waste (including hazardous waste) for disposal. It also seeks to manage waste as a resource, ensuring that waste treatment, disposal, recovery and re-use are undertaken in a safe, scientific and environmentally sound manner. It is hoped that this will assist in reducing greenhouse gas emissions and improving energy conservation and production, water efficiency and the productivity of the land (EPHC 2009b).

The development and implementation of the *National Waste Policy* may be the most substantive change to waste policy in recent history. The policy aims to provide leadership and guidance on waste management, while being clear that primary responsibility for the management of waste lies with the state and territory governments (EPHC 2010a). The *National Waste Policy* is explicit in its adherence to the waste hierarchy and the push towards waste avoidance as an underlying management framework. Implementation of product stewardship and EPR initiatives are also noted as desired outcomes for the Policy's 2020 vision. Legislation is being enacted to support these approaches to waste minimisation. As such, the *National Waste Policy* process has occurred alongside the ongoing development of state and territory waste management strategies.

The 2010–11 federal budget earmarked $23 million over five years for waste measures including the establishment of a national regulatory framework for certain forms of recycling (televisions, computers and tyres) and stewardship schemes for other products. Resource recovery is a focus, with some of the funding being used to cut the red tape preventing the use of waste as a resource. Gathering better data on waste through the development of a national waste data system is another focus (DEWHA 2010). The initial *National Waste Report* was released in May 2010, detailing trends in waste and resource recovery to help refine the *National Waste Policy*. This report will be updated every three years (EPHC 2010a).

New South Wales: Waste Avoidance and Resource Recovery Strategy (WARR) 2007

The Waste Avoidance and Resource Recovery Strategy (WARR Strategy), is required by the *Waste Avoidance and Resource Recovery Act 2001* (WARR Act). The *NSW State Plan 2010* (state plan) has adopted the targets for municipal, commercial and industrial (C&I) and construction and demolition (C&D) waste in the *WARR Strategy*, which the government suggests has given extra emphasis to the drive for improvement. Progress towards the Strategy was reviewed in 2010 (NSW Government 2010).

Victoria: Towards Zero Waste Strategy

In 2005, the Victorian Government approved a 10-year state waste strategy, the *Towards Zero Waste Strategy.* The waste reduction targets (to 2014) cover solid waste across several categories. The Metropolitan Waste Management Group was formed in 2006 and released the *Metropolitan Waste and Resource Recovery Strategic Plan* the same year to further deliver key targets of the *Towards Zero Waste Strategy*. The focus is on municipal waste as the C&I category met its waste reduction targets. Growth of C&I recycling has helped Victoria to slightly reduce its total waste going to landfill, but an identified challenge is the reduction of organic waste to landfill (EPHC 2010a).

Queensland: Queensland's Waste Reduction and Recycling Strategy 2010–2020

The Queensland strategy replaces the *Let's Not Waste our Future – Queensland Waste Strategy (draft)* and recognises that Queensland is one of the largest generators, the highest per capita producer, and the lowest recycler of waste in Australia. It sets targets and provides strategies for changes to landfill pricing, legislation and programs to achieve the targets. It identifies a series of priority wastes and end-of-life products.

Western Australia: Draft II – Waste Strategy for Western Australia

This was released by the WA Waste Authority for a review period that closed on 19 April 2010. The need for better waste information for industry was identified, with the Waste Authority appointing a communications manager to develop a state education and information campaign. Resource recovery and EPR (which requires industry to be responsible for managing some of the waste associated with its products) were identified as priorities, and additional C&I waste processing facilities are planned for 2016 and 2020 (Government of Western Australia 2010). A partnership between the WA Waste Authority (established in 2008 to develop a sustainable framework for waste in WA), federal government and local government, *Towards Zero Waste* is the strategic direction and vision for the WA Government. The goal for the strategy is to tackle waste generation at the beginning of the product cycle.

South Australia: Draft South Australia's Waste Strategy 2010–2015

The draft *South Australian Waste Strategy 2010–2015* was released August 2010 and replaces the *Zero Waste Strategy 2005–2010*. Zero Waste SA, a statutory authority, gives grants to local councils, the waste industry and businesses to help them develop waste reduction projects and encourage resource efficiency. Funded by 50% of the waste levy paid by waste depot licence holders, Zero Waste SA is aiming to reduce SA waste going to landfill by 25% by 2014 as part of *South Australia's Strategic Plan 2007*.

Tasmanian Waste and Resource Management Strategy (2009)

Tasmania's Waste and Resource Management Strategy was developed in collaboration with the waste management community, and the Waste Advisory Committee oversees implementation of the Strategy. Large distances to waste treatment or recycling facilities is identified as a barrier to waste minimisation in Tasmania and the strategy calls for local resource recovery solutions, improved waste data systems and better government partnerships with industry (Government of Tasmania 2009).

ACT – ACT No Waste Strategy: No Waste by 2010

The ACT claims to be the first government in the world to set a goal of no waste to landfill. It launched the *No Waste by 2010* Waste Management Strategy for Canberra in 1996, which focused mainly on waste and recycling activities for households and residents. It has led to the ACT achieving the lowest volumes of waste to landfill nationally (ACT Government 2006).

Northern Territory – Rethinking Waste Disposal Behaviour and Resource Efficiency Interim Action Plan

The Environment, Heritage and the Arts Division is working with partners to develop a long-term waste management strategy for the NT, with a focus on resource efficiency, a resource-not-waste management framework, and incentives for proper disposal behaviour (NT Government 2010). The NT already faces significant waste and recycling obstacles, largely due to distance and the lack of in-state infrastructure, meaning that all recyclables are currently transported interstate for processing (DEWHA 2010).

3.3 Targets

Waste strategies are developed to achieve the objectives of legislation. They frequently contain targets for waste reduction, as shown in Table 7. They are sometimes accompanied by a strategy for implementation, but this rarely involves costed options for reducing waste – used to determine the cheapest path to target (EPHC 2010b; DECCW 2011). For example, a marginal abatement cost curve that has been widely employed in the areas of urban water management and energy and climate change (White et al. 2008; McKinsey and Company 2009).

In interviews respondents from across all sectors broadly agreed that regulatory tools are a necessary element of waste management, and that the state level is an appropriate scale at which to develop these approaches. Targets were mentioned by several respondents; however there was disagreement on their effectiveness. For example, a government respondent noted:

> 'I am a zero waste fan as a concept and target. It brings in a whole set of psyches than setting other arbitrary targets.'

While another respondent believed:

> ‘There is debate about how good targets are – it becomes a bit arbitrary – reaching targets should be a signal that you can go further.’

A respondent from Zero Waste South Australia noted the benefits of:

> ‘Policies around adopting targets and putting in place implementation plans to achieve those targets.’

Table 7. Australian state and territory waste targets.

	MSW	C&D	C&I	Hazardous waste	Other
NSW	66% diversion from landfill by 2014	76% diversion from landfill by 2014	63% diversion from landfill by 2014	Phase out priority substances in identified products or if not possible, achieve maximum recovery for re-use by 2014.	
VIC	Increase % recovery 41% actual in 06–07 45% target 08–09 65% target 13–14	Increase % recovery 68% actual 06–07 65% target 08–09 80% target 13–14	Increase % recovery 71% actual 06–07 65% target 08–09 80% target 13–14		Projected 1.5 m tonne reduction in quantity of solid waste generated by 2014 Sectoral targets achieved by 2008–2014 75% by weight of solid waste recovered for re-use, recycling and/or energy generation by 2014 25% improvement, from 2003 levels, in littering behaviour by 2014.
QLD	Increase recycling to 2008: 23% 64 kg/pp/pa 2014: 50% 80 kg/pp/pa 2017: 55% 100 kg/pp/pa 2020: 65% 150 kg/pp/pa	Increase recycling to 2014: 50% 2017: 60% 2020: 75%	Increase recycling to 2014: 40% 2017: 50% 2020: 60%	Increase recycling to 2014: 35% 2017: 40% 2020: 45%	Reduce waste disposal to landfill from 2008) 25% by 2014 (4.6 million tonnes avoided since 2010) 40% by 2017(9.9 million tonnes avoided since 2014) 50% by 2020 (16.3 million tonnes avoided since 2017)
WA	Minimum 70% recovery rate by 2016 in Perth metropolitan area.	Increased recovery from 14% in 2006–07 to 50% by 2016 and to 70% by 2020.	At least one processing facility will be established by 2016 and a second by 2020.	100% by 2020	State has a vision of ‘Towards Zero Waste’ by 2020. In larger regional areas with a population greater than 25,000, at least a 45% recovery rate for waste by 2016.
SA					25% reduction of waste to landfill by 2014
TAS					Some aspirational targets. Setting of targets noted as a strategic Action
ACT					Targets: the growth in ACT waste generation is less than the rate of population growth. The rate of resource recovery increases by: – over 80% by 2015. – over 85% by 2020. – over 90% by 2025. The ACT waste sector is carbon neutral by 2020.

3.4 Similarities and differences across states and territories

The Australian waste policy landscape is seen by many stakeholders as being highly fragmented. This is driving increasing attention to harmonising policy regarding landfill management, standardisation of data collection and challenges in regional and remote areas as part of the *National Waste Policy* (EPHC 2010b). However, the analysis undertaken here has identified that while there are now unprecedented levels of agreement between federal, state and territory waste strategies, there are also aspects of the existing fragmentation that are unlikely to be resolved by the *National Waste Policy*.

3.4.1 Similarities

Almost all state and territory waste strategies (Table 5) are framed within the waste hierarchy with avoidance at the top, mirroring the *National Waste Policy* and aligning to COAG's 1992 *National Strategy for Ecologically Sustainable Development*. The ACT is limiting its aspirations to reducing waste (DECCEW 2010). Despite this, there is very little commentary on the role of reduced consumption in achieving this policy objective. Several interview respondents noted this as an issue, for example:

> '[I] would like to see more attention to sustainable production and consumption. [Taking a] harder look at EU, OECD, the way these issues are tackled. Look at the different scales – get a handle on what our footprint is like. And developing policies in that space.'

All state and territory waste strategies also recognise that waste disposal and waste recovery have financial, environmental and social costs. Victoria's *Zero Waste Strategy* was backed by a benefit-cost analysis, however other states do not appear to be attempting to gain a robust understanding of the full costs associated with waste management and mitigation (Allen Consulting Group 2003). While interview respondents were limited in their responses to a question on the social costs of landfill, more comprehensive responses were given on financial and environmental costs, with the former being given the most attention by the majority of respondents.

All state and territory strategies are also in agreement that not enough is being done to educate members of the public about waste management. This is also supported by findings from the stakeholder interviews. Several respondents noted that there has been some progress towards public awareness of their overall responsibility and accountability relating to waste management and mitigation. However many respondents also note the significant need to go further and the difficulties of doing so:

> 'In a confused communications environment where you are bombarded with different messages all the time and they are changing – there is difficulty in getting a core message through which is meaningful.'

Most state and territory waste strategies and interview respondents point to the relatively low cost of landfill as another impediment to the development of alternative waste management and mitigation options. As noted by an industry representative:

> ‘The [landfill] levy will keep going up at least for the next 3–4 years but it will still be too cheap. This will go to about $110/tonne but still [it will be] too cheap. It needs to be about $180/tonne to incentivise alternatives.’

The implication of this is that the cost of landfill will continue to be adjusted to facilitate the development of alternatives, however as noted by an interview respondent, levies do not always achieve the desired results:

> ‘The levy is in place but it is not achieving what it sets out to do. Therefore it could be argued it’s just a revenue raiser as its not encouraging an alternative to landfill – there is no foreseeable plan to come up with an alternative.’

As highlighted previously, this may be in part due to the failure to factor intangible costs into pricing.

Most states and territories have pointed to difficulties in collecting accurate and comprehensive data on waste generation in their jurisdiction, as highlighted by an interview respondent:

> ‘Data is problematic – every jurisdiction collecting data is different ways, [and therefore] difficult to compare states.’

The implication is an inability to aggregate up to the national level. This issue is compounded by the different definitions of waste and landfills, and methods of data collection. These compounding factors support the existing fragmented landscape that exists across Australia’s states and territories.

An ongoing role for landfill is identified in all waste strategies, but each strategy states that alternatives must be developed to ensure that there is sufficient future capacity. Alternatives being considered are waste to energy and composting, which are seen as the main technological directions for removing the largest remaining portion of what has been referred to as general waste – organic wastes (garden or green waste) and kitchen/food waste. This was noted by several interview respondents, with one arguing that the ‘solution is to turn waste into a fuel for electricity and heat.’

3.4.2 Differences across states and territories

Despite the similarities between states and territories described above, key differences exist in the way waste is managed in policy and practice. Some differences reflect location-specific conditions, for example climate, ground or soil type and waste volume. As noted by an interview respondent:

> ‘Each state has a suite of landfill and transfer station requirements based on climatic conditions, environmental plans. [The] rules are completely fractured depending on the state. Landfills do the same thing wherever they are and sure there are differences depending on climate and waste amounts etc. So apart from the design parameters, there could be a lot of streamlining of standards to make a national standard.’

As noted in WCS (2010), waste classifications range from two categories (QLD) to seven categories (WA). Landfill classifications also vary, and as a result, waste has sometimes been transported across state borders to locations where regulations and controls are less stringent (EPHC 2010a; WCS 2010).

Another difference between states and territories relates to the cost of waste management and mitigation. These differences are (and will to continue to be) due to social and geographical diversity. Costs have been the primary determinant of waste management and mitigation measures. Historically, policies have preferred the cheapest options (noted by an interview respondent '[it's] always about cost – everybody will go for the cheapest low cost option'), and the cheapest option varies between settlements. Differences in population density, distance to waste management facilities and logistical options vary widely between states. For example, Queensland's 2010 Waste Strategy notes the difficulty for viable waste management in its island communities, with challenges relating to small populations, limited transport options, significant transport and logistics costs, planning issues, and limited storage space (DERM 2010).

Lastly, a difference existing across states and territories that relates to waste classifications (noted above) is the lack of consistent data collection. This lack of a consistent approach to data collection was raised by several interview participants as a barrier to effective policy. For example:

> 'Data is problematic – every jurisdiction [is] collecting data in different ways, [it is] difficult to compare states.'

Attempts to address this challenge are being made via the *National Waste Policy's* Strategy Cluster on data (EPHC 2010b).

3.4.3 Summary of similarities and differences

Significant similarities and perhaps intractable differences between states and territories are summarised in Table 8.

Table 8. Summary of similarities and differences across states

	Similarities between states and territories[9]	Differences between states and territories
Drivers and opportunities	• Population growth and consumption rates are noted as a driver for waste strategies • The need to reduce and mitigate growth in greenhouse gas emissions from existing waste management technologies • A lack of public acceptance for new landfill facilities near human settlements and in areas that are considered to be more valuable if put to another use such as farming • Potential for more employment in resource recovery than is present or likely to be present in landfill disposal • Avoidance placed at the top of the waste hierarchy that underpins waste strategies	• History of source separation in SA's container deposit scheme is used as an explanation for higher rates of recycling with less residual material. More detail is provided in case study 1. • Due to the size and pattern of land-use, the ACT has developed significant employment in the existing system of waste management. Recognition of waste management as an important part of the ACT economy creates a stark contrast to other states and territories. • The Northern Territory's population is both small and widely distributed. Many communities are required to manage their own waste without support services provided by any level of government.
Challenges and barriers	• Carbon tax was seen by most as a challenge to landfills • Population growth and accelerated rates of consumption per head of population noted as placing pressure on existing waste management infrastructure • Seeking a reduction in the contribution of waste management to the greenhouse gases emitted in their jurisdiction • Noting that not enough is being done to educate members of the public about waste management • The low cost of landfill is an impediment to the development of alternative waste options (even in the face of levies) • Difficulties in collecting accurate and comprehensive data on waste generation in their jurisdiction	• Different state regulators have varied in their approach to developing guidelines relating to new technologies. • The physical landscape of some states present vastly different challenges to others, e.g. WA compared to Tasmania. • Differences in definitions of waste which make comparison of waste data at the national scale difficult • 'I am concerned that the ability to do it as a nation is unlikely because the bigger states want to do it [manage waste] on their own.' Different levels of interest in collaborating with bigger/smaller states for implementation/ policy coordination • 'There is a greater role for national leadership, and more co-ordination across states including the application of

[9] Either included in strategy documents, identified in interviews with policy makers or both – for all, or a majority of, states and territories

		regulation including landfill levies.' Different approaches to landfill levies – whether to have them, what the process are, and how to invest the revenue
Roles and responsibilities	• Each state and territory has waste related legislation • Each state and territory waste strategy specifies roles and responsibilities for waste management	• Relevant waste legislation varies widely between jurisdictions • Some states have targets and some do not. Some are aspirational while others are more specific
Gaps	• All states are talking about waste avoidance but no or few policies discuss about EPR or Product Stewardship.[10] No clear connections between long-standing policy to divert waste from landfill and food policy initiatives to address food security	• ACT is explicit in its consideration of the dependence of its waste management systems on the availability of comparatively low-cost transport fuels[11]

[10] Statements in waste strategies (for example, Victoria) and various reports indicate that the relationship is noted, but policy to address this is notably absent.
[11] It is worth noting that the issue of increasing transport fuel costs has been considered in the Victorian government-funded study of food supply scenarios (Larsen et al 2011) but does not appear in its waste strategy

As noted by several stakeholders interviewed as part of this research, the historical use of landfill as a waste management technology in Australia is underpinned by the view that there is no lack of land to fill. There is also a view that, in financial terms at least, landfill has been a low-cost waste disposal option. However, from this discussion of similarities and differences between Australian states and territories, it can be seen that the management of waste is highly dependent on local context. More specifically, local context affects the capacity to respond to the increasing cost of managing and mitigating waste.

Local context[12] is used here in two ways, the first being a common understanding. The *Oxford Dictionary* defines a context as 'circumstances that form the setting for an event … and in terms of which it can be fully understood'. The second sense of local context refers to specific combinations of social and geographic factors. This distinction between the two uses is made to distinguish between characteristics that are a feature of any given community (such as regular participation in a tidy town initiative), and higher-level differences in history, settlement pattern, and population.

A broad overview of these socio-geographic aspects is provided here as a foundation for further discussion of their potential implications for the medium- and long-term future of landfills as a waste management and mitigation technology in Australia.

3.5 Characteristics of the physical landscape and patterns of human settlement

Commentary from state and territory waste strategies, and comments in stakeholder interviews, indicate that the physical geography and patterns of human settlement in each state play a significant, but poorly articulated, role in each jurisdiction's policy approach to waste management.

As shown in figure 8 NSW and VIC have relatively large populations living in comparatively compact settlement patterns. These states have more than half of their total populations living within the capital city.

SA has a smaller population but has a similarly compact metropolitan population (73.2% live in Adelaide). For these states, challenges and barriers are described in terms of availability of land near to waste generators (businesses and residents), as noted by a VIC interview respondent:

> 'A 100,000 tonne p.a. facility needs a 2 km buffer – these sites are hard to come by and may not exist in Victoria. You may need re-zoning if in farmland. Under the Planning Act, farming prohibits recycling and rezoning takes time.'

[12] That is the response of a state or territory – this does not refer to local government specifically.

QLD) and WA have smaller populations than NSW and VIC, but their populations are widely distributed in over a large area. Commentary from the waste strategies of these states indicates that distance and patterns of development are impediments to waste management generally, and in particular, to the enforcement and monitoring of remote landfill sites. As noted by a WA interview respondent:

> '[It's] hard in WA to inspect everything – it is impossible to visit all [sites] due to distance and size of the state.'

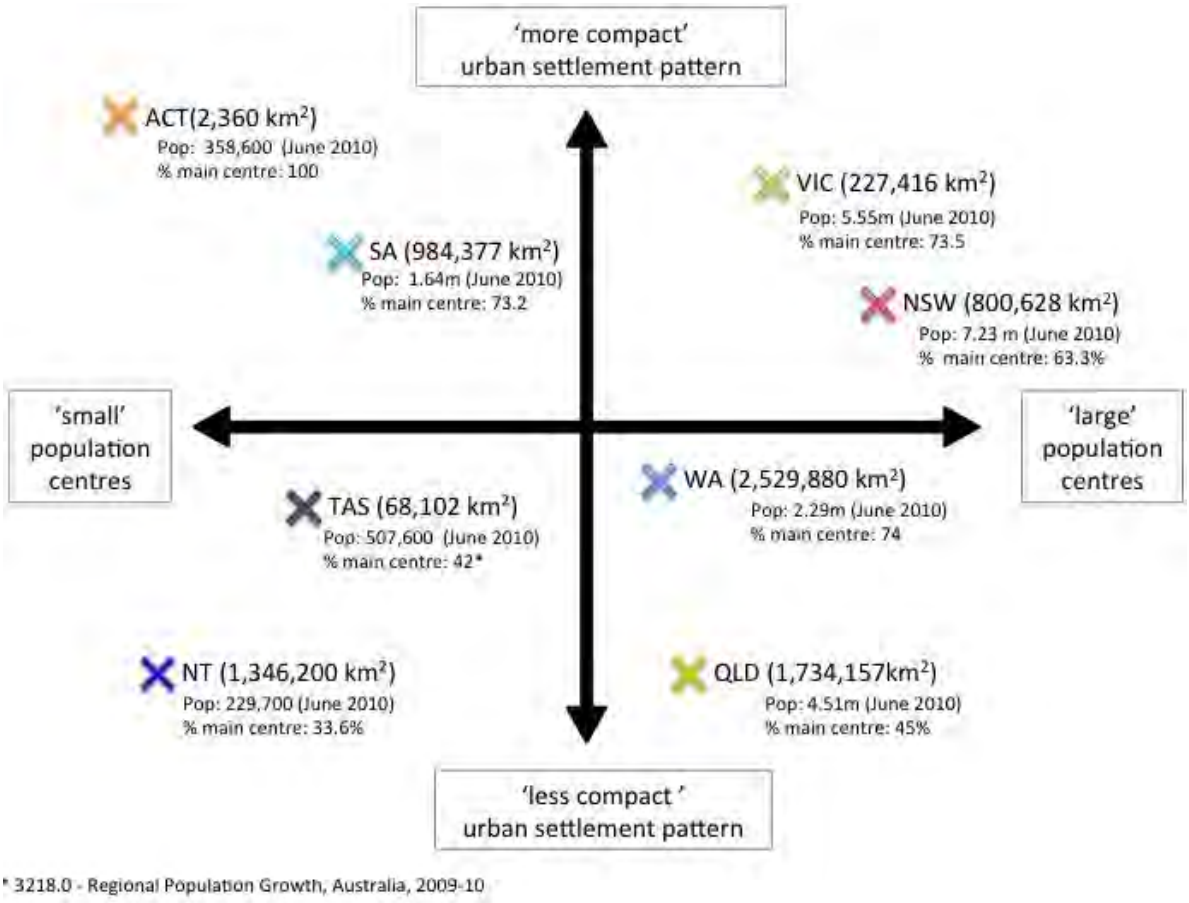

Figure 8. Populations and settlement pattern distributions in Australia.

Figure 8 also shows that the remaining states and territories present greater contrasts. TAS, NT and ACT have smaller total populations compared to the other states and territories. But here again, the concentration of population in a major centre appears to have a positive influence on the capacity for making progress in waste management and mitigation. States with the longest history of strategic waste management, and high levels of success in improving performance in diverting waste to resource recovery, are the ACT and SA (see case studies for more detail).

TAS holds its small size/population and distance from markets to be a significant impediment. The first waste strategy produced by Tasmania acknowledges unique

characteristics such as geographical distance to recycling markets and waste treatment facilities, and economies of scale. This view is supported by a government interview respondent '[our challenge is] economies of scale and distance from mainland.'

NT is also highly isolated in respect to the major centres of mainland Australia – Darwin is closer to Asian centres such as Singapore and Hong Kong than it is to Sydney. Furthermore, the NT has large numbers of small remote communities that manage their waste without access to local or state government services. Landfill is the dominant approach to waste management and NT has no targets for generation, diversion or recycling.

The ACT's draft waste strategy identifies many of the same issues raised by other states (increasing consumption and disposal per head of population), and many of the same barriers as the larger states (highly urbanised population centres with little opportunity to provide additional landfill), but does not view these as challenges. Rather, the ACT draft waste strategy clearly identifies these as contributing factors to the financial costs of maintaining high levels of progress against their targets.

The National Landfill Survey results indicate that almost three quarters (73%) of the solid waste disposed to landfill in Australia is placed in around 64 large landfills, each of which receive more than 100,000 tonnes of waste per year while only a very small proportion (3%) is placed in small landfills that receive less than 10,000 tonnes/year (WCS 2010).

From this analysis, it can be seen that while the physical landscape is very different around Australia, it is the historical pattern of human settlement that seems to have the most significant effect on capacity to manage and mitigate waste.

While *National Waste Policy* initiatives appear likely to resolve long-standing issues of poor data, inconsistent classification of waste, and variable markets for recovered resources, it is not clear that the existing strategies of the policy will resolve the fragmentation arising from the sheer variety of local contexts in which waste generation and management occur.

The extent to which a policy, or suite of policies, will impact waste management and mitigation across different jurisdictions may be dependent on the specific context in which they are applied. The aspects of local context that have been observed in this study indicate that the historical development of different human settlements, patterns of production and consumption, and the acceptance of technological interventions will need to be considered carefully. While they are not insurmountable problems, these aspects of human geography are important to understanding how well a policy will function in meeting national or regional objectives under local conditions.

3.6 Relationship to the international context

The preceding discussion has outlined the key features of the current Australian waste policy landscape. Analysis indicates that many of these issues have a direct relationship to the physical landscape, pattern of human settlement, history of waste disposal and management, and the relationship between policy-making and operational responsibilities for waste management. The majority of these features may be unique to the Australian context.

However, before turning to the implications for the future of landfill in Australia, it is worth considering what the international context might bring to the discussion.

Waste management frameworks have been developed and trialled internationally over the past few decades to better integrate the full sustainability costs of waste management and disposal. Policies have been implemented that draw upon frameworks such as life cycle assessment, extended producer responsibility, cost benefit analysis and waste avoidance. For example, EPR, which aims to reduce waste to landfill originating from Europe is widespread across EU member states (White et al. 2001b; European Commission 2010). The EU's approach to waste management is also clear in its focus on waste avoidance.

The European Union's *6th Environmental Action Plan* makes waste prevention, waste recycling and improved waste monitoring its priorities (EPHC 2010a). The *Waste Framework Directive* highlights waste avoidance as the preferred waste management and mitigation measure. In the *Waste Framework Directive* the waste hierarchy is prominent and ways to adhere to it are clearly articulated (European Commission 2010). This has led to a heavy reliance on incineration and waste to energy, especially in Denmark, Sweden and Germany (Worldwatch Institute 2011). In the EU, concern over landfill space was noted in 2002 and subsequently a preference for incineration, including waste to energy plants, over landfills (Hansen et al. 2002; Mazzanti & Zoboli 2008; Worldwatch Institute 2011).

Further legislation has been implemented to drive progress towards the goals set in the *Waste Framework Directive*. Examples include the *Packaging and Packaging Waste Directive*, *Landfill Directive and the Waste Incineration Directive*, *End-of-Life Vehicles Directive* and the *Waste Electrical and Electronic Equipment* legislation (European Commission 2010).

As of 2010 the European Commission's Landfill Directive 99/31/EC imposed annual restrictions on the amount of biodegradable municipal waste entering landfill, with landfill taxes imposed on local councils (and passed on through local council taxes to residents and commercial operators). These increase annually to encourage them to divert this waste stream to anerobic digestion or composting plants (Waste Management World 2010). Several countries (including Austria, Denmark, France, Germany, and the Netherlands) have implemented further restrictions or landfill bans on certain wastes (e.g. non-treated or combustible waste), and this has led to higher recycling and recovery rates. Sweden has banned organic wastes from landfill since 2005 (DEFRA 2007a).

The European Commission is currently debating whether to introduce separate legislation for biowaste (in the form of a *European Biowaste Directive* which would require source separation) (Foster 2010). A biowaste directive would provide incentives for businesses to invest in infrastructure to treat organic waste, create drivers for commercial biowaste management schemes and set compost quality standards (Environmental Media Group 2010).

The UK has strong food waste reduction goals, as stated in its *Waste Strategy for England* (DEFRA 2009). It has established voluntary schemes for the tracking of business waste collection, transfer and disposal in the *Electronic Duty of Care* pilot project led by the Environment Agency. The *Waste Strategy for England* encourages food and drink suppliers,

manufacturers and retailers to reduce the significant volumes of pre-consumer food waste they generate, and has floated the idea of requiring these industries to make their waste prevention strategies and performance public (House of Commons 2010). The strategy acknowledges that action and policy on C&I waste is underdeveloped compared to municipal waste reduction policy, largely due to a lack of C&I waste data and an industry waste reduction hard target equivalent to the existing landfill diversion targets for biodegradable municipal waste (under the European Commission's *Landfill Directive*) (House of Commons 2010). As a result, one of the overall future policy aims for the UK Government is stronger alignment between municipal waste policies and non-municipal (including C&I) waste.

WRAP, a not-for-profit organisation founded in 2000 and backed by funding from the UK government has focused research and programs on C&I food waste, business waste engagement, and industry-specific waste reduction strategies. A key program is the Courtauld Commitment, a food retail and manufacturing industry voluntary agreement to reduce food waste and household packaging by diverting food waste from landfill by sending it to anaerobic digestion facilities or to food distribution charities such as FareShare.

WRAP also commissioned a report on food waste, product damage and packaging generated at three key stages of the UK food and drink supply chain: manufacture, distribution (including distribution centres and wholesalers) and retail (supermarkets and convenience stores) (Lee & Willis 2010). The report emphasises that any C&I food waste strategy needs to encourage an integrated approach throughout the supply chain, from manufacture through to consumption, and must go beyond the boundaries of individual companies or industries (Lee & Willis 2010). The report also found that 'manufacturing is considered the area of greatest opportunity for resource efficiency outside the home' (Lee & Willis 2010, pg. 4).

As part of the UK Government's *Low Carbon Transition Plan* (launched in July 2009 by the Department of Energy and Climate Change), there is a drive to reduce the greenhouse gas emissions of waste by reducing the volumes of food waste generated. Diverting both municipal and C&I food waste from landfill toward bioenergy facilities (in particular anaerobic digestion processing plants), and considering total landfill bans on certain types of waste in the future may achieve this. The UK Government is committed to implementing increasingly strict landfill regulations, based on evidence from Europe that 'imposing legal restrictions on the types of waste that can be land filled has encouraged higher rates of recycling and recovery' (DEFRA 2007b). The Government is funding research on the viability of restricting the landfilling of biodegradable wastes, and has published consultations on setting C&I waste landfill diversion targets as part of the targets for the UK under the European Commission's Landfill Directive for the diversion of municipal biodegradable or active waste (i.e. wastes that contribute to GHG emissions) from landfill sites to AD or composting plants (Foster 2010). In 2005, the UK introduced Landfill Allowance Trading Schemes as a way of incentivising local councils to meet the *Landfill Directive* targets (EPHC 2010a).

Ireland 'is actively positioning itself as a global leader in terms of taking action on C&I food waste reduction' via the *Food Waste Regulations* (SI508 of 2009) and now requires major producers of C&I food waste to segregate and recover food waste material for separate collection. Ireland's policy does not allow C&I food waste to be sent for incineration or to be disposed of in the residual collection service.

Japan also has a food waste recycling law. Passed in 2001, this national legislation requires all food businesses to recycle 48% of their food waste. By 2005, on average, 59% of C&I food waste was being recycled, and the latest revision of the law required 66% of C&I food waste to have been recycled by 2012. The Japanese Government chose to target food businesses because it is easier for companies (rather than residents) to separate food waste from other waste streams, and it is easier for food recycling plants to collect food waste from companies rather than from individual householders. Currently the priority is converting this food waste to animal feed, with 37% of the food waste recycled in Japan converted into animal feed (around 2.5 million tons) (Stuart 2009).

In the USA, the EPA has been issuing messages about waste avoidance, or source reduction, since 1996 (US EPA 1996). Despite this, any mention of avoiding waste remains limited in national policy, which focuses instead on sustainable materials management (US EPA 2002). About 69% of the USA's MSW is sent to landfill, while 24% is recycled and 7% incinerated in waste to energy plants, of which there are 115 across the country (van Haaren et al. 2010). In 2005, the US set a 35% target for the recycling of MSW which was expected to be achieved mainly via voluntary measures (GHD 2009). For example, voluntary schemes such as *WasteWise* for MSW and *Plug-In to E-Cycling* for e-waste aim to encourage waste minimisation (US EPA 2010; US EPA nd). The recently announced *National Strategy for Electronics Stewardship* also targets e-waste via a product stewardship approach and voluntary commitment has been obtained by several large electronics companies (Waste Management World 2011).

The US EPA regulates waste management via its *Resource Conservation and Recovery Act* (1976) and, as is the case in Australia, each state implements policies, taxes and levies individually under the Solid Waste Disposal Act (WCS 2010). Some states have implemented legislation to promote recycling and have banned the landfilling of recyclable materials (EPHC 2010a). California provides an example of a state proceeding with legislating EPR. Its proposed EPR framework for paint and carpet organisations and individuals is being held open for public comment. Display devices such as cathode-ray tube televisions and computer monitors that contain toxic substances have been banned from disposal in landfills in the State of California and elsewhere (Lim and Schoenung 2009).

3.7 Discussion

The lack of space for landfills in Europe is the main factor driving policy and therefore changes in waste disposal measures. This contrasts starkly with the US and Australian situation. As one interviewee expressed it, there is a view that, 'it's not that we don't have enough land.' The contrast in land availability (at the theoretical level at least) between the EU and younger nations like Australia and the US may make the US a more appropriate comparison, despite some very important differences. For example, while the land area of the US and Australia is roughly the same, the USA has much larger population and it has larger markets for products, making some EPR initiatives more viable in the US. The US has a relationship to waste management and mitigation measures that is similar to Australia's but the US has different patterns of settlement, with many more large urban settlements over a

wider land area, and so there are many more locations that can support alternative waste technologies.

These examples illustrate that although the range of policy approaches identified in the preceding sections are not unique to Australia, there are clear differences in the geographical, social, cultural and economic circumstances of the EU, the US and Australia. Because of the importance of individual circumstances, Australia's policies need to be developed and assessed in the context of its unique social and geographical landscapes. By drawing upon a waste management framework that is holistic in its approach and takes into account local context, appropriate policy can be developed that accounts for the full sustainability costs of waste management and mitigation. Australia has considerable potential to address existing gaps in waste management and mitigation options. By harnessing the aspirations outlined in the *National Waste Policy* in a way which recognises capacity and constraints and local context, real progress towards effective waste policy may be achieved.

It is also worth considering the example provided by the EU states, whose variability is in some respects analogous to the fragmentation of Australian states and territories. These states develop context-specific strategies that still align with overarching EU directives.

The following section includes three case studies which highlight many of the issues raised in the discussion of similarities and differences. The case studies identify particular challenges and gaps in the context of the Australian policy landscape. We provide discussion of the success of South Australia (Case Study 1), the situation in the ACT (Case Study 2) and the challenges faced by local government (Case Study 3).

3.8 Reflections from the sector

Semi-structured interviews were carried out with key stakeholders in the waste management sector in August and September 2011. The interviews provided a range of views regarding current trends and future opportunities relating to landfills and waste management policy in Australia. Respondents were suggested and selected based on their knowledge, expertise and experience of waste and landfills. In addition, interview participants were chosen to ensure a broad geographic spread across Australia and a range of backgrounds across different sectors of the waste spectrum (e.g. government, industry, consulting, academic).

Key findings include the identification of a broad agreement on the relevance of environmental and social sustainability in waste management, and a range of different justifications for this view. Respondents also generally agreed that over time, community attitudes and awareness of waste issues have improved, however many stakeholders indicated that they believed further progress is needed in the area of behaviour change, and provided a number of examples of various barriers to change. The views of respondents from certain sectors (e.g. government) were varied, and highlighted the different situations and challenges relating to landfills and waste management across Australia's jurisdictions.

Overall, social sustainability was not given as much relevance in responses, with one respondent from the government sector noting the convoluted links between waste

management and social sustainability. An exception was the participant from the NGO sector who cited social justice to be relevant in waste management. The importance of community involvement in waste management was also mentioned by several industry and government respondents.

In response to a probing question relating to the experience of change, the majority noted an improvement in the awareness and responsibility of the community regarding waste and recycling, with one respondent from the consulting sector stating:

> ‘There has been a revolution by the community in terms of their environmental awareness about their need and want to recycle – industry has struggled to keep up.’

At the same time, information and knowledge was raised as a gap – in relation to both the public, corporate, and government spheres. In relation to public awareness and behaviour change an interviewee noted:

> ‘In a confused communications environment where you are bombarded with different messages all the time and they are changing – there is difficulty in getting a core message through which is meaningful.’

Many commented on the lack of formal waste education and research and development related to waste. Another highlighted the lack of waste focus in tertiary education as a challenge:

> ‘we talk a lot about sustainability in education – waste management is an important issue but not covered as much as other issues such as the greenhouse effect which is more fashionable. Need to highlight other sustainability issues such as waste management.’

Table 9 contains a list of other challenges highlighted, and illustrative quotes.

Table 9. Key challenges and pressures to landfills and waste management identified in stakeholder interviews.

Key pressures or challenges	Key Quote	Respondents raising this issue	Times the issue was raised*
Carbon tax	'The carbon price will double the cost of landfill before the levy. This is going to happen in nine months' time and not a lot of people understand what's going to happen and what it's going to do to the industry.'	7	11
Contamination of waste stream	'There are challenges around contamination in kerbside organics, which can be 20–30% by volume.'	3	6
Lack of data	'Data is problematic – every jurisdiction is collecting data in different ways, [it's] difficult to compare states.'	5	6
Fragmentation of waste policy	'The rules are completely fractured depending on the state. Landfills do the same thing wherever they are and sure there are differences depending on climate and waste amounts… So apart from the design parameters, there could be a lot of streamlining of standards to make a national standard.'	5	12
Labelling	'Labelling in general – for materials and packaging and identifying whether it's recycled or not rather than what plastic it is.'	1	2
Lack of formal waste education and R&D	'Challenges for example, tertiary education – we talk a lot about sustainability in education – waste management is an important issue but not covered as much as other issues such as the greenhouse effect which is more fashionable. Need to highlight other sustainability issues such as waste management.'	4	10
Lack of guidelines	'In Victoria – EPA only developing guidelines for the use of fuel from C&I waste because we've been hassling them for a year and a half – they are always playing catch-up. They are not thinking in advance and reactive rather than proactive.'	4	14
Lack of markets	'In WA, there's no doubt about it, the issue is markets – we are consumers of products from elsewhere. These end products have to be sent elsewhere to be reprocessed e.g. most glass goes to Adelaide. This is costly and not sustainable.'	4	6
Limited resources and capacity	'The regulators are not in a position to take on the technology. Part of this is due to the regulators being under resourced, lack of expertise thus reluctant to embrace the technology.'	4	7
Landfill costs of disposal	'Governments are sensitive to increasing the charges therefore very wary of this and the impact on business and industry which causes a big impact.'	10	22
Landfill siting and space	'A 100,000 tonne p.a. facility needs a 2km buffer – these sites are hard to come by and may not exist in Victoria and may need re-zoning if in farmland. Under the *Planning Act*, farming prohibits recycling and rezoning takes time.'	6	14

Key pressures or challenges	Key Quote	Respondents raising this issue	Times the issue was raised*
Operational costs	'Economic imperative that is imposed by the levy and the ever increasing costs of landfill. Also the costs of environmental compliance of the landfills – it's more expensive to run a landfill and this must be passed on as a gate charge.'	6	8
Planning	'There seems to be no strategic plan in place in how we're going to achieve less waste to landfill.'	6	12
Public awareness and behaviour change	'In a confused communications environment where you are bombarded with different messages all the time and they are changing – there is difficulty in getting a core message through which is meaningful.'	11	38
Responsibilities and behaviour change	'There is too much burden put on local government, not enough on producers of the articles which end up in the waste stream. Individuals need to be more responsible – need to be recognised and updated.'	11	41
Wastes of concern	'State government – List of Wastes of Concern Report from 10 yrs ago e.g. tyres, car batteries, household batteries. These have not had systems set up to deal with them – all these are still an issue.'	5x	>5

*Note the numbers in this column refer to the number of times the issue was raised throughout the interview, not just in relation to question B1

Successful techniques and approaches to waste management were mentioned across a range of questions, including question C4 which asks, 'Are there sustainable waste management strategies or initiatives being undertaken by other organisations that you would like to see being applied more broadly?'

Successes mentioned by respondents are described below:

- Resource recovery and recycling in the C&D sector: 'C&D is very successfully recycled – there's little going to landfill, no incentive for it to go to landfill.'
- Resource recovery and recycling as a job creator: '10,000 tonnes of waste will create 6.3 jobs in waste disposal and 9 in recycling. In resource recovery, the number of jobs created is exponentially more than that.'
- C&I waste-to-energy business in South Australia: a specific example was provided from an industry representative who spoke highly of the success and subsequent possibilities of waste treatment in the C&I sector.
- South Australia's policies, including container deposit for beverage containers, a plastic bag ban, a ban on certain materials to landfill and an effective levy which includes a possible rebate. Thus, several respondents were of the mind that 'other states should try and emulate South Australia's policies'.
- Businesses such as Visy and Amcor who vertically integrate their operations, i.e. recycle materials and have a market for the end product.

Technological innovation in Australia, including:

> 'Landfill gas to energy was developed in Australian landfills 10 years before it was developed USA and Europe to the same extent – we have had innovation come through.'

In relation to alternatives to landfill and existing waste management approaches, EPR was noted by four respondents (from government and consulting sectors), with one noting:

> 'EPR could achieve a great deal more if it were pushed in a more hard line way. Other countries have been more fearless about taking industry on about their environmental impact.'

Product stewardship was also raised by four respondents (from a mix of sectors and with two being different to those raising EPR) as an alternate strategy, for example:

> 'Product stewardship is well established in EU and US and needs to be expanded here. We have made a start on that front.'

The possibility of using industrial ecology approaches, including the re-use and recycling of products within industry, were also noted. One industry respondent stated:

> 'I would be looking for a process that can convert waste to be consumed and generate power and not pollute the atmosphere, but we haven't come across one of those yet.'

Issues of life cycle accountability and cradle to grave were also raised across all sectors.

3.9 Reflections from stakeholder workshop

Participants agreed that current pricing is too low as it does not reflect the real costs of waste or recycling. This reveals a market failure since it does not encourage waste diversion from the cheaper option of landfill which, although offering an important service, can be a more expensive option when all internal and external costs are considered in relation to the costs and benefits of waste mitigation options. Participants thought that while levies can be useful for developing markets (e.g. for organics), additional tools also need to be considered such as regulations, education, legislative safety nets, incentives, re-investment into programs and infrastructure.

The need for the waste sector to undergo major reform was agreed. Parallels with the reform in the health and aging sector were raised, noting they had decades-long mechanisms to drive progress. Participants noted the same mechanisms and architecture are absent in the waste sector which is characterised by a lack of consistent dialogue within the sector. Participants indicated the need for renewed persistence and a champion to drive the reform.

The concept of social licence to operate waste management facilities was discussed, and how the industry has lost the ability to consider certain technology options due to loss of community trust through past disenfranchisement. For example when introducing technologies such as waste to energy and incineration. Trust building was agreed as central to introducing any new future options, with exploring the best agencies or organisations vital to provide independent information to the community on options. Experts shared their opinions regarding how and when the community should be engaged in decision-making, revealing differing views on best practice. Some preferred community engagement from an early stage (to include the community in developing options), and others preferred externally identified options from which the community can select between.

The need to increase general community awareness and dialogue about waste, resources and mitigation was discussed and participants agreed on the importance of reaching beyond already engaged community members. It was noted that the majority of people remain disengaged and need an effective mechanism to participate in decision-making processes.

The workshop participants reinforced many of the issues identified in the survey of existing policy and strategies, namely that:

- costs for landfill need to be higher
- there is a need for better data
- the community needs to be engaged more intensively
- the community needs to be engaged on an ongoing basis
- local governments should band together or be better resourced to achieve more, and
- zero waste is controversial.

3.10 Case studies

3.10.1 Case study 1: The success of South Australian waste policy and management

SA is cited as an example of Australia's best practice in relation to implementing effective and holistic waste strategies. Commentary in discussions of best practice provide some insight into what SA is doing well, with a recent report by UN-HABITAT (the United Nations Human Settlements program) pointing to Adelaide as an example of international best practice (UN-HABITAT 2010). Australian stakeholders interviewed for this research also nominated several aspects of South Australian waste management and mitigation as a model that '[o]ther states should try to emulate…' The *National Waste Report 2010* indicates that SA had a reduction in waste disposed to landfill of 15% compared to 2008. Recycling rates are also improving significantly, and apart from the ACT, are the highest in Australia (EPHC 2010a).

Historical waste management

SA has pursued its own path with respect to waste management and mitigation, and its Government has often been the first in Australia to introduce legislation for specific items of waste (UN-HABITAT 2010). For example, SA was the first to implement a ban on low-density polyethylene shopping bags (*Plastic Shopping Bags (Waste Avoidance) Bill 2008*), and has operated a container deposit scheme for over 30 years. The unsightliness of these items when they are disposed of inappropriately seems to have been a key reason for legislative attention, and this connection can be seen both in the early imposition of a deposit for single use beverage containers, and the effectiveness of the SA recycling industry. Early recognition of the connection between increased litter and the introduction of smaller single use containers enabled pre-existing bottle collection and re-use infrastructure (collection depots) to be used as places where containers could be taken for a five-cent refund (EPA SA 2011). The deposit for containers was raised to ten cents in September 2008, and presently there are 127 collection centres across the state (47 within metropolitan Adelaide and 80 in regional SA), which continue to provide a well-separated stream of materials for recyclers (EPA SA 2011).

This historical focus on litter-related waste issues began to change when waste management roles and responsibilities changed to meet international obligations to limit the transport of potentially hazardous materials in the early- to mid-1990s (SA Environment Protection Act 1993; National Environment Protection Council (SA) Act 1995). However, public opposition to further development of landfill in Adelaide, and a failure to reach waste reduction targets prompted the South Australian Government to create Zero Waste SA in 2003, a statutory corporation that aimed to 'drive forward waste reduction, recycling and re-use practices' (UN-HABITAT 2010). The SA Environment Protection Authority (SA EPA) acts as the state's regulator for environmental issues and works in tandem with Zero Waste SA in the implementation of waste strategies (including collecting the waste levy), as specified in the act. Zero Waste SA and the SA EPA released SA's first waste strategy in 2005.

What makes SA practice international best practice?

Whereas many cities in the world are striving to bring all waste into controlled disposal, SA is striving to make disposal as irrelevant and unnecessary as possible (UN-HABITAT 2010).

It may be that a large part of SA's success rests on the presence of significant numbers of materials reprocessing companies in South Australia, with the most recent draft strategy noting that there are 'more than 50 local companies that reprocess paper, metal, glass, plastics, tyres, concrete, asphalt, timber, e-waste and garden organics (UN HABITAT 2010; Zero Waste SA 2010). The proximity of these facilities to waste generators in the major population centre (Adelaide) is also seen as an important factor.

Establishing the same level of capacity for reprocessing in all Australian states is likely to depend on the extent to which policies, or specific contextual factors, have contributed to performance. For other states and territories, this may not be practical or cost effective. However, there are a number of other aspects of the waste management and mitigation model that SA embodies that support the continued success of these facilities. These aspects are highlighted in the UN-HABITAT report, and are explored in further detail below.

Well-developed institutional structures: state and local government working together

Setting up Zero Waste SA was a key development underpinning the SA government's commitment to establish a new legislative framework for state and local government to work together under an integrated strategy (UN-HABITAT 2010).

Effective partnerships underpin much of the success of SA's waste management policies and strategies. Zero Waste SA work with SA's Local Government Association (LGA), the Waste Management Association of Australia and tertiary institutions and also engage with national/state policies (Zero Waste SA 2011).

An industry sector interviewee noted the benefits of working in SA as regulatory guidelines had been established for new technology, allowing AWTs (e.g. waste to energy for C&I waste) to proceed. This is in contrast to other states, for example VIC, where the lack of regulatory guidelines is delaying progress on this front. The interview respondent noted that a policy to allow the C&I sector to proceed was needed – the new Victorian environment Minister went to SA to inspect the situation.

Integration of waste strategy with climate change priorities is also a key focus of Zero Waste SA.

Financing mechanisms: levies, programs and grants

One of the most innovative aspects of Zero Waste SA is that their revenue stream is linked (hypothecated) to the landfill tax revenue receipts of state government. Out of every dollar of landfill tax charged, 50 cents is made available to Zero Waste SA for initiatives which divert waste from landfill (UN-HABITAT 2010).

SA's waste levy aims to drive waste away from landfill. A portion of SA's waste levy, which is collected by the EPA, is transferred to the waste to resources fund, which funds Zero Waste SA programs. Interview respondents view the SA waste levy as an effective means to better outcomes:

> 'Victoria and SA have most effective levies and [are the states where it is] easiest to get rebates. Also, they reinvest their levies in [waste management] projects. The intent is to get the processing to occur, not to collect the money. Those states are the most advanced in getting it right.'

Organisational capacity: partnering with state and local government, other sectors, and the public

SA has demonstrated a high level of political commitment and willingness to stick its neck out and implement policies and legislation upon which other administrations take a more conservative position (UN-HABITAT 2010).

As noted above, the effectiveness of Zero Waste SA may lie in its partnerships with a wide range of important stakeholders. This includes state and local government, waste and other industries, the public, and groups in regional areas. For example, to address the needs of SA's remote indigenous areas, Zero Waste SA also partner with the Aboriginal Affairs and Reconciliation Division, Department of the Premier and Cabinet, and the Australian Government Department for Families, Housing, Community Services and Indigenous Affairs to increase resource recovery and improve landfills (Zero Waste SA 2009).

Further organisational capacity is provided by meaningful public engagement, which addresses social and behavioural change relating to consumption. The UN-HABITAT assessment noted that SA's user and provider inclusivity is an important element of best practice (UN-HABITAT 2010). The generally neglected connection between consumption and waste generation has been, and continues to be, tackled via a range of approaches.

Actions to support a move towards zero waste

The need to adhere to the waste hierarchy and the focus on diverting waste away from landfill are clearly articulated in South Australia's Waste Strategy 2010–15. This is in part via two long-term strategic objectives: avoid and reduce waste and maximise the value of our resources. Zero Waste SA provides programs and funds projects that focus on waste avoidance and achieve a reduction in waste. Objectives are outlined in the Zero Waste SA business plan with actions aligning with goals and priorities, for example the target of a 25% reduction in waste to landfill disposal by 2014 (based on a 2002–03 baseline).

Setting targets and developing a clear pathway for implementing those targets is an additional strength of the SA approach, as noted by an interview respondent regarding initiatives that should be expanded:

> 'Policies around adopting targets and putting in place implementation plans to achieve those targets.'

Methods to monitor and evaluate Zero Waste SA's programs are also documented.

What is the role of technology in SA's success?

High levels of source separation – separation of recoverable and recyclable materials from other material – are considered to be another element of SA's successful approach to waste management and mitigation (Rawtec 2009). Source separation for a range of recyclable beverage containers is provided through the container deposit scheme's network of collection depots. High levels of source separation for municipal solid waste are provided for the majority of South Australia's total population (around 73.2% live in metropolitan Adelaide), through access to:

> '… a high-quality kerbside waste collection service' consisting of '… three bin systems for… recyclables, green organics and residual waste (UN-HABITAT 2010, pg. 46),'

As the UN-HABITAT report explains, wood and food waste is also recycled:

> 'Garden organics and food waste as well as 75% of recovered timber and wood products are processed into soil conditioner, compost, potting mixes and mulches, which are sold for residential and commercial use. … The use of timber as a fuel in cement manufacture began in 2004/2005 and has utilised significant quantities of timber previously disposed of to landfill (UN-HABITAT 2010, pgs. 46-47),'

In its 2006 position paper, Zero Waste SA noted its desire for AWTs to focus on waste streams not captured by their existing systems, highlighting C&I and residual MSW (Zero Waste SA 2006). The paper also notes the main barriers to AWT uptake as economic cost and the unknown nature of the new technology. An argument is provided that advocates for AWTs that address waste streams with a less valuable (economic and resource value) end use (Zero Waste SA 2006).

In 2007, approximately 4.5% of waste included in an SA waste audit (comprising 7 sites) was treated by AWT (Zero Waste SA 2007). To better understand the outcomes – both direct and indirect – of waste policy options including AWT, Zero Waste SA commissioned a cost-benefit analysis in 2007. Results showed that CDL and AWT would yield a small negative impact on gross state product ($-2.8 million in 2010 increasing to -$8.9 million in 2030) but a positive impact on state employment (167 in 2010 rising to 518 in 2030) (McLennan Magasanik Associates 2007). This conclusion is quite similar to that of the review of targets and strategies commissioned by the ACT government (see the ACT case study).

Summary: South Australia

SA is recognised both locally and globally as a model for effective waste management and mitigation. Their policy is driven by a high-level objective to reduce the need for landfill. Many elements of their approach are recognised by different stakeholders, and a common

observation is that the policy is well integrated with implementation efforts, including pricing structures and distribution of resources. A key feature is the commitment made by a key state agency (Zero Waste SA) to increasing organisational capacity through developing relationships – with agencies, local government, NGOs, remote indigenous communities and the broader community. The policy approach is well supported by infrastructure, with a large number of waste processors (including processors for recyclables) situated in close proximity to the waste generators.

3.10.2 Case study 2: ACT – Integrating policy and management functions for more reliable outcomes

The Australian Capital Territory (ACT) is unique amongst Australian states and territories in that the level of government that sets waste management policy is also responsible for the daily operations of waste collection and resource recovery.[13] This case study illustrates the importance of precise alignment of population centres and waste management/mitigation infrastructure, and the impact of a close relationship between waste policy-making, target setting and operational responsibility for waste.

Prior to addressing these unique aspects of the ACT waste policy landscape, it is worth noting several other areas in which the ACT presents a contrast to all other states and territories. This includes its pattern of development – the ACT is predominantly urbanised across a very small land area with the highest population density of all Australian cities (ABS 2010). The population is also comparatively well educated. Table 10 provides an overview of the extent of post-school qualifications for the capital of each state or territory (measured in terms of persons over 15 with post-school qualifications). This comparison shows that there is generally a small difference in the levels of education in populations outside capital cities, but much larger differences between the educational attainments of the populations of state capitals and the ACT population.

Table 10. Percentage of population over 15 with post-school qualifications (data collated from: ABS 2010, 2006 census).

State or Territory	Capital city (SD)	State as a whole	Difference	Difference Compared to ACT
ACT	61.3%	NA	0	
NSW	57.2%	54.5%	2.7	4.1–6.8
SA	50.0%	48.3%	1.7	11.3–13
QLD	52.4%	50.4%	2	8.9–10.9
WA	54.7%	53.2%	1.2	6.6–7.8
NT	57.6%	52.6%	5	3.6–8.6
TAS	51.5%	47.9%	3.6	9.8–13.3
VIC	54.2%	52.5%	1.7	7.8–8.8

[13] Brisbane City Council may be considered as analogous, in terms of the size and the waste management task, however it is not responsible for setting the overarching waste policy agenda.

Although this comparison is a blunt instrument for identifying a relationship between the education level of a population and that population's performance in generating and managing waste, it does confirm views that the income associated with higher levels of education increases the amount of waste generated (Emery et al 2003). The ACT is noted as the highest per capita generator of waste (EPHC 2010a). However, similar levels of performance, with respect to the diversion of waste from landfill, indicates that education and socio-economic status may be less important than the availability and convenience of waste management infrastructure and services.

Further contrast between the ACT and other cities is provided by the small land area over which the ACT's waste operations are conducted. The ACT occupies a total of 2,360 square kilometres. The ACT is also unusual for a capital city, in that its landfills and public recovery and re-use centre (a transfer station facility located in the industrial area of Mitchell) are regularly accessed by large numbers of the general public. The WCS review of landfills indicates that this is unusual in capital cities (WCS 2010).

For these reasons, a case study of the ACT provides an opportunity to evaluate the impact of many factors that are seen as being important for understanding the future of landfill as a waste disposal technology.

Waste management history

The ACT has largely relied on landfill for the majority of its waste disposal needs. In more recent years, resource recovery and diversion of waste from landfill have become a focus for the ACT Government. For example, the *Waste Management Strategy* for Canberra, released in 1996 resulting in the ACT being cited as the first government to set a goal of achieving no waste going to landfill. Several waste management strategy documents were developed over the following ten years, accompanied by semi-regular audits of domestic waste (eight audits in total, including kerbside audits and other types of audits), audits of recycling at its two major waste management facilities (Mugga Lane and Parkwood landfills) and audits of the Hume MRF (four audits) between 1996 and 2011 (ACT Government 2006; ACT Government 2010).[14]

Since 1996, the ACT has been very active in waste management, monitoring progress, setting high targets, and achieving many of these targets over a period of 15 years. Indeed, the most recent ACT waste strategy notes that:

> '… the ACT has doubled the amount of resources recovered and recycled from waste, rising from 185,000 tonnes in 1995–96 (or 42% of waste generated) to more than 584,111 in 2008–09 (73% of waste generated) (ACT Government 2010, pg. 7).'

The ACT Government has also been very active in examining alternative methods of dealing with waste, including composting programs such as the composting of green wastes from

[14] This does not include: 'In June 1997 a waste inventory was conducted of solid waste being recycled and disposed of in Canberra. The inventory measured waste into 28 different categories. In October 1997 the beverage Industry Environment Council sponsored an audit of 250 Canberra households.'

government landscaping which it has been doing since the early 1990s. In 2001, it was noted that the ACT diverted 90,000 tonnes per annum of garden green waste to commercial compost and mulch producers – around double the amount of domestic waste collected at that period. The ACT draft waste management strategy notes that over 90% of ACT's total garden waste (200,000 tonnes per annum) is being turned into high value potting mixes and garden mulch (ACT Government 2010, pg. 8).

The ACT Government has also examined the potential for household organics collection to make a contribution to reducing waste to landfill. A ten-month trial, undertaken in a statistically representative suburb of Chifley, aimed to collect food and kitchen wastes from single unit households and multi-unit complexes and test whether these materials could be turned into high quality compost that would comply with Australian Standards.

The final report on the trial notes that the average weekly collection of food and kitchen waste was 3.7 tonnes, and that contamination levels were initially very low (average of 1.3% contamination in the first five months) increasing to an average of 9.2% over the final six months of the trial (ACT Government 2010).

This report also notes that the nitrogen, phosphorus, and potassium levels were:

> '…much higher than in the general composted green waste' [and] 'produced a high quality product (ACT Government 2010; 21).'

Current policy

As noted in earlier sections, the ACT is one of the many states and territories whose most recent waste strategy is currently in draft form. Unlike the majority of state and territory waste strategy documents, the latest ACT waste policy document is a radical departure from previous strategies, and clearly states why this change has occurred. After many years of progress against ambitious diversion targets, increases in waste generation have outstripped the capacity to maintain growth in diversion from landfill. Like many of the other state and territory waste strategies, the ACT has nominated population growth, and an increase in consumption per head of population, as looming constraints on existing budgets and infrastructure:

> 'More resources have been recovered each year, but the increasing generation of waste has kept the resource recovery rate at around 70% (WCS 2008, pg. 7).'

Recognising that progress had plateaued, the ACT Government commissioned Wright Corporate Strategy to assess the existing *No Waste by 2010 Strategy* and analyse whether the targets remained achievable. This report found that individual initiatives were 'realistic and achievable within the constraints of the materials contained within the waste streams' (WCS 2008, pg. iii). This report undertook a financial and economic analysis of six different scenarios (one of which was a base case) and determined that:

> 'With annual increases in operating costs and significant capital demands for landfill cell management in the near future, the recurrent budget for ACT No Waste will need to increase appreciably (WCS 2008, pgs. iv – v).'

This assessment viewed an increase in budget as a necessity for maintenance of targets that are at or around historical highs of 74% diversion of waste from landfill (attained in 2005–06).

This study also noted that budget data:

> 'considerably under-forecast the demand for forward capital expenditure in waste management particularly in relation to creating new landfill cells, closing old cells and long-term maintenance of closed cells (WCS 2008, pg. iv).'

The fact that the study considered such issues and showed a detailed understanding in policy planning for the ACT may be attributable to the fact that policy setting and ongoing management of landfill sites are both carried out by the same level of government.

Future Policy – Implications for landfill in the ACT

In addition to the change in direction taken by the most recent waste strategy, there are two other distinctive features of the ACT waste strategy that are worth considering when attempting to understand the future role of landfill for other jurisdictions.

Costs for all options are increasing

The ACT government has undertaken detailed analysis of the financial and economic costs and benefits[15] of waste management and mitigation as part of its policy development. The results of this analysis have generated a more restrained approach to target setting, and confirmed the necessity, benefits, and comparatively lower costs of greater investment in alternatives to landfill. Although the ACT has a very small population compared to other states and territories, community expectations of the ACT are high, and the pattern of land development in the ACT restricts further landfill developments.

As standardising and improving data on waste generation, collection, disposal and recovery is a key element of the *National Waste Policy*, it seems likely that more jurisdictions will be able to develop an understanding of the financial and economic costs and benefits of existing policies and practices that has been achieved in the ACT. Once this occurs, it is possible that other states and territories will take a much more pragmatic approach to evaluating their options and their capacity to achieve targets. The ACT has demonstrated that such an evaluation does not necessarily result in an expanded role for landfill.

Knowledge of the environmental impacts of all options is increasing

Knowledge of the environmental impacts of a range of options for waste management and mitigation is increasing, and this knowledge is being used by policy developers to set priorities. The ACT Government is focused on reducing greenhouse gases as part of its draft strategy, and has already made considerable progress in diverting a large proportion of

[15] That is, the direct financial costs to the service provider, and the range of broader economic costs and benefits to society. In this case, financial modelling, included full system costs and revenues, including estimates of likely carbon credits, and revenues received from gate fees. Economic modelling included a conventional cost-benefit assessment of economic impacts and incorporated monetary valuations of key impacts, including environmental impacts. (WCS 2008)

carbon-heavy materials, particularly garden waste, into resource recovery. The ACT has demonstrated that some forms of waste-to-energy are not acceptable.

The *National Waste Policy* supports this approach as reducing greenhouse gases is a priority. GHGs are measured through National Greenhouse and Energy Reporting requirements, with the price of these emissions likely to increase over time as the costs are included as a routine element of business.

Alternative waste technologies are increasing

The ACT Government has invested significant time and effort in evaluating alternatives to waste disposal. Existing technologies for dealing with organic waste such as garden clippings have been demonstrated over two decades. However, as noted in the WCS report on alternative waste treatment technologies, there is considerable uncertainty about what the most appropriate technologies are.

The ACT exemplifies the dilemma of increasing costs and higher expectations facing many local governments. Their decision to reduce their targets until they have secured the resources required may be instructive.

The benefits of resource recovery are increasingly well understood

The ACT recognises the contribution of waste services to its economy:

> 'From the financial perspective of the ACT Government the overall cost of waste management will increase as efforts at resource recovery are intensified, due primarily to a dramatic fall in gate fees received as less waste is landfilled and the increasing cost of waste management services. While from a community perspective, the economic benefit improves as efforts at resource recovery are intensified, due primarily to the reduced environmental impacts as less waste is landfilled (WCS 2008, pg. viii).'

Further to this economic incentive to landfill:

> 'Further efforts at resource recovery are supported by economic analysis, job creation opportunities and intergenerational benefits; however revenues received by the Government from high landfill gate fees present land-based disposal as more financially attractive (WCS 2008, pg. v).'

The ACT has established that there are benefits available at higher expenditures that aren't available at lower rates of waste recovery and diversion.

The *National Waste Policy* is also very clear on this point. This indicates that with a greater understanding of the waste burden, clear definitions, and regular and standardised auditing procedures, it may be possible to recover more.

Summary: ACT

The ACT is unique in two important areas. Firstly, it is almost entirely urban in nature, with little in the way of regional variation in costs and available infrastructure compared with other states and territories in Australia. The second aspect of the ACT's unique position is that policy making and day-to-day waste management are carried out by the same level of government, rather than different levels of government as is the case elsewhere in Australia. This has allowed for targets and strategies to be based on accurate data on the costs and practicalities of daily waste management. The ACT's engagement with the detailed financial cost implications of various options, and direct exposure to the values of the community for managing waste has shaped their approach to developing waste policy.

3.10.3 Case study 3: Local government and waste management roles, responsibilities, capacity and gaps

In contrast to the wait and see approach being taken by policy makers at the national and state levels – demonstrated by the number of *draft* state waste management strategies – local governments have legal responsibilities to deal with waste disposed of in their designated areas that cannot wait. While for most, these legal responsibilities are limited to the solid waste of residents; it may also include illegally dumped business waste. This waste may be brought into the realm of local government responsibility through the need to remove waste dumped in public places, or through prohibited wastes disposed to landfills. Local governments are, in most cases, also responsible for managing the operations of landfills and alternative waste treatment facilities.

As noted in almost all existing and draft strategies for waste examined here, there is a connection between growth in consumption per head of population and challenges for existing waste management systems. However, as noted in the first Australian *National Waste Report 2010*, the increasing variety of the materials which need to be processed is also a factor in the increasing need for disposal options (EPHC 2010a). In the absence of a policy that mandates minimal packaging and high levels of durability and adaptability as design criteria for all consumer goods, it is widely accepted that waste generation will continue to rise.

This case study explores the challenges faced by local governments, including their responsibilities within the current and future waste management environment, their capacity for undertaking the task that they have been set, and the limits of their existing resourcing and technical capacity.

Roles and responsibilities

The local government sector is widely acknowledged in the literature, waste policy commentary and responses of many interviewees as having a major responsibility for managing waste (ALGA 2008). The Australian Local Government Association (ALGA) submission to the public consultation on the *National Waste Policy* held during 2008–09 argues:

> ‘local councils which, in all Australian jurisdictions, provide regular collection and processing services to households and some commercial premises (ALGA 2008, pg. 1).’

As well as collection services, many councils own and operate waste transfer stations and landfills.

There are several variations in the structure of local government waste management, and this variation occurs within particular states as well as across state jurisdictions. Regional waste management groups made up of groups of councils, for areas outside capital cities, are common.

Limited financial, available land, and treatment capacity

As noted in the ALGA submission to the public consultation on the *National Waste Policy*, local government becomes responsible for many consumer goods whose toxicity at end-of-life has not been considered in the same depth as public safety issues such as whether a product includes parts that may cause choking (ALGA 2008). Their submission also argues that:

> ‘There is an expectation that Local Government will adapt to new circumstances and deal with new types of waste as they arise. This may not always be economically or technically feasible.’ (ALGA 2008, pg. 2)

One interviewee stated:

> ‘There is too much burden put on local government, not enough on producers of the articles which end up in the waste stream.’

This comment raises questions about EPR.

As noted earlier, the role of local government also includes managing or having some responsibility for waste disposal and recovery facilities (DERM 2010).

The table below provides some sense of the decision making burden that rests upon local governments for waste management. Despite the fact that waste management is one area of council activity that is actually guaranteed ongoing funding, the funding is not necessarily adequate to the task that arises from the use of landfill for MSW, C&I and C&D wastes.

Table 11 provides figures for the estimated wastes for which local government has direct and indirect responsibility. Direct responsibility lies in the MSW stream (shown in column 1), and these figures illustrate the volumes of waste that local councils must manage – funded through state allocations, rates and grants. Column 2 shows the estimated volumes of waste for which local government has indirect responsibility through the requirement to manage local street cleaning (including illegal dumping of business wastes), and through roles as operators or local consent authorities for landfill sites. Column 3 shows the total wastes landfilled, and it is here that it is possible to gain a sense of the performance of different states and territories, and the extent to which local government may be under-resourced. For example, in NSW the estimated total figure for MSW is just over half of the estimate for total

wastes sent to landfill, while in Victoria MSW makes up around 70% of the total wastes sent to landfill. In contrast, the ACT, whose performance in recycling and reuses has been explored earlier in this section, presents a different picture. For ACT the estimates for wastes generated in the MSW and other streams of waste are both significantly higher than the total wastes sent to landfill (shown in column 5).

Table 11. Comparison of all wastes generated and landfilled by jurisdiction and stream in tonnes 2006–07 (EPHC 2010a, pgs. 26–27).

State	Estimated MSW generated[16]	Estimated C&D/C&I waste generated	Total of all wastes landfilled	Estimated MSW as percentage of total wastes landfilled
NSW	3 891 000	14 969 000	7 365 000	52%
QLD	3 100 000	4 981 000	4 302 000	72%
VIC	2 783 000	7 501 000	3 925 000	70%
WA	1 424 000	3 824 000	3 539 000	40%
SA	753 000	2 566 000	1 144 000	65%
NT	74 000	108 000	151 000	49%
TAS	340 000	181 000	446 000	76%
ACT	363 000	421 000	197 000	184%

While it is likely that figures for landfilled wastes are underestimates due to the absence of data gathering at many of these sites, the percentage of wastes generated by in the MSW sector is significantly less that that generated by the C&D and C&I sectors. When the full estimate of the MSW generated is translated as a percentage of the wastes landfilled, it becomes apparent that the MSW sector is underwriting the waste management of the business sectors. Better data would be required to evaluate the precise extent to which this is the case, in each state, however; at least one state local government association has explicitly identified this problem:

WA's local government association has not accessed the limited state and federal grant schemes for the financing of waste management facilities. Consequently, new facilities may have to be funded from rates which places considerable burden on councils (WALGA 2011).

As well as supporting a long-term view of the costs associated with waste options, WA's LGA notes the burden on councils and their communities to cover upfront costs:

> 'The whole-of-life costs of infrastructure, in particular, are not usually taken into account by the funding bodies when projects are proposed. Costs incurred by Local Governments include the cost of capital, staffing costs, utility costs, as well as refurbishment and general depreciation costs. Local Government supports the allocation of funding that incorporates the long-term costs of managing infrastructure (asset management), and the need to operate and staff these facilities, particularly in regard to funding programs for the delivery of waste management infrastructure (WALGA 2011, pg. 5).'

[16] Note that waste data in Australia is considered to be less than reliable at present and that these figures are provided with caveats in the *National Waste Report 2010*.

Similarly, in its submission to Tasmania's first draft waste strategy, the Local Government Association of Tasmania expressed both commitment to achieving positive outcomes in waste management and a view that finding an appropriate funding mechanism would be a major hurdle:

> 'Until this is agreed upon and there is clarity about what each party is financially responsible for the strategy is unlikely to progress or be accepted by Local Government (LGAT 2009, pg. 2).'

With the majority of Australia's population living in eight major cities, the ability to dispose of waste to landfill sites that are close enough to be socially acceptable, and economically feasible is limited. For example, Sydney looked for additional capacity for more than a decade before having to accept an arrangement to transport waste around 197 kilometres to the Woodlawn facility near Goulburn. Similarly, South East Queensland local governments are running out of space (DERM 2010).

The combination of competition between states for the highest targets, the realities of limited funding for waste services, deficits in key information and data, and a lack of leadership with respect to the production and consumption cycle can be seen as skewing the decision-making parameters for local government and waste management service providers.

Questions of capacity, at the level of local government, to make the right decision are posed in terms of a lack of understanding, as noted by an interview respondent:

> 'At the local government level, there is gap in understanding the technology. They can get caught up in the superficial side rather than the effectiveness.'

However, a review of AWT undertaken for the ACT government provides some reason for local governments to remain cautious:

> 'The review covered more than 300 waste processes from over 26 countries and found that some 43% of the operations have little operational experience on which to base credibility and 25% not yet even at a demonstration stage. Aside from the novelty of many technologies, the reviewers commented significantly on the uncertainties relating to many of the products generated by many facilities and the capacity for markets to absorb those products, raising serious questions about the ability of principals to raise the requisite capital to fund projects (WCS 2008, pg. 39).'

Furthermore, rather than uncertainty about technology, concerns for the comparative cost of AWT appear more consistent with local government submissions regarding waste strategy. This is particularly clear in the discussions of the relative merits of landfill, waste-to-energy technologies and composting technologies for alternative waste management. An interviewee commented:

> 'All councils (are) looking for alternate investments. AWT is the direction but the issue is cost. Landfill costing is still cheaper option.'

Gaps in leadership and support

At present most Australian states and territories have waste strategies that remain in draft form, perhaps signalling a level of reluctance to commit to difficult targets or measures. For example, the local government response to *Draft Waste Management Strategy for Tasmania* indicates broad support for the *Tasmanian Waste Management Strategy* but also demonstrates a lack of commitment to objectives and priorities (LGAT 2007).

The need for local governments to receive more support relates to several matters. These include the support of communities and rate-payers in pursuing particular standards of waste management, dealing with new initiatives arising from state waste strategies, as well as legislative and regulatory support for aspects of the production and consumption cycle that local government has little ability to influence.

The Queensland LGA submission to *Queensland's Waste Strategy 2010–2020: Waste Avoidance and Recycling Consultation Draft* recommended that the state government (via QLD Department of Environment and Resource Management) conduct community education on the state's proposed waste levy.

Local governments also rely on national and state governments to use their statutory powers to influence the top of the production chain and regulate materials and products that come into the marketplace (ALGA 2008). Local government has indicated that support is required from other levels of government – ALGA argues that it needs:

- legislative support to reduce the impact of consumer goods and the requirement for more infrastructure and complex technologies, and
- or in the absence of this kind of support, more resources to address absence of capacity for reviewing and implementing such infrastructure and technologies.

EPR is highlighted as a useful strategy to address the top of the consumption chain (ALGA 2008; WALGA 2011) and while some progress is being made with e-waste, it has been noted that there is wider scope for this kind of approach across a wider range of consumer goods.

Case study summary – Local government perspective

For most states and territories, waste policy development, including targets and strategies, happens at the state government level, while responsibility for operations and outcomes is firmly with local government. Local governments may or may not have the financial or technical capacity to meet the objectives set by state policy. Support that the sector says it needs from other levels of government include leadership with respect to producer responsibilities in avoiding waste and guidelines for assessing technologies against public health, environmental and value-for-money objectives. Compared to SA, whose integration between policy and operations is ensured through institutional coherence provided by ZeroWaste SA, and the ACT whose performance is supported by fully integrated delivery of policy and services, other states and territories demonstrate the difficulty of setting achievable targets in the absence of this integration.

3.10.4 Reflections on the case studies

The case studies illustrate the importance of integrating policy making, target setting and strategy development responsibilities. This needs to be done with a clear understanding of the full costs of various waste management options and with an appreciation of the practical realities of delivering waste services to the community.

The SA and ACT examples provide insights into the many elements required to support consistent movement towards targets, which require reliable performance at a high level. These elements are high levels of integration between policy and implementation, the involvement of stakeholders (both users and providers), detailed knowledge of the costs of various options, and establishing financial mechanisms which encourage waste reduction in line with their stated policy goals.

SA also demonstrates the value of its distinctive history with the container deposit legislation (CDL) and the retention of decentralised re-use infrastructure, and high concentrations of population corresponding with waste processing facilities. The ACT has a similar geospatial relationship between generators and processors, which suggests that high performance may be aided by more centralised populations, situated close to re-use and recovery facilities. This may confirm that states with highly distributed populations in small centres require greater resourcing and different approaches to achieve similar levels of performance.

The ACT example also demonstrates that current levels of resourcing are a constraint to continued progress towards achieving targets; the ACT has signalled the need for a significant increase in revenue through increased landfill pricing.

Despite the advantages of the geospatial configurations of these jurisdictions, both SA and the ACT have demonstrated that this is not the only determinant of high performance. The ACT shows that resourcing is an issue in the face of increasing population/consumption and reliance on landfill income to fund other waste options (including recovery and re-use). SA's Zero Waste SA and the *Waste Strategy 2005–2010* recognise that both a strategic approach and institutional coherence is an important element of meeting targets.

3.11 Challenges and gaps

Key challenges associated with progressing the waste management and mitigation policy landscape to one of greater overall sustainability include:

- fragmentation
- disconnection between production and consumption
- responsibilities are dispersed among three levels of government
- higher transport costs
- concerns regarding greenhouse gas emissions and organic waste
- achieving waste targets, and

- implementing appropriate technology.

We acknowledge other challenges and gaps, including lack of consistent data, and the issues surrounding landfill pricing.

3.11.1 Fragmentation

Fragmentation is a phrase that has become common in discussions of the Australian systems of waste management and mitigation, and in the waste policy landscape more generally. However, this review of waste policy and stakeholder interviews have identified that there are many ways in which the waste management systems of Australian states and territories are similar. There are several types of fragmentation that have some bearing on the challenges, gaps and opportunities that can be seen in the future direction of waste management and mitigation in Australia.

In many cases, fragmentation is seen in the absence of standard regulations between states and territories, and this is viewed by some as a barrier to achieving particular goals in waste avoidance and resource recovery. However, differences in the physical setting of a particular place (e.g. climate, topography and soil type) require specific regulatory controls and, as such, states have developed their own landfill and waste management guidelines. The result is a fragmented approach to landfill management across Australia's jurisdictions – an issue described by an interview respondent:

> 'Landfills do the same thing wherever they are and sure, there are differences depending on climate and waste amounts, etc. So apart from the design parameters, there could be a lot of streamlining of standards to make a national standard.'

Others see fragmentation in the disconnections in the roles and responsibilities of different stakeholders. According to one interviewee, responsibilities for waste management are:

> 'incoherent – from the national down to the state level. People who bear the cost most do not generate the waste.'

Further, fragmentation may also be used to describe disconnections between objectives, and targets and the implementation of state and territory waste strategies:

> '[There are] vastly different [landfill] guidelines across states. I'm not saying they should all be the same because a landfill in Bourke requires different attention to one in Greater Hastings. But the overall principles of environmental protection should be the same and level of enforcement is of a concern.'

The sense of fragmentation may seem particularly sharp at present because many state and territory waste strategies were in a state of flux while negotiations of common frameworks were undertaken as part of the *National Waste Policy* development process (EPHC 2010b). Although these negotiations are aimed at reducing regulatory fragmentation by standardising waste classification and by addressing variations in markets, standards and data collection, they will not be concluded until 2014. For this reason, it is likely that fragmentation will continue to be a characteristic of the Australian waste policy landscape for several years.

These aspects of fragmentation represent only one part of the variation in the geospatial and social landscapes of Australian communities, and variation will continue to be a part of the waste policy landscape for this reason. This situation need not be considered a problem – it could be seen as an opportunity to develop flexible and adaptable processes or technologies that can be deployed effectively in a range of conditions and circumstances. These innovations could contribute to improving outcomes for waste in other countries with high variability in local context.

Despite commentary about fragmentation in waste policy across jurisdictions, this analysis of current waste strategies has also identified high levels of agreement on many matters. These include the goal of avoiding waste and the economic benefits that accrue from viewing waste materials as resources for new production.

3.11.2 Disconnection between production, consumption and disposal

National policy does not address the link between production and consumption. The question of how it is possible to have a zero waste and waste avoidance strategy when our society measures performance on economic growth that is driven by consumption arises. This was highlighted by several interview respondents, for example:

> 'Reducing production is the key [to waste minimisation] and it can happen at any point along the chain.'

This lack of integration between production and consumption can be seen at all levels of government – statements in waste strategies and various reports indicate that the relationship is noted, but policies to address this are notably absent. Some states highlight the need for national action. For example the *Queensland Strategy 2010* observes that some end-of-life products are currently targets for national product stewardship action: tyres, packaging waste, computers and televisions, mercury-containing lamps, and plastic bags (DERM 2010). They also observe that some industry sectors already have voluntary recycling schemes: the telecommunication industry (MobileMuster), agricultural and veterinary chemicals (DrumMuster and ChemClear) and newsprint (Publishers National Environment Bureau).

The Queensland State Government has a general commitment to support industry in the area of working with industry and promoting product stewardship activities (DERM 2010).

Some interviewees appeared to associate reducing disposal with everyone going on a big diet, as noted by a government representative. This would appear to be a result, and a confirmation, of the historical absence of producer-oriented policies (such as EPR or product stewardship (PS)) from the waste policy landscape. Only four interviewees appeared to consider this matter, and only two of these distinguished between the different approaches of EPR and PS.

The federal EPR and PS legislation, which is being applied to a limited number of electrical and electronic goods from mid-2011, demonstrate that there has been some progress in this regard. International examples indicate that once systems and processes for a limited number of goods are developed and implemented, it is easier to apply them to a wider range

of goods. In this sense, the new EPR and PS legislation may begin to address what we have seen as an important absence in the Australia waste policy landscape – a connection between production, consumption and disposal. However it is important to note that targeting these products does not address the majority of waste volume or mass.

This gap is also apparent in discussions of organic waste, which on best estimates represents approximately half of the waste that is routinely taken to landfill. Also, organic waste is a major component of household waste in Australia, accounting for 72% of MSW waste sent to landfill in 2006–07 (EPHC 2010a). Despite the concurrent development of a *National Waste Policy* and a *National Food Policy*, there do not appear to be clear connections between waste policy initiatives to divert waste from landfill and food policy initiatives to address food security.

This gap acquires greater significance when considering the serious need to improve soil quality in Australia and to account for increasingly scarce and expensive fertilisers, particularly phosphorus (Commonwealth of Australia 2001; Cordell & White 2010). This may reveal a very significant shortcoming in the leadership provided by the *National Waste Policy* in that connections between production, consumption and disposal are not recognised. Action at the state level is difficult to justify in the absence of a recognition of this need at the federal level and without national coordination.

3.11.3 Disconnection of responsibility between Commonwealth, states and local government

This research has identified a disconnection between the roles and responsibilities of state government and local government with involvement in waste management on a day-to-day basis. This is shown in comments from stakeholder interviews and supported by local government commentary in reports. It is described in more detail below.

The state and national approach of zero waste fails to recognise the varying levels of capacity at the local government level. The push towards zero waste has led many local governments to explore AWT options, but many local councils have limited technical and financial capacity to evaluate them. This was noted by an interview respondent from the industry sector:

> ‘At the local government level, there is a gap in understanding the technology. They can get caught up in the superficial side rather than the effectiveness.’

The disconnection between federal and state aspirations on the one hand and day-to-day local government realities on the other has also led to certain behaviours which, when viewed from the perspective of the system as a whole, appear to be irrational and counterproductive. As noted by one interview respondent:

> ‘[State] Governments are trying to keep up with their counterparts by having ambitious aspirational waste diversion targets to say that they’re the best.’

This competitive attitude can clearly be seen in the ACT’s waste strategy with comparisons among other jurisdictions and the assertion of itself as a leader (WCS 2008).

However, with the notable exception of the ACT, waste policy development and management of operations occur at different levels of government. For most states and territories, there is a separation between those setting the targets and those with day-to-day responsibilities for waste management, creating a situation in which targets are set without reference to the capacity of managers and operators to attain them. Commentary from local government bodies, and interview respondents, indicates that the drive to improve performance at the state or territory level is not adequately supported with resources (funding, information, and regulation). For example one interviewee said:

> 'There is too much burden put on local government, not enough on producers of the articles which end up in the waste stream.'

These issues are described more comprehensively in case study 3, which outlines the challenges for local government.

3.11.4 Preparedness for higher costs associated with transporting waste

The ACT appears to be the only jurisdiction that is explicit in its consideration of the dependence of its waste management systems on the availability of comparatively low-cost transport fuels. It is planning to investigate the electrification of its collection vehicles to address this problem (ACT Government 2006). It is worth noting that the issue of increasing transport fuel costs has been considered in the Victorian government-funded study of food supply scenarios but does not appear in its waste strategy (Larsen et al. 2011).

It seems unlikely that the ACT will be the only state or territory whose waste collection and management system will be affected by increasing transport fuel costs, and this may be another significant gap in the waste strategies being developed at present. This issue was indirectly raised by an interview respondent when asked about the major costs associated with waste management:

> 'Costs will escalate as landfills become more distant.'

Interestingly, other respondents overlooked transport costs (both in terms of increasing fuel prices, and increasing distances to waste management facilities) when asked the same question. Transport impacts, including emissions, are noted in EPHC (2010a) as an external cost of landfill.

3.11.5 Growing concerns regarding greenhouse gas emissions and organic waste

As mentioned previously, there are growing concerns regarding the gap in discussions of organic waste. The greenhouse gas implications of decomposing organic waste are significant as heat-trapping gases such as methane, carbon dioxide and other gases are released during the decomposition process. The sustainability costs of greenhouse gas emissions from landfills, including the future implications of the carbon tax on the cost of landfills were also highlighted by several interview respondents.

A key objective of the *National Waste Policy* is to enhance biodegradable organic resource recovery and reduce landfill-sourced greenhouse gas emissions (EPHC 2009). Most states and territories are therefore seeking, via their waste strategies, to reduce the contribution of waste management to the greenhouse gases emitted in their jurisdiction and many already have abatement initiatives in place (EPHC 2010a). This was noted by an interview respondent:

> 'Collection of [methane] gas is seen as a benefit – but with the carbon tax it may prove cheaper to flare it. That's a bit of a conflict as some operators don't like that from a moral point of view but from an economic point of view they may have to do that.'

Some states have responded by implementing effective organic waste collection initiatives. For example in South Australia, after a successful pilot of 17,000 households, an increasing number of councils are offering a food waste collection and recycling service (Zero Waste SA 2011). Food waste is collected alongside garden organics in several other areas including Lismore, Camden and Broken Hill (NSW Government 2007). This was noted by an interview respondent, who highlighted the associated challenge of contamination:

> 'Some progressive local governments in other states collect kitchen scraps with green waste. [There is] opportunity there, but huge issues with contamination. There are good choices with technology. [It has] largely been done by anaerobic digestion. [But] these have all failed.'

Composting is another option for management of organics however as one interview respondent noted:

> 'Composting is not recognised under the carbon tax. You don't get any advantages. We were hoping it would get a lift out of the carbon initiative but it hasn't. Now it's convincing farmers of the merits of compost – and the agricultural sector in Australia is running very skinny because of the GFC. Compost has got limitations and it's hard to sell the product.'

The location of organic processing facilities is also a challenge as the locations can be somewhat sparse, for example in NSW most facilities (processing MSW, C&I and C&D waste) are located in the greater Sydney area (EPHC 2010a). Community concerns over odour issues can be an additional challenge, as noted by an interview respondent, who also raised the issue of the reliability of AWTs:

> 'Reliability of AWT is a concern. For example, composting near residential [has] odour issues. They [AWTs] might be shut down then the materials need to go elsewhere, like back to a landfill.'

3.11.6 Achieving waste reduction targets

Most states in Australia have developed targets for waste minimisation of various waste streams (see Table 12). How these targets will be achieved in some states remains unclear,

with limited practical and applied strategies in place to track a path to progress and with most state strategies also remaining in draft form – as noted by an interview respondent:

> 'There is an expectation from the community that government needs to set benchmarks – then struggle to meet them without a roadmap of how to get there.'

Aspirational goals and targets are often mentioned, for example in WA. Zero waste is a long term goal for WA Waste Authority, to be achieved through continuous improvement in technical processes and capabilities, improved waste management systems and community partnerships (WA Waste Authority 2010).

In Queensland, the *Waste Reduction and Recycling Strategy 2010–2020* sets clear targets and outlines the priority program areas for the first four years (DERM 2010). It includes introducing a waste disposal levy as a price signal to change disposal behaviour, enhancing successful existing programs and adopting programs from other states.

The following table provides further details on how each state's waste strategy addresses the question of how it will meet its targets.

In addition there appears to be disagreement within the sector on the pros and cons of zero waste. In the stakeholder workshop some thought it a motivator, while others thought it a distraction:

> 'If you're pitching something that's unachievable it's setting yourself up for failure'.

Whether stakeholders think it is unachievable, or whether there is a recognition that it is unachievable using current infrastructure and policy responses, remains unclear. However, such discussions suggest that policy makers believe the use of targets may not be attainable.

Table 12. Waste strategies addressing state targets

Waste Strategy	Targets addressed
NSW Waste Avoidance and Resource Recovery Strategy	• 'The NSW Government will develop sub-targets for each of the 2014 waste targets to avoid waste generation and increase resource recovery of certain material types' • Barriers and strategies to overcome these for 5 focus areas are put forward with the aim to achieve waste strategy targets.
Victoria Towards Zero Waste Strategy 2005 Victoria Metropolitan Waste and Resource Recovery Strategic Plan 2009	• Strategies and actions for achieving waste targets clearly articulated. • Costs and benefits (environmental and economic) of reaching targets also included.
Queensland Waste Reduction and Recycling Strategy 2010 – 2020	• Key actions to address targets are described at a high level (e.g. sector-wide actions, product stewardship schemes, and state-wide strategies). The actions will be funded by capital raised from the levy over four years.
Waste Strategy for Western Australia (Draft 2) 2010	• 42 strategies are briefly described (2–3 lines each) covering a range of issues including product stewardship, community engagement, market development, recycling and regulation.
Draft South Australia's Waste Strategy 2010 – 2015	• Long-term strategic objectives outlined alongside priorities for action with specific ongoing and new actions described for each target.
Tasmanian Waste and Resource Management Strategy 2009	• Targets yet to be set – 'improved data collection and data management systems will provide a means to measure the progress of initiatives and actions designed to meet the objectives and enable meaningful, achievable and realistic targets to be set. Targets will provide both a goal and a measurement of success and are critical in assessing the success of implementing the Tasmanian Waste and Resource Management Strategy.'
Draft ACT Sustainable Waste Strategy 2010-2025	• Key strategies and actions to address targets are included.

It should be noted that having a well-established and detailed strategy with clear actions and goals is not necessarily a prerequisite to achieving targets. SA provides an example of a state that only developed its first waste strategy in 2005 and despite this, is a world leader in waste management and minimisation and is recognised by UN-HABITAT as global best practice for waste management (UN-HABITAT 2010). As noted in the case study on SA, the high level of performance is seen to rely on a number of factors that are missing in other states and territories.

The national and state approach of developing waste minimisation targets and efforts towards zero waste does not appear to recognise the variable capacities at the local government level. Some local governments have made poor decisions because their limited financial resources and technical capacities have left them unable to adequately review potential AWT options (Collins 2011). An interview respondent pointed out:

> 'All councils [are] looking for alternate investments. AWT is the direction but the issue is cost. Landfill costing is still [the] cheaper option.'

Assessment of the cost-effectiveness of their options is lacking, and as a result some local governments make decisions that result in inefficient waste management.

3.11.7 Implementing appropriate technology

As the push for resource recovery and zero waste gains momentum, so too does the quest for technological solutions as an alternative to disposing of waste to landfill. As noted in section 2.5.3, it is often local governments – who are required to manage MSW – who explore and attempt to proceed with alternative waste treatment technologies (AWTs) as an alternative to waste to landfill. The challenges in implementing appropriate technology are explained by an interview respondent, who notes that contracts for AWTs are sometimes pursued despite unproven suitability which can lead to financial losses:

> '[Regarding technology] – there's a lot on offer, [but] none are proven. There are anaerobic digestion systems that were bought for $100 million, now they are worth $1. This is a concern. There's always industry moving into Australia to sell their technology – sometimes it's awarded.'

The failure of some AWTs was also pointed by another industry sector interview respondent:

> 'Some AWTs in Australia and overseas have failed dismally for councils – they have been and gone and the legacy will be around for a while.'

Another respondent noted:

> 'AWT broadly seems to be solution but the jury is out on what and how effective it is – the complexity of waste streams – processing a diverse range of materials in terms of size, moisture content [is] always different. That level of complexity presents challenges that are hard to get around.'

The challenges alluded to in the latter quote highlight again the difficulties faced by local governments in implementing appropriate technology. This was further explained by Collins (2011) who described local governments' challenge in securing long-term infrastructure, leading to a failure in AWT tenders which has occurred in several locations across NSW. The private sector invests significant amounts of time and money in submitting tenders. An interview respondent from the industry sector quoted a figure of $520,000 as the cost involved in submitting a tender for an AWT facility in Victoria. Ensuring the continuation of private investment in AWTs in the future therefore requires adequate technical and financial capacity to support AWT infrastructure (Collins 2011).

Achieving progress towards zero waste is seen by many as most easily achievable through a waste-to-energy technology approach. This may be due to the perception that this approach would be simpler to manage than the logistics and quality control issues currently associated with composting or promoting waste avoidance. However, several examples of uncertainties associated with waste-to-energy facilities are useful points of reference for assessing the ultimate contribution of this technology. For example, Wright Corporate Strategies report on the status of AWT in Australia (conducted for the ACT government in 2008) notes that the technologies that are proven, in the Australian context, rely on source separation that does not occur in the majority of LGAs, and that:

> 'AWT for recovery of saleable resources from mixed residual waste remains an emerging technology in Australia. Aside from land remediation of degraded sites, the technology is still to be reliably and independently verified to deliver

sustainable and significant reductions in waste to landfill and products that are readily saleable on diverse and robust markets (WCS 2008, pg. 13).'

3.12 Discussion of future developments in waste policy and opportunities

The preceding policy assessment suggests that the future waste policy landscape in Australia is likely to be characterised by significantly less policy fragmentation across state and territory jurisdictions. The newly developed *National Waste Policy* has set several processes that will reduce or eliminate long-standing differences in waste classification and improve the frequency and consistency of data collection. Furthermore, the most recent of state and territory waste strategies already demonstrate an increasing alignment of the policies of state and territories jurisdictions. Interestingly, this new dynamic does not appear to be recognised by respondents in interviews, indicating that policy is not translating into practice. However, this may also be due to the fact that many of the initiatives being undertaken under the *National Waste Policy* to harmonise and align jurisdictions will not be completed until 2014.

To begin the process of examining the current waste policy landscape in order to identify future developments and opportunities, we have returned to the situational analysis used in the companion report on sustainability costs for waste management and mitigation. As this earlier exploration noted, the future of waste and materials management cannot ignore the constraints of the present, or the weight of past practices. In order to understand what is required to progress towards a desired future (defined as pulls or aspirations), the inertia of existing assumptions and investments in particular systems of waste disposal and diversion (weights of the past), and factors that demand a response, such as rising costs for steadily increasing waste generation (future pushes) must be identified and analysed (Inayatullah 1998). Some of the pushes (forces acting on the system) include the rising costs of landfills, changing transport costs and the limits to existing landfill capacity. Some of the future pulls (aspirations or things we may wish to change) include the need to minimise or eliminate methane gas release and the importance of effective institutional arrangements.

In relation to the policy landscape in particular, some additional aspirations might be the recognition of effective institutional arrangements in best practice and the need for high levels of inclusivity with respect to users and providers of waste services (as described in the earlier South Australian case study). The use of financial incentives to modify behaviour is another pull – for example waste levies used to encourage innovation in waste avoidance (as in SA and VIC). This highlights the wide range of waste-related issues that emerge as the full costs and impacts of existing practices and technologies are better understood.

This analysis indicates that the future will hold a significant challenge to local governments, as it is this level of government that is most exposed to the pushes and weights outlined here. Many will also continue to bear the financial and economic weight of national and state government pulls or aspirations. The extent to which local government can rise to these challenges may be determined by the leadership and support of national and state

governments in assessing the ultimate value of increasingly technical (and expensive) waste management and mitigation solutions.

The increasing focus on international commitments that limit the transport of hazardous waste can be seen in the National Environment Protection Measure (NEPM) covering the transport of controlled waste between Australian states and territories, and in the objectives of the National Waste Policy (EPHC 2010a). Additionally, the introduction of EPR and PS legislation will initially target televisions and computers (EPHC 2010a). Growth in consumption and disposal of these types of goods have created global concerns about the toxicity of some components (including lead, arsenic, copper and mercury) contained in these items (Zhao et al. 2009; Lim & Schoenung 2010). There is also interest in finding ways to recover and re-use more valuable elements such as coltan (columbo-tantanite) and gold from mobile phones, and europium and terbium from LCD and plasma televisions (DTI 2005; Chancerel et al. 2009).

Given the contemporary examples of countries such as Japan, initiatives to reduce hazardous waste and increase the recovery of high-value metals from the e-waste or waste electric and electronic equipment stream of wastes are likely to be expanded to other products and waste streams as institutional and organisational capacity is developed. Interestingly, the *National Waste Policy 2010* notes that SA is proposing to use its extensive network of container collection depots in new initiatives to increase the collection of other recyclables, such as electronic wastes (EPHC 2010a). If pursued, this initiative will be the reverse of the trend established in other countries where e-waste is the initiation point for EPR programs that is then extended to other consumables.

The following sections explore the likely impact of these dynamics upon the future development of waste management infrastructure, planning frameworks and opportunities for innovation.

3.12.1 Impact on future development of waste management infrastructure

Increased consideration of the social, environmental and economic impacts of waste disposal (including disposal to landfill), and a growing interest in technologies that provide alternatives to waste disposal, indicate that avoidance and reduction of waste are likely to remain preferred approaches to the problem of waste. Indeed many of the environmental, social and economic aspects of this understanding are described in some detail in national, state and territory waste reporting and strategies.

State and territory waste strategies confirm that waste is increasingly being seen as a resource – it contains minerals and elements that are finite and useful for production – and resource recovery presents significant prospects for long-term employment. Resource efficiency or closed loop approaches are used in countries such as Japan, Germany, and Sweden to reduce environmental impacts from end-of-life consumer goods and reduce costs for inputs to production through recycling of old products. Although efforts to introduce similar types of resource efficiency have been introduced in Australia, expansion to items such as computers and televisions through the introduction of EPR and PS will require partnerships with manufacturers to achieve the same impacts.

Another example of closed loop thinking can be seen in policy responses to the increasing costs of imported agricultural inputs and the need to divert organic wastes from landfill as a means of reducing greenhouse gas emissions. It has been suggested that landfills remain an appropriate long-term option for waste management, based both on cost, the potential for improved landfill design and operation, and the potential for future mining of landfill sites for commodities (Barrett & Lawlor 1997).

With such a range of different processes and technological solutions, some of which are prospective rather than proven, it is clear that a robust approach to reconciling objectives (i.e. zero waste and waste avoidance or waste reduction) and costs is required to assess the appropriateness the different options. One example of such an approach, IRP, used in future planning for water and energy, is provided in the following section.

3.12.2 Integrated resource planning: A new waste management framework?

Various waste policy instruments in Australia are now tending towards a focus on waste minimisation and re-use, following community values and behaviours, and international trends (EPHC 2010a). Increasing alignment in state and territory waste strategies indicates that policy and regulatory fragmentation will be reduced, but differences in historical, social and geospatial contexts of communities across Australia will continue to present a challenge to assumptions that a one size fits all approach will achieve reliable results in all areas.

The existing waste policy landscape may be seen as a reflection of weights from the past (e.g. existing physical and institutional infrastructure) and pushes – important factors that cannot be avoided, and must be responded to, such as the increasing costs of disposal to landfill or the potential impacts of climate change. In addition, aspirations or visions for the future are also reflected in waste policy and they indicate a path to a desired future.

Although there is now agreement between federal, state and territory jurisdictions that waste avoidance and the waste hierarchy are to be the guiding principles of waste management and mitigation, there is little in existing waste strategies to provide material support for the goals of zero waste and waste avoidance. An exception is the federal EPR and PS legislation, which may begin to address the neglected relationship between high levels of production, consumption and disposal.

The case studies outlined here provide an indication of the circumstances under which waste recovery and waste diversion efforts can achieve the stated aims of policy makers and where they may not. Analysis of policy documents and stakeholder interviews has provided insights into the gaps and disconnections that remain, allowing us to identify what viable policy might address. From this analysis it can be seen that an effective policy for avoiding waste will incorporate strategies that intervene at points across the entire production, consumption and disposal cycle. It will engage meaningfully with key stakeholders and recognise the full costs and benefits of waste management.

The workshop commentary suggests that what is currently missing is a framework to negotiate the conflict of values, interests, historical investments, and assumptions about the future. Notwithstanding important concerns raised by participants, when used alongside

other mechanisms, the IRP tool was believed to hold promise through its inclusion of a time dimension to decision making and potential application to embrace waste avoidance and consumption before it becomes waste – i.e. incorporating supply and demand in the same context. It was seen to offer benefits as a decision-making framework beyond currently available frameworks, as it attempts to go beyond existing cost benefit tools.

The response of the participants at the workshop to the idea of IRP indicated that what may be missing is a process that can bring together all of those with a role in managing waste (including those that are largely the subject of waste management at present – i.e. the public) and information on a wide range of options, for a discussion of how the objectives and needs of the different participants can be met.

IRP aims to determine a range of options that meet the objectives of all stakeholders, and develops a prioritised strategy for implementation that focuses on lowest cost opportunities as the foundation for long-term goals. The use of this framework in areas of water and energy has revealed solutions that address a broader group of objectives and aspirations. For example, water planners across Australia are being supported to use an IRP framework to model demand forecasting and different supply and demand options to ensure long term water security, at least cost, across a variety of planning areas. The National Water Commission's IRP for urban water project provides tools for applying this methodology for water, and these tools support the balanced consideration of overarching objectives and the full costs for a range of different options (ISF 2011).

Workshop participants expressed interest in the opportunities offered by IRP to consider inputs and outputs as part of the same process; identify objectives that meet multiple criteria from a range of different stakeholder groups; identify and compare options (or combinations of options) to meet these objectives; incorporate information and test assumptions about changes to circumstances over time.

IRP could prove useful in formulating a prioritised approach to tackling waste targets and accounting for local costs and drivers that have been observed as significant in waste management decision-making. The IRP framework could also enable a robust economic comparison of policy options for waste mitigation, taking into account issues surrounding sustainability.

3.12.3 Opportunities

Addressing fragmentation is likely to require adaptable waste management and mitigation options for a range of different climatic conditions and human settlement patterns. There is an opportunity to develop specific and appropriate systems that can be used elsewhere.

Challenges associated with the diverse and varied physical and social landscapes may be overcome by considering the lessons of several relevant national and international examples. For instance, Australian communities with close access to resource recovery facilities and direct exposure to (at least part of) the costs at the site of disposal/recovery, appear to be more closely engaged with resource recovery efforts. This supports the conclusion drawn by the British Trade Commission regarding the success of Japan's system

of appliance recycling – that the ability of consumers to drop off their end-of-life equipment at the nearest post office overcame many of the logistical barriers experienced in other systems and in other countries (DTI 2005).

The ability to introduce waste reduction measures into the manufacturing process, through design for disassembly for example, provides a way to reconnect production and consumption. This would involve providing clear information about whether the components were suitable for re-use, or for processing and recycling as components in new products (printed or embossed on the components). There may also be an opportunity to put more effort into improving the relationship between organic waste and the agricultural production cycle – increased use of organic wastes as soil enhancers will improve soil quality and reduce dependence on imported materials. The ACT has been very successful in avoiding waste to landfill through its diversion of 200,000 tonnes (per annum) of garden green waste to locally-based commercial composting.

Further opportunity comes from recognising the high value of minerals and elements that are useful for new production. This is mirrored in the trend towards resource recovery, which we see emerging in the recent language of waste policy and strategy.

Community engagement through both extended informal and formal education on the broader issues associated with waste and resources would provide the foundations for greater involvement in decision-making.

Addressing the disconnect of responsibility between Commonwealth, state and local jurisdictions provides an opportunity to improve awareness and performance by ensuring that waste management and mitigation measures are developed with an explicit focus on shared responsibility. Frequent communication of the roles that each must play to achieve the goals would also be a key component to meeting this challenge.

Reductions in the organics waste stream will reduce the weight of waste collected and assist in reducing the amount of fuel used, thereby providing an opportunity to address the challenge of increasing transport costs. The ACT is also investigating the use of electric vehicles for waste collection to minimise these costs. It is estimated that in ACT, SA, and VIC, between 45% and 52% of the existing waste stream is organic waste.

As noted above significant progress towards reducing GHG emissions can be achieved by making better use of organic materials in the general waste stream. Reducing the amount of this material in landfill will reduce GHG production from any new landfills, and improve the terms for recovering recyclables from mixed collection systems.

Seadon (2010) has criticised target setting as part of a command and control approach, which may be less useful than focusing on the capacity of agencies to undertake the work, or a systems approach to understanding how and why tasks are carried out – an approach used by government agencies. One opportunity is to reflect on the degree to which targets and actions are aligned, and whether targets are being set irrespective of considerations of capacity. While having aspirational targets in the hope that they will drive action is potentially a useful tool, as noted by the draft *SA Waste Strategy*, for most states and territories this has not achieved the same level of performance. For this reason the value of a continuous improvement approach should be weighed up against the possibility that the targets

themselves are being used as a sign of progress, with states competing to have the most ambitious targets rather than making comparisons on the basis of recent achievements in waste reduction.

It seems likely that the harmonisation taking place currently through the *National Waste Policy* will do little to resolve the variability of the physical and social factors that provide the context for waste management and mitigation in Australia. What does this say about the assumption that a uniform approach to technology in different areas will be a silver bullet for addressing the problem of the increasing generation of waste? Could a more grounded assessment of the geospatial issues deliver more nuanced criteria for new waste technologies? As noted above, this may be an opportunity for Australia to develop appropriate technologies for other countries with similar patterns of climate and human settlement.

Finally, there is an opportunity to more consistently integrate the objectives, costs and preferences of the community in the selection of waste management and mitigation options for achieving objectives. As demonstrated by its application in planning for energy and water, IRP may be an appropriate framework to support the development of locally appropriate options (Fane et al. 2011). These will be options that remain sensitive to the geospatial differences between jurisdictions while seeking the lowest cost to society of managing or mitigating waste.

3.13 Conclusions

The move towards adopting zero waste and waste avoidance frameworks, supported at the federal level by the *National Waste Policy*, has revealed various (and sometimes unexpected) costs and benefits for changes to historical waste management and mitigation. Although some states have applied formal cost-benefit analysis to initiatives to achieve zero waste (e.g. the ACT, VIC and SA), local governments across Australia have provided illustrations of several gaps in understanding of the full implications of a zero waste approach.

Such analysis is likely to reveal high costs to local government, as it is local government that shoulders most of the burden of waste management and mitigation. The case study of the ACT is instructive, as costs and benefits improve with higher targets. However, upfront capital is still required.

With the introduction of the *National Waste Policy*, waste management and mitigation in Australia is approaching a crossroads. When completed, the findings of seven working groups, formed as part of the *National Waste Policy Implementation Plan*, are intended to reduce the regulatory differences between jurisdictions. Existing state and territory waste strategies, many of which are drafts, remain in a holding pattern in anticipation of developments. However at the level of daily operations, local government must continue to dispose or recover materials discarded by members of the public, businesses, government, and non-government organisations.

International examples of EPR and PS indicate that once systems and processes for a limited number of goods are developed and implemented, it is easier to apply them to a wider range of goods. In this sense, the new EPR and PS legislation may begin to address what we have seen as an important absence in the Australia waste policy landscape – a connection between production, consumption and disposal.

Despite these recent and ongoing developments, key factors that have supported historical systems of waste management and mitigation in Australian states and territories are likely to remain a source of fragmentation, as many relate to the different geography, climatic conditions, and patterns of human settlement that characterise these jurisdictions. These differences have implications for the financial and economic costs associated with waste management and mitigation in these jurisdictions, making the goal of a standard environment for waste disposal and resource recovery a more complex proposition. While several commentators have pointed to the harmonisation of different regulations as being the silver bullet to allowing more cost effective waste management, it seems unlikely that a one size fits all approach to addressing waste in different jurisdictions will meet the health and safety needs of communities, the budgetary limits of local government, or the profitability thresholds for companies that increasingly provide waste management services.

This review of existing waste policy in Australia provides support for a more integrated approach to avoiding waste by taking action at a wider number of points in the cycle of production, consumption and disposal. It also argues that the prominence of economic and financial considerations – for those involved in the day-to-day management of waste – is not well represented in the objectives and target-setting of state government-level policy making. As the costs and impacts for all forms of waste disposal and mitigation become better understood, the costs and objectives of waste policy will need to be better integrated. This is particularly pressing if the high-level goal of waste avoidance continues to be a priority.

4. Integrated resource planning for waste

Australian cities and towns face significant challenges to mitigate and manage growing waste production from an increasing, ever-consuming populace. Each year Australians generate approximately 44 million tonnes of waste, about half of which is deposited into licensed landfills. It is well documented that this waste causes environmental damage and increases costs for businesses, consumers and government (EPHC 2010a). To tackle these challenges, the waste industry – together with stakeholders across the production consumption chain – must adopt new supply and demand strategies to reduce waste generation, improve waste management, and protect our environment. All this needs to be done in a transparent and cost-effective manner, rather than the typical focus of managing the problem at the end of the production and consumption chain (Figure 4).

IRP is discussed as a decision-making framework to support strategic decision-making by waste planners, policy makers and industry to begin meeting the challenges of sustainable waste mitigation and management. It involves forecasting long-term demand (in this case the production of waste, by type and sector), quantifying the effect of changed technologies and behaviours on waste management and mitigation options over time, and assessing the waste savings and cost-effectiveness of a range of new management and avoidance options. Thus, it allows a range of diverse options for managing and mitigating waste streams to be assessed and compared in a systematic, but context-specific way. Central to the framework is its ability to engage with stakeholders representing the complexity of the sector in setting an objective for the system and criteria for assessment of options and trade-offs. The approach has been successfully applied in the water and energy planning sectors, and offers significant potential for waste. A worked example for an urban centre is developed and the section concludes by exploring the merits and challenges of a wider application of the methodology to the waste sector.

Historically, waste management in Australia and internationally has been dominated by the collection and disposal of unwanted material in an attempt to manage health and immediate, local environmental concerns (WMAA 2008; EPHC 2010a). Examples of the simple, small-scale technologies and approaches used include local landfills or disposal out at sea (as was the case for the Sydney area from the late 19th century until 1932) (WMAA 2008; EPHC 2010a). Recently, alternative waste management approaches have been attempted, including energy from waste and kerbside recycling schemes, with varying degrees of success in Australia. However, in the past few decades there has been an increased awareness of some of the social and environmental challenges associated with the creation, handling, reuse and disposal of waste and waste management has become more complex.

The era of cheap landfill is over and future investments are higher cost and higher risk. Furthermore, today's waste management and mitigation drivers cover issues outside public health and sanitation, including environmental concerns, property values of the surrounding areas, as well as many other tangible and intangible costs and focusing on waste avoidance at source, rather than at the end of the post-consumption system. These new drivers have sharpened the need for new approaches to waste planning and management with a more

ambitious objective. As Seadon (2010, pg. 3) writes regarding waste management in New Zealand:

'Waste in New Zealand is not the problem. New Zealand has the capacity to contain solid waste in landfills that capture leachate and methane emissions. Waste water can be treated to almost drinking water quality and the harmful nature of air emissions can be mitigated through the application of technologies like scrubbers and precipitators. Waste is actually only an indicator of the real problem – the inefficient use of resources and the unsustainable manner in which New Zealand uses resources.'

4.1 Beyond the waste hierarchy

4.1.1 Wastes are not only solid

Despite the widespread adoption of a waste hierarchy that promotes reduction, recycling and reuse above disposal, managing and mitigating waste remains complex at several levels. Part of this complexity relates to the system boundary that has been used as the foundation for managing and mitigating waste.

In Australia, waste systems are often explicitly limited to the solid waste stream, with little or no reference to wastes that are emitted as dusts or vapours to the air, or to wastes disposed of through the sewers and stormwater systems. It is important to keep the focus on waste as broad as possible to avoid problem shifting between solid to air or liquid. Figure 9 shows the distinctions that have been drawn within the solid waste category as part of management and mitigation strategies.

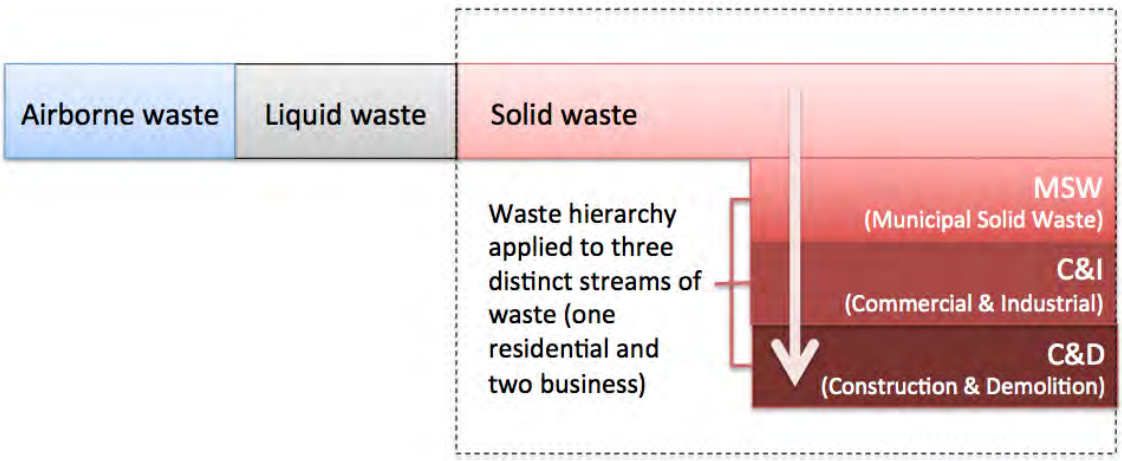

Figure 9. Present focus of waste management and mitigation across three media (air, aqueous, solid)

The concept of the waste hierarchy has been useful to structure discussions regarding the magnitude and variety of impacts that waste can have on human settlements and the environment. However, the application of the waste hierarchy to only one of three main

waste media (solid, aqueous, air), has allowed the problems of solid waste to be transferred without much recognition of the problems that are transferred in the process, such as through trade waste (to water) or incineration (to air). Figure 10 illustrates the transfer of environmental or social problems of solid waste into the two media that are not currently the focus of solid waste management and mitigation systems. An improved process for waste management and planning must avoid problem shifting and be able to reconcile trade-offs between options.

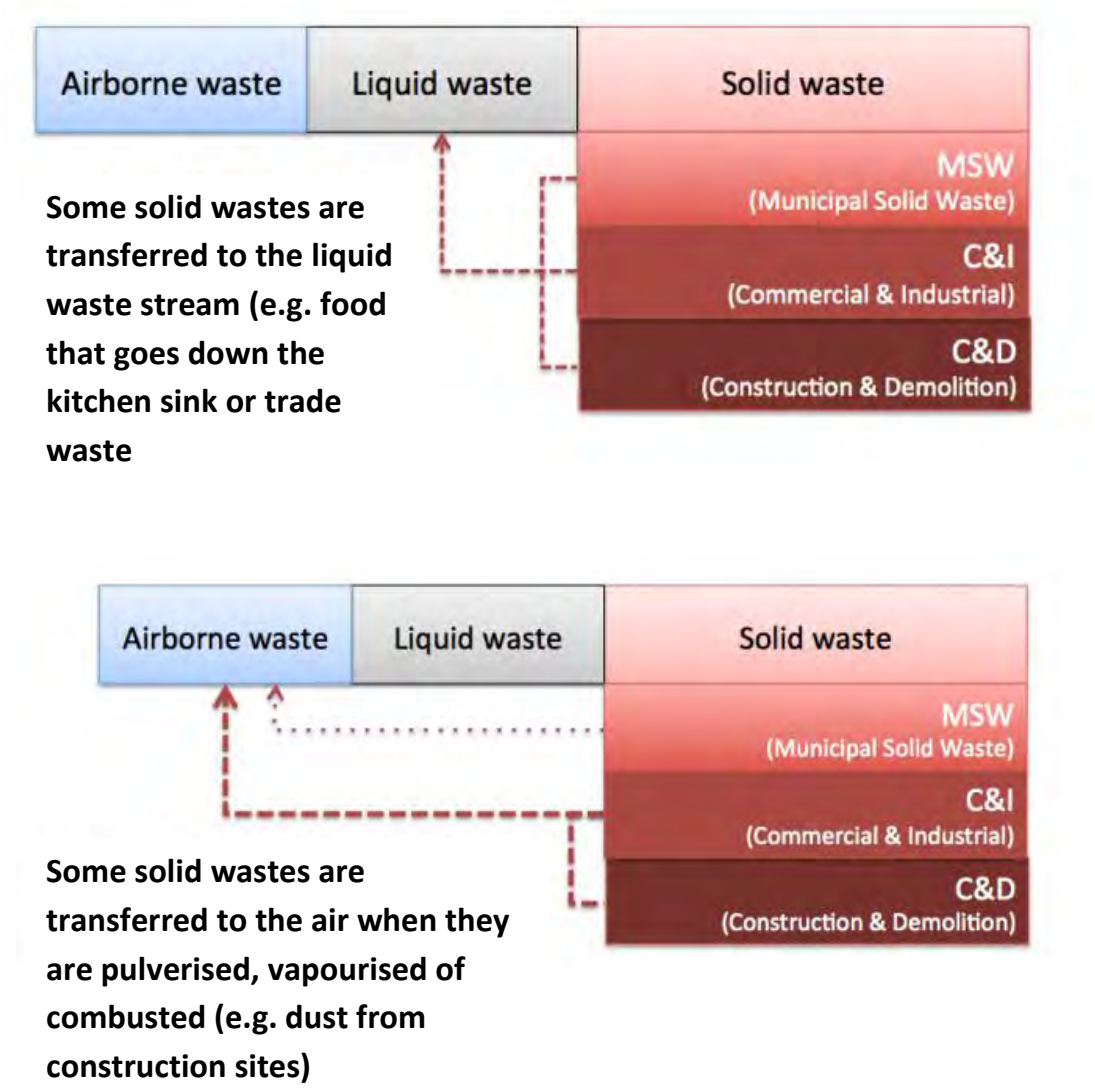

Figure 10. Transference of solid waste to water and air mediums.

4.1.2 Limitations of hierarchy – lacks stakeholder perspectives and context specific rankings

In Australia, the waste hierarchy is now a standard element of state and territory waste strategies. There are variations where the original configuration of reduce, reuse, and recycle has been expanded to include ideas of avoidance, treatment, and recovery.

Figure 11 outlines the waste hierarchy as it is used in several Australian states and territories.

The simplicity of the waste hierarchy has popularised its application in communicating with the public:

- the merits of recycling instead of landfilling, and to a lesser extent, and
- the merits of avoiding or reducing above disposal.

As a tool for making decisions regarding waste planning, the waste hierarchy seeks to create a more systematic approach to decision-making. Expanding the number of approaches between each end of the spectrum provides some flexibility. However, three significant problems remain:

- implementing individual options for waste management relies on a favourable cost-benefit analysis which assumes cheapest is best and does not always take account of the total costs of waste generation and management (lack of a system perspective and benefits all monetised)
- the default hierarchy puts insufficient focus on the objective of the waste management system and how this can differ between contexts which does not lead to best practice (one size fits all), and
- it provides a poor basis on which to engage stakeholders views in decision making (limits trust and transparency).

Contrasting the approaches taken by QLD and SA, the inclusion of avoidance by SA makes a substantial difference to the initiatives that are considered. Furthermore, there is considerable disagreement about the meaning and practical application of the idea of avoidance or reduction of waste at the source. For example, in a study of the state of alternative waste treatment technologies provided to the ACT government as part of its review of waste strategies and targets, clear differences are seen in the interests of the groups in terms of negotiations around deploying a new technology or approach to waste management (WCS 2008).

Waste Hierarchy as it appears in the ACT Draft Waste Strategy 2010–2025 (ACT Government 2010, pg.7)

Waste Hierarchy as it appears in Queensland's Waste Reduction and Recycling Strategy 2010–2020 DERM 2010, pgs15 & 24)

Waste Hierarchy as it appears in South Australia's Waste Strategy 2010-2015 (Zero Waste SA 2010, pg. 14)

Figure 11. Waste hierarchy approach across three states/territories in Australia.

While there are some areas of overlap, in broadly defined areas such as cost, risk and performance, a more detailed evaluation of focus for each group illustrates the potential for conflicts of interest and misunderstanding across multiple objectives.

When the concerns of members of the public are incorporated into such negotiations, there are a larger range of considerations that must be evaluated when making a decision about different approaches to waste management and mitigation. For example, where a policy developer is focused on broad cost and environmental effectiveness, a household is focused

on ensuring that disease-causing, odour-producing and pest-attracting aspects of routine food-preparation are minimised to the greatest extent possible through regular removal from neighbourhoods. Individuals within communities have different priorities for how costly, how regular, and how thorough this process should be.

In summary, the complexity of the waste management landscape highlights the need for a more nuanced approach beyond cost-benefit analysis and the waste management hierarchy for decision making which is systematic and can reconcile multiple stakeholder perspectives.

4.1.3 From waste hierarchy to strategic sustainable development

The broad adoption of the waste hierarchy provided a much-needed level of organisation and direction to waste planning but has over-simplified the problem and does not provide a sufficient basis for meeting future waste planning needs. It has not resolved the uncertainties or conflicts that arise from different interests and investments in the discussion. Nor has it been able to assist in addressing issues such as avoiding problem shifting and technical lock in – where the use of a particular solution is so costly that it constrains change to more effective solutions in the future – or the transference of waste-related environmental or social impacts from one geographical area to another.

The strategic sustainable development or SSD approach has been developed to assist in managing complex interactions between industrial processes and ensure they are aligned toward sustainability (Robert et al. 2002). More recently, Seadon (2010) has applied and evaluated this approach to waste in New Zealand's dairy industry and concluded that while a waste management hierarchy is a useful and systematic form of guidance, it is limited in incorporating context and combinations of options, and is one of several tools required for a holistic approach to waste management.

SSD explicitly identifies five levels of focus. Consideration of each level promotes decisions where actions are consistent with objectives. The five levels are:

1. understanding of the context or bounding parameters in which decisions are being made
2. identifying desirable objectives (e.g. sustainability, noting value-laden aspects in objectives) that the decisions must reflect given the understanding of context outlined in step 1
3. the processes and tools that are useful for achieving success given the context and values/objectives outlined in steps 1 and 2
4. the concrete actions that can be taken to meet objectives, and
5. the methods appropriate for understanding how effective these actions have been in aligning actions with values, objectives and context.

SSD gives authority to the first, second and third steps to stand as guidance to the fourth and fifth steps of the decision-making process.

Table 13 proposes process oriented questions which arise for each of the five levels of SSD and adds comments on the focus they have received to date in waste planning in Australia.

Table 13. Current progress against strategic sustainable development (after Robert et al 2002; Seadon 2010).

Strategic sustainable development	Process oriented questions	Progress in waste to date
1. Principles for the constitution of the system.	What is the nature of the system?	Largely ignored, main focus is on solid waste (not water liquid), role of material cycling in sustainable cities is poorly understood.
2. Principles for a favourable outcome of planning within the system; principles for sustainability as the desired outcome.	What is desirable/ sustainable?	Implicit commitment to what is desirable as represented in waste hierarchy and National Waste Policy. Conflict between product-based growth economy and desire to reduce waste.
3. Principles for the process to reach the above outcome sustainability	What processes can we use?	Cost benefit analysis dominates. Waste hierarchy as a guide for decision making is insufficient – this is where IRP could assist.
4. Actions and concrete measures.	What actions will we take?	Actions and concrete measures for waste management have been taken with limited consideration of steps 1,2 and 3, leaving actions as end-of-pipe and not well directed to progressing sustainability. The increased production of waste has not been matched by an increased ability to manage it.
5. Tools and metrics to monitor and audit.	How will we measure progress?	There has been a limited commitment to measuring and monitoring; available data is inconsistent and inaccessible across jurisdictions which inhibits good planning.

By contrast, Table 14 presents process oriented questions which arise using the waste hierarchy and cost-benefit analysis. The waste hierarchy acts as a filter that successively asks specific questions about materials and the processes that might exist to divert them from disposal as a waste – proceeding in a singular direction from avoidance to disposal. For cost-benefit analysis, the worth of any option becomes assured when benefits outweigh costs, however, difficulties in quantifying costs leave this approach open to undervaluing important externalities. In SSD, a useful degree of robustness is introduced as the decisions made in the first step remain relevant to decisions that are made at each following stage, and can be referred to in the event of a conflict or trade-off arising.

Table 14. Process oriented questions prompted by waste hierarchy and cost benefit analysis (waste hierarchy based on EPHC 2010a)

Waste hierarchy	Process oriented questions
Avoid Reduce Reuse Recycle Dispose	What can we avoid? What can we reduce? What can we reuse? What can we recycle? What is left to dispose of?
Cost-benefit analysis	Process oriented questions
Between options in a sector	What is the net benefit or cost of a waste option (on its own)?

As can be seen in this comparison, use of the five levels of SSD aimed to introduce greater levels of consistency in decision-making through a systematic identification of the nature of the problem, the desired outcomes, acceptable process/es, appropriate actions and concrete measures, and finally tools and metrics to monitor and audit progress. In short, the questions are more strategic than those asked via the waste hierarchy and for cost-benefit analysis. Implicitly, they also deal with longer time horizons which are important for sustainability.

The need to consider a wide range of concerns, media, impacts, stakeholders, and circumstances calls for a flexible decision-making approach, that allows a wide range of options, and combinations of options to be considered. IRP has been used for this task in water and energy planning and its application to the waste sector is explored in the next section.

4.2 Overview of integrated resource planning

Few waste management/mitigation frameworks provide an overall high-level integrative decision-making framework. The IRP framework methodology proposed here will allow for both resource recovery and waste avoidance options to be assessed in the same framework. The process is iterative and adaptive with the ability for significant stakeholder engagement during the process as outlined in Figure 12.

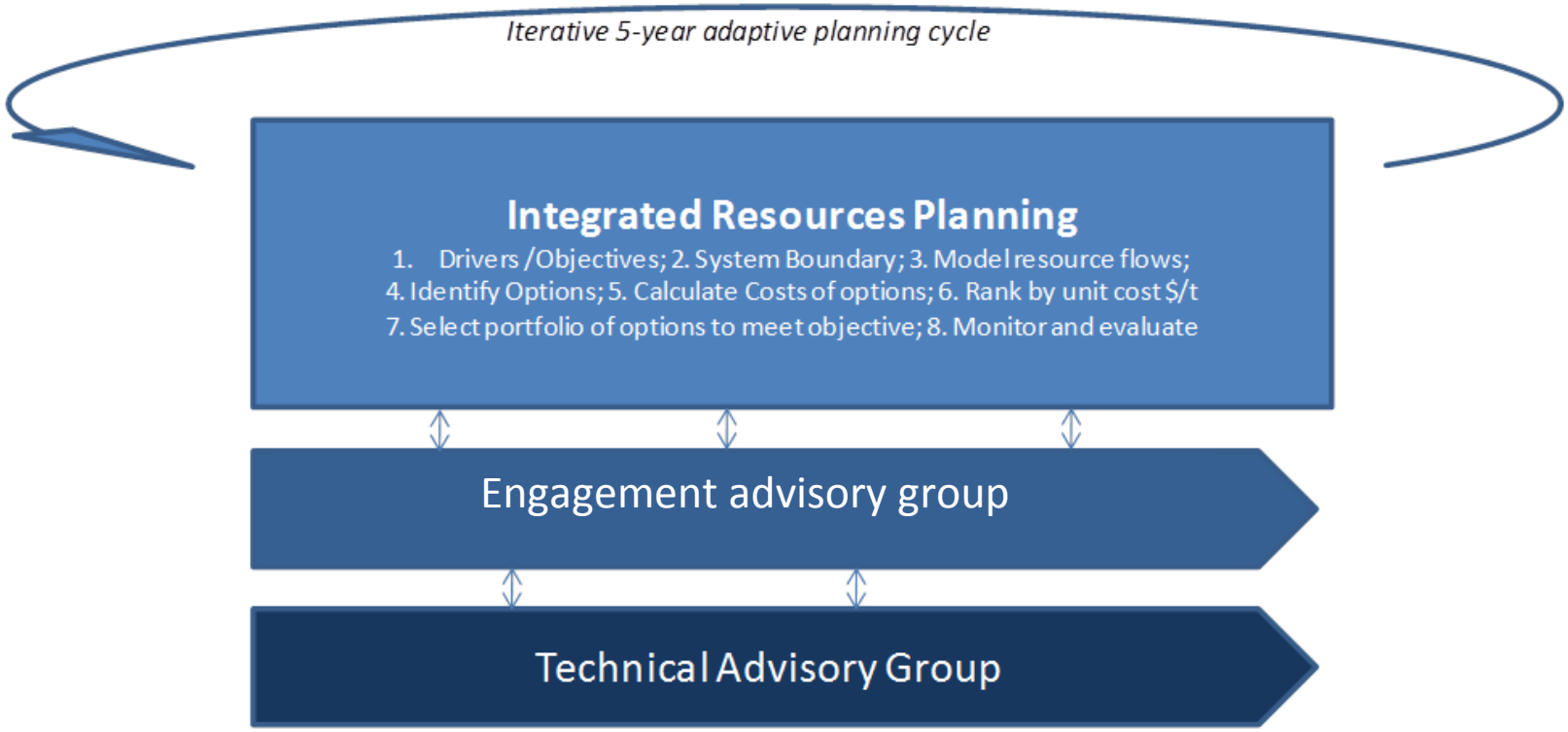

Figure 12. Adaptive planning cycle of integrated resource planning with stakeholder/technical input.

4.2.1 Objectives and proposed approach for public participation

A key component of IRP is the structured approach to stakeholder engagement and deliberation at stages throughout the process (Table 15).

4.2.1.1. Objectives

Carson and Hartz-Karp (2005) describe the requirement for open dialogue, access to information, respect, space to understand and reframe issues, and movement toward consensus in deliberations. Inclusion is also a critical element of deliberation, as a variety of perspectives, backgrounds and levels of influence enrich the discussion and validate the outcomes (NCDD 2009). Inclusion is often approached through random selection of participants, with a focus on recruiting a demographically diverse group of citizens or having a broad range of views represented. The key principles which the engagement program seeks to embody should be identified in the planning phase.

4.2.1.2. Who might be engaged and when?

Public participation can be targeted at stakeholder groups, ordinary citizens and a combination of the two. Stakeholder groups might include organised interest groups, resident groups and representatives from particular levels of government or sectors of industry. All of these are important to consider in any public participation process accompanying an IRP approach.

Citizens, householders and the general public may also be targeted – through for example advertisements in the newspaper inviting a submission on a draft plan, or inviting attendance at a public meeting. Some of these approaches tend to attract only people with a strong existing view, and may tend towards excluding people from certain cultural, or socio-economic groups. The design of these processes can sometimes become highly adversarial and be less well suited to considered discussion of various options and viewpoints. In repose to this observation, more deliberative approaches are often proposed as a way to gain insights from a diverse and demographically (if not statistically) representative group of citizens, and to achieve citizen inputs in top more complex decision making situations, such as deliberative valuation.

Engagement may follow the IRP process and play a key role at certain stages. For example, at the beginning of the IRP process (step 1, Figure 12) engagement may be focused on identification of drivers and objectives. The community and stakeholders can also be involved here in defining the metrics by which options generated later in the process will be evaluated (i.e. what combination of economic, social, environmental, technical criteria will be used and how will trade-offs be managed). The community and stakeholders would also be central to the generation and evaluation of options and step 6 describes two processes for option evaluation. Such is the flexible yet structured nature of IRP that parts of the process can be adapted to suit the local context.

4.2.1.3. A proposed approach for planning participation

A useful structure relating to IRP is to establish an Engagement advisory group and a Technical advisory group. The role of the Engagement advisory group is to plan the process of community and stakeholder engagement. This group might include invited community engagement researchers and practitioners, as well as representatives from associations who have an interest in seeing effective community engagement take place (for example community service or equity groups, and associations such as the International Association of Public Participation). This group would help establish the objectives and indicators of successful engagement, identify stakeholders and assist in design of specific processes to be used for engagement.

In parallel, the Technical advisory group would bring together knowledge regarding the technical issues associated with waste management context and options. Inputs from the Technical advisory group would be fed into the community engagement process – for example by identifying key facts and background reading that was important for citizens in their deliberations.

Table 15. Key steps in integrated resource planning for waste

Step	Comment
1. Identify key drivers and objectives	What are the key local and global pressures and how are they changing? e.g. transport distances to landfill, landfills reaching capacity and product stewardship. Together with stakeholders, define key objectives (e.g. reduce generation of waste, minimise waste to landfill) and appropriate metric for measuring progress towards the goal.
2. Define system boundary	System boundary should be defined in terms of space, e.g. city, region, LGA, time for planning horizon (e.g. 20 years, 50 years) and production consumption chain. This should take into account the whole production and consumption system to ensure waste avoidance and management are both included. Flows to air and water in addition to solid waste could also be considered in the system boundary definition.
3. Analyse size and nature of current and future waste and material flows through the system	This should include both pre- and post-consumption waste and materials, and include quantities between and within different sectors. This provides the baseline requirement in the absence of any mitigation or management options. Rates of waste generation can be modelled to change over time.
4. Identify potential waste management/ avoidance measures and their capacity	E.g. specific resource recovery, avoidance, AWT technologies and initiatives suitable to meet the strategy objectives identified in 1. Importantly, IRP considers waste avoidance and disposal options simultaneously. Identify possible policy instruments (economic, communicative, structural or regulatory instruments) that could be used to implement these measures, noting that savings could differ for voluntary or regulatory options.
5. Estimate option costs	Option costs should be calculated for each option across the whole life cycle and including real and avoided; economic, environmental and social costs; costs to all stakeholders; and present and future costs. Stakeholder deliberation can be used to decide which costs are monetised and which criteria remain to be assessed qualitatively.
6. Determine unit cost for each option	Unit costs ($/tonne) enable the cost effectiveness of each option to be assessed and ranked by developing supply curves developed from lowest to highest unit cost. The cost curve is used as input to a deliberative process regarding option selection.
7. Select portfolio of options to meet objective	The deliberative option selection can be run in several ways: deliberation on options which should be ruled out based on environmental and social criteria then remaining options are selected based on least economic cost (White et al 2008). Or, all options are assessed on sustainability criteria and this is an input to a multi-criteria analysis for final option selection which could involve greater or fewer stakeholders and citizens. When selecting a portfolio of options, care should be taken to avoid double counting between mutually exclusive options (i.e. waste-pyrolysis; waste-gasification is either/or, not both as they would use a similar waste stream).
8. Develop implementation monitoring and evaluation plan	A plan for option implementation as part of an adaptive management strategy should then be developed and include monitoring and evaluation to ensure data is collected on whether individual options as implemented have performed as planned and whether the portfolio of options is sufficient for progress towards meeting targets in a changing context. The iterative nature of IRP should ensure the process is undertaken every five years.

Table 16. Application of integrated resource planning across sectors

	Energy	Electricity	Water	Transport	Waste
Unit of focus	Energy (electric, gas, renewable)	Electricity only (kWh)	Potable water (ML)	No of trips, Vehicle Kilometres Travelled	Tonnes waste (or tonnes to landfill)
Challenges	System boundary (all energy needs for a city or just some)	Simplest	Recycled water demand, fit for purpose water	The number of trips to supply service to a city is unclear – how many trips should be allocated in a resource efficient city	Waste types, waste per person in a resource efficient city is unclear
Strengths		Electricity utilities (one company) can often deal with supply and customer demand	Water utilities (one company) can often deal with supply and customer demand, thus cost savings from demand management can offset supply augmentation		Diverse players along supply chain from product designers and builders to waste recyclers and landfill operators – incentives not aligned
Example	New Hampshire, USA requires electrical utilities to file a biannual *Least cost integrated resource plan* (Scholer et al 2008)	(NAPP-Utilities 2010)	Drought response planning, Sydney Australia (White et al 2000; White et al 2008; Turner et al 2010)	Reframing urban transport decision making (White & Brennan 2010)	
Dominant Stakeholders	Government, utilities	Utility	Utility, customers, water appliance manufacturers, government	Transport operator, users, government	Local government, federal and state, government, businesses, householders, waste service providers, waste transporters, product manufacturers

4.2.1 Considerations from application of IRP to energy, water, transport

This section explores the application of IRP across various sectors. Table 16 illustrates the usefulness of IRP as a robust approach with a well-developed history of application. In fact, IRP can be traced back to the work on future energy planning of Lovins (1976) looking at new supply and energy efficiency to meet demand. Additionally it highlights the challenge of a diverse range of stakeholders present in the waste sector compared, for example, to electricity and water where often one utility controls supply all the way to customer sales.

4.2.1.1. Application of IRP in the energy sector

Similar to the water sector, traditional planning for energy has focused on increasing supply – utility planners would project future demand and select from the options of increasing supply to meet their projections. As for water, the energy sector is beset by numerous challenges associated with increasing supply and maintaining transmission and distribution networks as demand for energy increases (D'Sa 2011). In some cases, the projected costs of increasing supply are greater than what utilities and jurisdictions can meet.

By employing IRP, utilities can determine the lowest cost options that enable electricity services to be maintained and accounting for avoiding or minimising the externalities associated with increasing supply, explains D'Sa (2011, pg. 2):

> 'IRP can identify a series of the most cost-effective options, from the array of available generation technologies and transmission upgrades, as well as endues efficiency improvements and other demand-side management (DSM) measures. This is because the costs of delivering and saving a kWh of electricity – from improved lighting retrofits or centralised thermal generation plants or decentralised biomass generation facilities – are compared on a 'level playing field'. IRP is therefore technologically-neutral, treating deferred or avoided end-use demand as equivalent to 'delivered supply' of electricity.'

The application of IRP in the Australian energy sector has been less prevalent than for water. However, a heightening awareness of the role of energy efficiency in meeting demand continues to play a key role in making IRP more attractive to utilities. In 2004 for example, the NSW Government released the *Demand Management for Electricity Distributors Code of Practice*. The (former) Department of Energy, Utilities and Sustainability states the purpose of the Code is to:

> 'provide guidance to electricity distributors in implementing the requirement in the NSW Electricity Supply Act 1995 to investigate and report on demand management strategies when it 'would be reasonable to expect that it would be cost-effective to avoid or postpone the expansion [of a distribution system] by implementing such strategies (DEUS 2004, pg. 4).'

IRP frameworks have also been used by consultancies and other organisations. In late 2011 for example, in a report to the Commonwealth Treasury, ROAM Consulting used a long term integrated resource planning model to evaluate electricity generation and transmission development in Australia between 2010–11 and 2049–50. In another case, IRP was used to

justify hydrogen-energy futures for HydroTasmania, which had proposed a wind-hydrogen pathway development (Pigneri 2006).

International experience

To further demonstrate the proven nature of IRP as a decision making framework, attention is drawn to international examples. In South Africa, the electricity sector is legally required to produce integrated resource plans; and in British Columbia, Canada, the BC Hydro and Power Authority is required to submit an integrated resource plan so as to facilitate its path to self-sufficiency by 2016 (D'Sa 2011). IRP was undertaken in Denmark in 1995 and in 1997 for the 1997–2030 planning horizon. After the year 2000, Danish distribution companies were required to implement demand-side management (Lopes et al. 2000 cited in D'Sa 2011).

In the United States, IRP has been a significant part of the energy policy landscape for the last few decades (Watson and Peterson 2011). In 1992 the *US Energy Policy Act* mandated utilities develop and implementation of IRP. IRP was effective in balancing demand and supply-side initiatives:

> 'IRP showed that DSM could produce large economic and environmental benefits and could avoid the need to build unpopular and polluting generating plants. The adoption of IRP was thus driven chiefly by the increasing costs of electricity generation and the consequent need for greater efficiency in the use of energy, as well as environmental concerns (D'Sa 2011, pgs. 14–15).'

In the late 1990s and early 2000s the restructuring of the US electricity market weakened the application of IRP. Following the energy crisis of 2000–01 however, there was renewed interest in IRP. As of November 2010, 23 states had laws requiring integrated resource plans or long-term (resource) procurement/strategic plans be drawn up. In total, IRP is practised in 31 states (D'Sa 2011).

Californian experience

California has been especially successful in using IRP, with the demand side management strategy of enhancing energy efficiency now recognised and implemented as a more cost-effective solution to supply-side initiatives as the state sets an 'aggressive pace to maximise cost effective energy efficiency savings' (Motamedi 2005). In 2003, energy efficiency programs stemming from IRP accounted for 1.3 billion kWh saved at a cost of $300 m. In 2004–05 the California Public Utilities Commission expected to increase these savings to 3.72 billion kWh. Some of the key DSM programs that have enabled these savings include Conservation and Energy, Building Standards and Appliance Standards.

4.2.1.2. Application of IRP in other sectors

The theoretical grounding of IRP in supply-demand balance allows for its application in any number of production/consumption systems. IRP therefore has the potential to improve

decision-making in the transport sector by ensuring that all options for meeting a need, which might be defined as access, are treated equally. In 2010–11 for example, Queensland's transport authority, Translink, in partnership with the Institute for Sustainable Futures (ISF), examined the feasibility of using IRP in the transport sector and developed a suitable methodology for future application at the program level, to help select a portfolio of discrete projects to implement within a limited budget, or at the directorate level, the model can assist prioritising between programs and large projects. Across the organisation, systematically comparing projects and programs, which have diverse objectives, will aid the leadership group to identify short- and long-term priorities that best align the authority's objectives.

Whilst an emerging area, the application of IRP to transport demonstrates the flexible nature of the framework and how it might usefully be applied to the waste sector.

4.2.1.1. Further considerations for applying IRP to waste

At an ISF stakeholder workshop held in Sydney (November 2011) the following points were raised in relation to how IRP will need to be framed to ensure uptake in the waste management sector:

- Participants agreed on the potential of IRP as a future tool for the waste sector. There was concern over where the opportunities are to engage with stakeholders and how to sell costless or cost negative initiatives to treasury.
- IRP adds a time dimension to decision making – cost of deferring can be assessed holistically.
- IRP appears to act as a springboard up into avoidance and reuse issues, where the traditional waste hierarchy does not work for dealing with supply and demand.
- Knowledge gaps make it difficult to identify opportunities. There is a need for a benchmarking study in assisting to overcome absence of information.
- Interest in how to apply IRP, e.g. apply to each level of the hierarchy and then apply to overall decision.
- Recognition of both the need for economic rationalism for treasury and translating value for community. Sustainability should support community, but it's needs to be measurable and confidence inducing.
- Policy needs to recognise diversity and it was questioned whether IRP can handle the diversity present in the waste sector that may be absent in water and energy sectors.

4.3 Worked example for waste: urban centre

In the ACT the level of government which sets waste management policy is also responsible for the daily operations of waste collection and resource recovery. Other aspects of waste management and mitigation in the ACT include the absence of a metropolitan/regional divide

in service provision, the presence of higher than average incomes and education levels, and a concentrated but low-density urban form.

While the ACT has performed at a high level in diverting waste from landfill, it has not been immune to a global trend towards increasing waste generation. This growth has caused a shift in the ACT's no waste policy, with a lack of resources to deal with increased waste generation cited as the basis for the decision. Despite this, the current draft waste strategy document notes a high community expectation for performance in waste management, and the need to consider options that will allow for future opportunities to regain its previous levels of progress (ACT Government 2010).

Submissions to the current draft waste strategy consultation process indicate that:

- The move away from a no waste target is disappointing to some members of the community but acceptable to those providing or hoping to supply waste services.
- The proposed approach is now centred on reducing the volume of materials rather than on extracting the highest value from the resources contained within various waste streams.
- There are unidentified costs and benefits to approaches or technologies that are not currently being considered.
- The strategy needs to consider a wider range of initiatives for different waste generators.
- The strategy needs to consider a wider part of the production and consumption cycle.

These concerns and tensions may be well suited to resolution through the canvassing of different options, or combinations of options, through an IRP approach.[17]

4.3.1 Applying IRP in the ACT

Comprehensive waste data in Australia are limited, but the ACT has been active in auditing to determine progress towards a world first target of no waste (ACT Government 2006). Annual statistics are compiled on waste disposal to landfill and resource recovery levels (ACT Government 2006). Data on waste disposed to landfill were derived from the ACT No Waste weighbridge transaction database and data on reuse, resource recovery and recycling were derived by surveying approximately 100 organisations involved in these activities (ACT Government 2006). The data capturing infrastructure and processes in the ACT have allowed other organisations such as WCS (2008), A. Prince Consulting (2010) and URS (2010) to undertake various feasibility studies and audits. These reports and others have been used in the creation of this indicative IRP waste framework.

[17] Indicative ACT data have been used here to illustrate the application of IRP only. It represents a preliminary analysis and does not yet represent a sound basis from which to draw conclusions.

4.3.2 IRP: Illustrative example

This sub-section illustrates a worked example of components of IRP for waste management and mitigation in Canberra. The data used in this example are taken from documents that have been published by the ACT Government, and are used illustrate the potential for using IRP in the waste management sector with actual data. ISF has made no independent verification of the original information, and takes no responsibility for inaccuracies present in the data set. For these reasons, the illustrative example provided here should be viewed as indicative. A more comprehensive IRP assessment would be required to inform future waste policy in the ACT.

4.3.2.1. Future projections

The illustrative example depicted in Figure 13 is derived from data found in the publicly available reports *Australian landfill capacities into the future*, *Economic modelling of options for waste infrastructure in the ACT* and *ACT landfill audits* (Hyder 2009a; APC 2010; URS 2010). The graph represents historic (2000–2010) and projected waste supply up to 2030. The demarcation of the waste streams is not demonstrative of how landfills are layered and the jump at 2010 reflects the change between actual data and forward projections. The graph indicates that considering business as usual (around 275 kt waste/year and rising) waste supply, in the year 2016, the ACT will have reached its approved landfill capacity of 1.4 Mt.[18]

[18] Approximately calculated as1400 kt divided by average of 275 kt/a ≈ 5 years

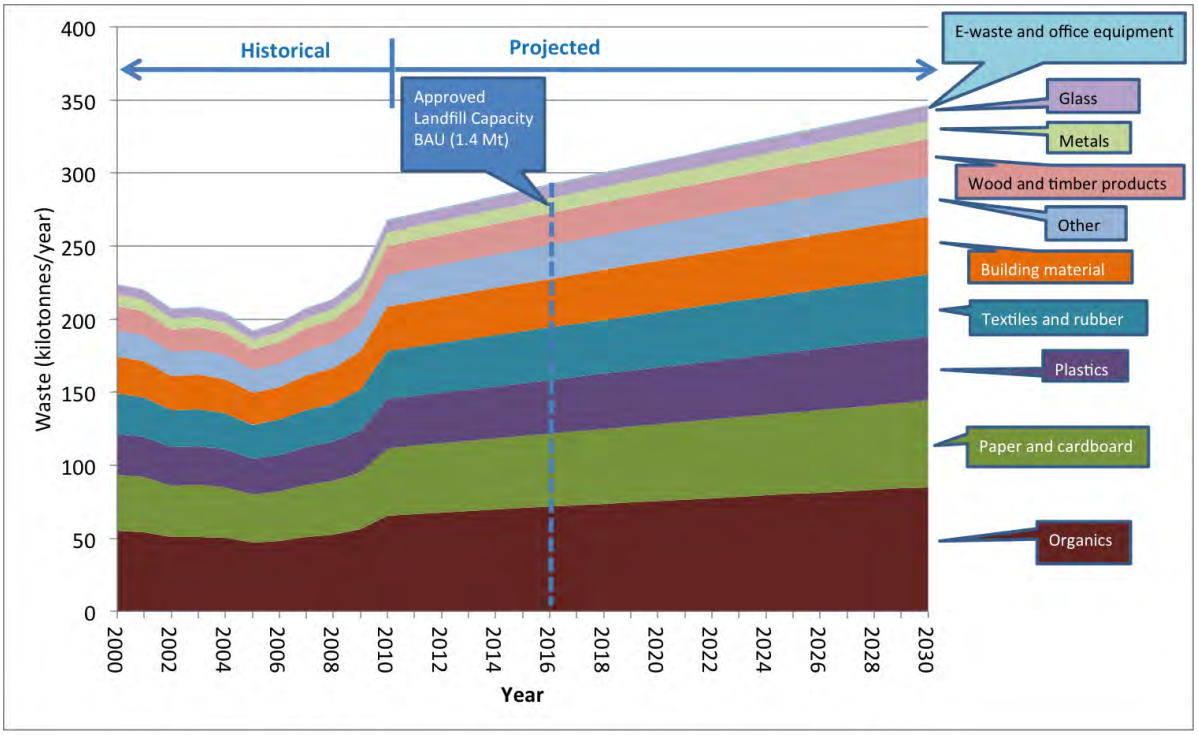

Figure 13. Waste supply projection versus approved capacity.

If growth in waste generation proceeds as projected, then options for creating additional capacity or increasing diversion options will need to be considered within the next five years.

4.3.2.1. Cost effectiveness of potential options

The ACT Government has been very active in testing the effectiveness of its strategies for managing and diverting waste from landfill. In 2008, prior to the release of its latest draft waste strategy, a review of the strategy and targets was undertaken, and a range of scenarios developed to test the economic and financial costs and benefits of different targets. For the purpose of this exploration, we have used data compiled from a more recent study by URS *Economic modelling of options for waste infrastructure in the ACT* (2010) to illustrate the cost effectiveness of various options (other than extending landfill) for closing the gap between available waste and available capacity for managing waste. As noted earlier, numbers are highly indicative – further data is needed to assess social and environmental costs associated with options. Additionally a complete understanding of the interaction of waste streams and options must be considered, namely where two options target the same waste stream. A $/t landfill cost would also be included in a more comprehensive analysis.

Figure presents this analysis in a cost curve that illustrates the cost per tonne of the illustrative options. The lowest cost waste management options are presented at the left of

the diagram, and plotted against the quantities of waste which could be avoided or handled (waste capacity) by each option in Canberra in 2030. In the case of options such as a food waste campaign, waste smart, deposit and refund for containers, the waste capacity refers to the tonnage reduction achieved by the option, while for MRFs and energy from waste the waste capacity refers to the tonnage that can handled by the option. A similar cost curve could also be drawn for 2020 (or any other year), reflecting different costs and volumes.

In practice, there are additional cost-effective waste avoidance and mitigation options which could be pursued which are not shown on the graph. Part of the challenge with avoidance and mitigation options is that they are poorly evaluated, leading to inadequate data for assessing their costs and effectiveness – a further reason to engage in IRP with its explicit focus on monitoring and evaluation.

Experience applying this approach to other sections reveals that the options often vary by an order of magnitude, so even using the available data (with all its uncertainties) tends to lead to the same relative costs. As costs and waste volumes change over time however, the mix of options used may need to change.

The costs are also the direct financial costs – this illustration does not take into account a range of avoided costs (benefits) of some options and environmental and social costs.

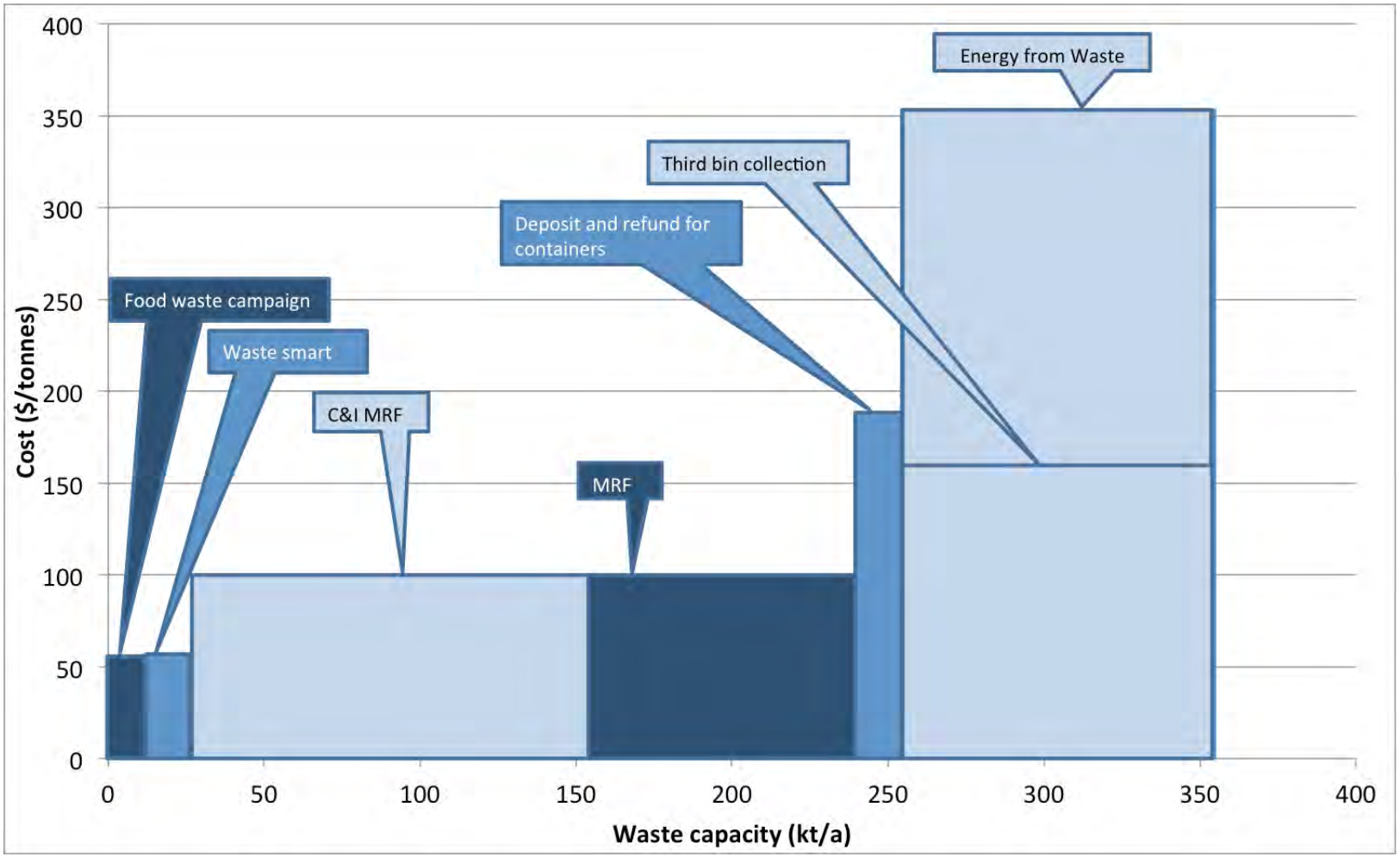

Figure 14. Illustrative cost curve for waste management options in kt/a in 2030.

While there are several important limits to this analysis,[19] Figure 14 demonstrates the utility of examining options that address reductions of waste at the source (avoidance) with options that address reductions in volumes of waste at the end of life (disposal). The options shown in Figure 14 are described below in Table 17. In practice, further options could be generated with additional stakeholder input.

Table 17. Illustrative option descriptions (not exhaustive)

Food waste campaign	Similar to the NSW program Love Food Hate Waste – reduces organic waste to landfill.
Waste smart	Targeted advertising and behaviour change to target non-food waste resulting in a nominal 5% reduction in waste generation.
C&I MRF	Commercial and industrial materials recovery facility
MRF	Materials recovery facility
Container deposit-refund system	Deposit-refund system for used beverage containers
Third bin collection	Household organics collection
Energy from waste	Combustion of waste to provide energy (could include heat, liquid fuels etc.).

While not a comprehensive listing of all possible options for reducing waste, this limited analysis of different initiatives indicates that the options on the left side of the graph (e.g. food waste campaign and waste smart) are the front runners for least cost, however these options are not considered to be appropriate for contexts where high impact (e.g. large volumes of waste) is a key objective. Options on the right hand side of the graph are significantly higher cost per tonne but capable of delivering greater volume reduction.

It must be remembered this study presents a worked example of how the IRP methodology could be applied. Options have not been fully assessed, especially the interaction between the various waste streams and how implementing less expensive options may affect the costs of other options. A more comprehensive study would address these matters and consider the characteristics of waste streams (MSW, C&I, C&D) to eliminate options that may be impractical or less relevant.

4.3.2.2. Portfolio of options to meet waste management need

As mentioned earlier, and demonstrated in Figure 14, projections indicate that considering business as usual waste supply (around 275 kt waste/year and rising), the ACT will have reached its approved landfill capacity of 1.4Mt in five years' time.[20] Given this indicative timeframe the ACT has five years to reduce the rate of waste disposal to landfill, or identify and develop new facilities. The next example in Figure 15 illustrates the potential for a

[19] Options are prioritised according to unit cost ($/t) but interactions between options have not been considered. Tonnages diverted from landfill have accounted for a residual, which goes to landfill. Please note that social and environmental costs were not included for this illustrative example.
[20] Approximately calculated as1400kt divided by average of 275kt/a ≈ 5 years

combination of options from those outlined in Figure 14 to meet the supply demand gap or shortfall in landfill space.[21]

The logic of the approach is as follows:

- Reduce the rate at which waste is going to landfill – this means that the red area in Figure 15, which represents the landfill filling in the next five years, changes to the light red rectangle (horizontal) when waste is added at a lower rate. The areas of the two rectangles are about the same, as the landfill has a fixed volume.
- Do this by selecting and implementing a set of waste mitigation options to address the shortfall in landfill capacity, that is, the space required to accommodate the business as usual disposal rate (shown as the grey area with blue arrows in Figure 15) a selection of options from Figure 14 would be implemented in the years 2011–2030 to address the shortfall. To select the combination of options, two sets of information are required. Firstly, the magnitude of the shortfall to be filled, and secondly, the costs and impacts of each option. Whilst only financial costs are shown in Figure 14, technical, social and environmental factors should also be considered.

The philosophy of IRP is to select a portfolio of options at the lowest cost which can meet the shortfall. For example, if the shortfall was only 10 kt/a then the food waste option is the lowest unit cost.[22] In Figure 15, the shortfall is around 275 kt/a so more options need to be implemented together. Figure 15 demonstrates that this level of reduction is estimated to extend the life of the existing facilities from five years (i.e. full in 2016) to twenty years (i.e. full in 2031).

[21] At this stage, the specific portfolio of options is unspecified for the illustrative purposes of explaining IRP.
[22] Again noting that in this example the cost is only financial and in practice all costs should be considered.

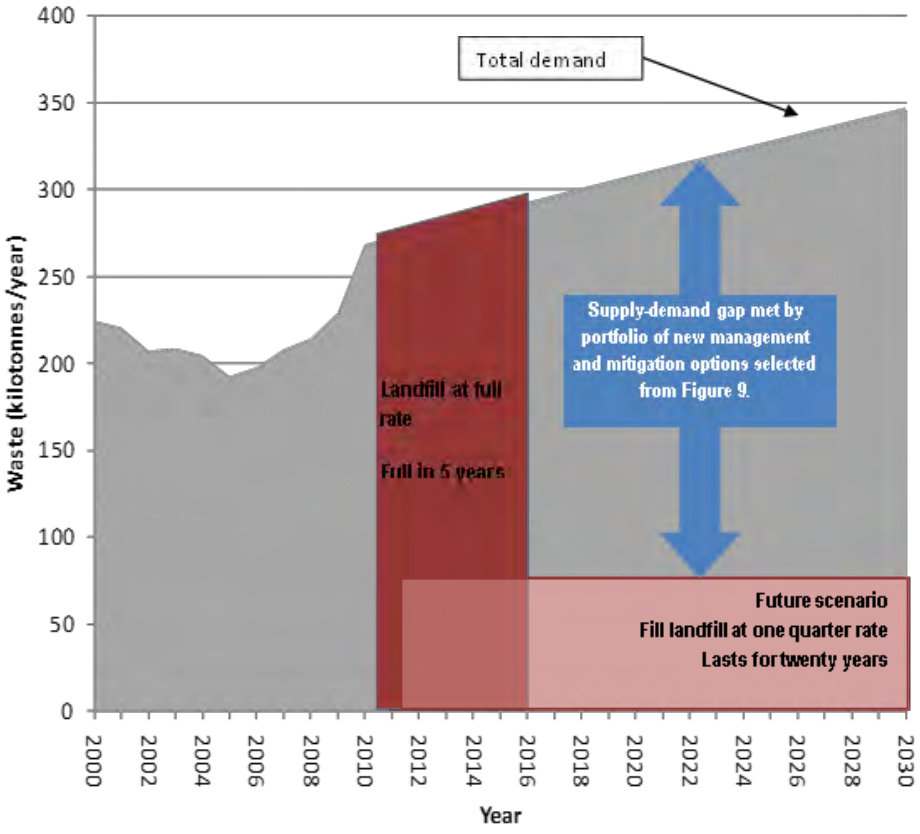

Figure 15. Waste projection versus available capacity

4.3.2.3. Further consideration of specific examples

Trends for growth in waste generation could be addressed in different ways through measures that target specific wastes, such as organics or paper and cardboard. For example, a trial of separate organics waste collection conducted in the ACT suburb of Chifley during 2001 identified a reduction in the kitchen waste component of the general waste bin from 52 percent (by weight,1997 audit) to between 25 and 17 percent (by weight, trial audit data).

The high level of performance already demonstrated by the ACT with respect to garden organics, also provides some sense of what can be achieved. As noted in the *National Waste Report 2010*, the ACT has been very successful in diverting garden organics from landfill, with around 200,000 tonnes being processed by local compost and mulch producers in 2009 (EPHC 2010a).

4.4 Conclusion

This section has shown that the complexity of future waste management requires a new approach beyond cost-benefit analysis and the waste hierarchy. By using the SSD framework, the role which IRP can play in the process to select and connect actions to objectives was identified.

The steps in IRP have been outlined and key stages have been illustrated in a worked example for Canberra. This approach allows resource recovery, disposal and waste avoidance options to be assessed on an equal basis.

Good-quality, robust, relevant information is needed to help the sector make decisions concerning these emerging challenges. Furthermore, such data must be coupled with an effectively deliberative process of stakeholder engagement to support adaptive decision making for the long term. IRP can fulfil this role.

IRP has been successfully applied in the Australian water sector and internationally in the energy sector, but IRP has not yet been applied in systems with the variety of materials currently in the waste system. Additional complexity comes from the different health and environmental impacts associated with each of these materials. Developing agreement about clear and achievable objectives in such circumstances will require significant mapping of issues, implications, barriers, incentives, in addition to the processes and technologies that might be used to achieve objectives.

IRP offers strong potential to handle the complexity of today's waste paradigm, both in terms of the number of relationships and interactions between different stakeholders, and with respect to the nature of the materials being addressed. IRP's focus on objectives and its support for exploring a wide range of alternatives simultaneously, may be very useful in resolving issues between more numerous and diverse stakeholder groups.

5. Waste futures: Workshop report

This report provides details of a workshop facilitated by the ISF, as part of the CRC CARE funded Landfill futures project (see Appendix A for details). The future of waste – a conversation exploring pathways for a sustainable future event aimed to engage multiple stakeholders, from across the waste sector, in a discussion focused around waste policy, costing and the future vision of waste and resource management in Australia

The workshop objectives, design and activities, participants, speakers and materials including background reading are outlined in following sections. Key questions, key findings, and several key outcomes (including some participant feedback) are also summarised.

5.1 Conversation objectives and features

The format and content of the workshop were informed by several literature reviews conducted by the research team, targeted stakeholder interviews, and input from the Project Reference Group (PRG), which were combined to inform the workshop (here in referred to as conversation) design. A project team meeting held on 21 October 2011 identified an initial range of objectives for the conversation, together with a number of features that the conversation should embody.

5.1.1 Conversation objectives

A series of possible internal (implicit, research focused) and external (explicit, participant focused) objectives were identified as being important to the success of the event.

Internal objectives included:

- Building positive relationships with key stakeholders to help ground the research in the knowledge and experience of industry and government stakeholders, and increase the potential for change creation as a result of this work
- Clarifying assumptions for scenarios used in further research activities
- Identifying tradeoffs/tensions, and different perspectives and values between different industry groups/stakeholders, and
- Offering opportunities for stakeholders to review of the working report (in part or the entire draft report).

External objectives included:

- Providing an opportunity for networking amongst the workshop participants
- Creating a space for discussing the future of waste in Australia

- Creating a space for the waste community to bring their innovative ideas in waste policy, technology etc. for long term sustainability
- Discussing ideas that are both innovative, practical – and address questions of appropriateness
- Gathering useful information for inclusion in a new decision making framework
- Informing stakeholders of this CRC CARE funded project
- Obtaining input on existing draft materials and working papers, and
- Providing an opportunity for participants to provide some direction for future stages of the project, or ideas for future research.

5.1.2 Conversation features

The project team agreed that the workshop should have the following features to ensure success and a high participation rate:

- Be attractive/relevant to key stakeholders
- Showcase and encourage the development of innovative ideas and approaches
- Align with current policy debate, but not be captured by it
- Provide some useful insights to the questions and contradictions that exist in the current approach to sustainability and waste
- Encourage interactions between participants rather than just interactive between ISF and individual participants
- Be realistic about what we can do in the time available
- Cater to a broad range of starting points in terms of participant knowledge, understanding, and historical views or positions
- Involve those who take on costs of waste management/mitigation, resources people, including recycling, local government and perhaps involvement of NGO's, and
- Recognise the existing visioning/consultation/policy landscape and try to avoid duplication of previous or ongoing processes.

Importantly, links between the conversation workshop and the broader research context were considered.

5.2 Conversation design

As noted earlier, the focus, format and content of the conversation were developed by the project team in collaboration with the PRG. See Appendix C for the workshop agenda.

5.2.1 Workshop focus

The focus of the workshop was to allow space to discuss the following questions:

- **Question 1.** Does the Integrated Resource Planning (IRP) approach have a place in waste decision making?
- **Question 2.** How might the community be better involved in waste decision making in future?
- **Question 3.** How might the different levels of government be involved to make the policy changes we need going forward?
- **Question 4**. What needs to change in relation to costing, pricing etc. for the future?

5.2.2 Conversation design

The conversation was designed to provide opportunities for both blue sky and pragmatic thinking that could assist in futures oriented research (Table 18). Futures research presents exciting opportunities for understanding and addressing environmental, social, political and technological challenges. This approach allows us to anticipate trends, identify desirable futures and respond appropriately. For this reason, futures oriented approaches can offer a way to address complex challenges and to turn the outcomes of these processes into decision and action.

The workshop format included three conversation prompting presentations and three group activities to assist in generating broad discussion that could then be focused along a logical and coherent path to a future for waste management in Australia. The importance of active participation, allowing for robust discussion, was acknowledged in the design of workshop activities.

A summary of the final design of the conversation is presented below.

Table 18: Conversation design.

Time Allocation	Process	Details
40 mins	Welcome, introduction and background (includes participant ice-breaker activity)	Background to the workshop and agenda Activity 1: Ice-breaker: One high point or break through they've experienced personally or at work in relation to waste and resources in the past year or two, and what hopes this high point or break through might give for the future. One area or issue in the waste landscape that has room for improvement in the future. Then people introduce their partner to the plenary Project background
1 hour 40 mins	Guest speakers and conversations including participant discussion	Conversation discussions: guest speakers Introduction of the idea of conversation prompt speakers and the format it will take (5 mins on 'what is', 5 mins on 'what could be', 10–15 minutes conversation. Speakers to include: Darren Perrin, Paul Starr and Stuart White
1 hour 20 mins	'Future of waste' group activity	Activity 2: Shape of the future of waste Step 1 Individuals write as many as possible ideal characteristics or features on separate sticky notes in terms of waste futures Step 2 In small groups (3 or 4 people) the sticky notes are discussed as a group and affinity mapped/grouped like with like to identify commonalities. Each group to report back on the grouping topics only (with a focus on what's different each group) Step 3 In small groups they then choose 2 or 3 of their favourite characteristics/features and focus on these for the next step using butchers paper. Key questions for groups to consider against each of their top 3 issues or characteristics– • How would you rate where we are now against this sticky? (could be by state and/or federal) rate out of ten (quick and dirty) • As far as you know, how does this characteristic fit with current federal and state waste policy/strategy? Is it supported? And where are the gaps? • What would need to stay the same or be strengthened in policy/strategy and practice to realise this characteristic? Small groups report back to the whole and allow for discussion
1 hour	Lunch and informal discussions	

1.5 hours	World café group activity with groupings to include: • IRP • Costing and pricing • Government relationships • Stakeholder engagement • Wildcard table Report back to whole group.	Activity 3: futures roundtables Focus = main areas of policy, process or institutional change that would be needed to bring about the vision? Four futures roundtables plus a 5th wildcard (bringing in additional issues noted on sticky note exercise and put on the transfer station sheet). Bell ring with option to change tables. Guiding questions: 1. What are three major shifts that might help create a future where *IRP approach*/*costing and pricing*/*government relationships*/*stakeholder engagement* approaches have been adjusted to help create our desired waste future? 2. What would it take to make these happen?
10 mins	Summary, next steps, thank you and close	Overview of the session, key highlights and themes emerging Reflections by participants Where to next – what happens to the information from today Thanks Evaluation form (3 quick questions)

5.3 Participants

Participants came from a range of sectors relating to various aspects of waste management. The scale and focus (within the current systems of waste management) for each participant also varied, with some having a national focus, while others were more state-based or regionally focused. A breakdown of participants is provided below.

- Industry: 11 participants (focus on AWT, landfill, consulting, biohazards and general consulting)
- Government: 4 participants (focus on waste reform, policy and planning), and
- Research: 1 participant.

It is worth noting that most participants hold additional positions, across peak waste groups, affiliations or government advisory in addition to their main place of work.

The geographic focus of participants included:

- National focus: 6
- New South Wales: 7
- Queensland: 2
- Victoria: 1

While it was felt that a great deal would be gained by the participation of local government groups, waste-related non-government organisations, and members of the public, this was difficult to achieve in practice. For this reason, it may be useful to identify opportunities to have these groups engage with the draft and final research outcomes of the project to establish where important information, perspectives and roles have been omitted. It is likely that this would address outstanding questions, make the research more robust and engaging.

In addition to those groups mentioned above, it would be beneficial to also engage with additional stakeholders dealing with resources along the different stages of waste production and consumption including packaging producers and uses and major waste generators in industry, a selection of whom were invited but unable to attend.

See Appendix D for the participants in the workshop. Potential participants had been identified by the ISF team, the PRG, Hyder Consulting and Martin Stewardship & Management Strategies Pty Ltd.

5.4 Speakers (conversation prompts)

Speakers were selected based on internal team discussions and discussion with the PRG as well as input from key people in the waste industry in Australia and New Zealand. The aim of this selection was to expose participants to a range of different perspectives from speakers with strategic backgrounds and varying experience across the waste sector. The choice of

speakers was also informed by the need to generate discussion that is directly relevant to the research project – strategically increasing its breadth and depth.

Initial discussions with Ms Anne Short from WasteMiNZ were fruitful, and whilst Ms Short was unable to attend, her suggestion of Mr Darren Perrin (formerly of DEFRA in the UK) as an appropriate person was taken up by the project team. Mr Perrin accepted the invitation to present, alongside Professor Stuart White (ISF) and Mr Paul Starr (Department of Sustainability, Environment, Water, Population and Communities. Other speakers and topics were considered, though to allow time for fruitful conversation following the conversation prompts, the program only allowed time for the three aforementioned contributors. Refer to Appendix E for the speakers and their biographies.

5.5 Background material

Background materials were provided by email to all participants (see Appendix F). This material was intended to brief participants on the scope of the conversation, including the content of the morning and afternoon sessions. It included details of the afternoon session's future focus – the roundtable discussion topics. This material was sent out two days prior to allow time for participants to reflect on personal views, and canvass the views of colleagues, prior to engaging in group discussions at the workshop. The roundtable discussion topics, and guiding questions included:

Futures roundtable topic A: • Could Integrated Resource Planning (IRP) be a useful tool in the waste sector? • And if so, what would be needed to make it work?
Futures roundtable topic B: • How do we design and obtain appropriate costing and pricing to reach desired change for the future?
Futures roundtable topic C: • How do the relationships between different levels of government affect decision-making with respect to waste?
Futures roundtable topic D: • How do we engage stakeholders and the broader community in waste decision making?

5.6 Conservation outcomes

5.6.1 Key questions

Given the aim of encouraging robust discussion, it was important to note the questions and comments raised by participants in various sessions. These have been captured below in Table 19.

Table 19. Key questions and comments from conversations with speakers

Session	Comments during the plenary
Speaker 1: Darren Perrin On a comparison between the UK waste arena and Australia's	• There is a big difference between Australia and the EU – EU Directives! We don't have a policy framework here. Constitutionally – is this an issue? • Understanding of drivers for reform in Australia vs UK? Drivers for reform – not running out of space argument doesn't work in most parts of Australia – are the drivers different here, if so what are they? We don't have the markets for material – we have a small economy – changing standards – are there local solutions? • With respect to data – the lack of data is too big an object – can we get around this? • National Waste Database attempt failed. How do we deal with lack of data? • How does the data translate into policy when it is so poor? What are the agents of translation in these cases? What's the difference in the level of professionalisation, in terms of who collects the data? What data is held by the LGA sector and why isn't it making it through to other levels? • Mantra of landfill is bad recycling is good – How do we sit with UK at the same stage of development? What is the carbon balance? Why don't we manage the generators better?
Speaker 2: Paul Starr On national waste policy and data	• Only 20% of data is making it into public domain - is this a translation or quality issue? • Local Government (LG) provide information to state government but these are not necessarily keen on being outed or rated publicly by the volume of their data – but does LG look at the data? Are opportunities to collate data at higher levels missed? • Consistent waste composition reporting standard should commence soon • Data gathering issues – resourcing is a big issue as high up staff levels not adequate to task.
Speaker 3: Stuart White On Integrated resource planning (IRP) as a tool for waste management	• IRP for energy and water – what was the imperative? And what are the imperatives for waste? • Until there is a cost for the inputs there is no driver for IRP – landfill is still cheapest option. Location argument is accepted - particularly highly urban areas will be less amenable to new facilities but where space and buffers are less of an issue how do we deal with the least cost arguments? • Even if our targets for resource recovery remain static, the total volume of waste per capita is increasing, and there is a current and shirt term infrastructure gap across a range of types of infrastructure – the infrastructure gap that develops could be a driver for using IRP if generation continues to grow. Lots of gaps – the question is where do we best apply IRP? • Least cost approach – utility sector – however monopoly issues? Does this approach deal with competition? How can IRP deal with competition? • LCA and environmental costs – how does IRP deal with natural economic cost? • Who is working out the costs to put in the IRP tool? How accurate are they? Are the values utilised solid enough to use when discussing budgets with policy makers? How to deal with uncertainty in costing out different options?

5.6.1 Discussion of key findings

Activity 1: Ice-breaker and high points/breakthroughs

From the first ice-breaker activity, key participant high points or breakthroughs in the waste sector were described and are listed below:

- Introduction of waste levy in Queensland to be launched Dec 2011
- Success of compost programs in each jurisdiction
- The creation of the *National Waste Policy*
- Seeing movement in food waste Commitment to national approach to food waste. Leads to more focus on this waste stream.
- Publication of integrated strategy for COS – automation and recovery of waste
- Shifting focus to available materials in waste stream and keeping them within the economy
- Tools and modeling are being broadened and refined for decision making
- Confronting non-existent culture of waste
- Involvement in GHG and NGERS register reporting system, and
- Being member of young professional WMAA – offers opportunities to raise and discuss issues in a non-monetary environment.

Activity 2: Shape of the future of waste – key findings

Participants explored what the shape of the future of waste would look like by individually brainstorming characteristics of a vision for the future. They then shared their ideas in groups of five or six. As a group they built on the individual activity by grouping their characteristics (via affinity mapping) in to likeness. Results of this process are summarised in Table 20.

Table 20. Affinity mapping reflecting raw information collated.

Group	Key themes derived from affinity mapping	Desirable features for the future of waste
Group 1 (5 participants)	National leadership	• All governments collaborate well on common vision for waste and resources • Feeds to policy and legislative space • More power to Canberra • Uniform national policy and strategy • National definitions • Waste treatment standards – national • National consistency of regulation and classification
	Funding options *(note there was some disagreement on the issue of hypothecation of waste levies)*	• Full hypothecation of all landfill levies • Waste levies fund waste avoidance and reduction • No waste levies needed! • Proper funds for waste • Zero wasted!
	Energy and resources	• No mixed waste (unsorted, covered, etc.) to landfill • All wastes considered as resources • No resources that could be sensibly recovered sent to landfill • Big decline in C&I waste • Energy from waste • All landfill gas captured and used for energy generation • Energy from residual non recoverable wastes
	Education and behaviour change	• Accreditation for waste professionals • National education campaign for public • People can recycle at work at least what they recycle at home • Change consumption behaviour
	Organics	• Organics returned to lands and soils
	Data	• Third party accredited data collection and analysis • Undervalued data • Data: timely and publically available
	Better enforcement	• Better enforcement
	Politics and waste	• Getting politics out of decisions • De-politicisation of waste issues • Real vision: why are we doing this
	Hazardous waste	• Less hazardous stuff • All hazardous waste handled appropriately
	Policies	• Understand change in materials and product design in relation to waste

		• Disaggregate cost of waste management from GDP • Internalise production costs (raw materials) into consumption costs • Government planning of infrastructure needs and location
Group 2 (5 participants)	Education and consistency	• Educated informed skilled stakeholders • Reinforcement of the waste levy, for example towards a national community communication plan • Increased national education and standards, e.g. recycling campaigns supported by bin system specs • Fully integrated system • Standardised approach and guidance
	Data	• Informed decisions based on sound scientific evidence • Clear recognition and certainty about re-use sector
	Integrated systems and planning	• Consistent approach on all levels of government and waste stake holders • Integration in waste decision making on all levels involving as many stake holders as possible • Readily available analysis of the hierarchy of the value of material for specific technology e.g. organics for composting or energy • Planning and siting: waste facilities planned and sited as part of development buffers protected • Focus on output rather than solutions
	Consumption and resource efficiency	• Investment in resource and energy efficiency strategy as part of waste strategy • True cost of waste assessment and knowledge • Effective packaging design • Change in people's behavior and attitude towards consumption • Economic policy mechanism to stimulate product service system update
	Waste reduction	• 'Back to basics' i.e. avoidance reuse • Less waste generated
	Policy	• Manage for carbon (transport, energy recovery, material flow, materials) • Honest and meaningful discussions: which politician will tackle consumption? No one will! • Dismantle economic rationalism • Policy that takes into account human behaviour • Changing language of waste from tonnes avoided landfills to $/ tonne kept in economy • Dematerialised economy • Have smart targets
Group 3 (6 participants)	Data	• Robust waste data: disposed and recycling • Consideration of volume of waste, not just weight
	Policy and planning	• Waste management plan system that is not hijacked by minority/interest • Waste policy with depth, not shallow • Joining the planning and approval functions • Less prescriptive methodology in government policy • Policy with focus on reducing resources consumption and waste generation as opposed to anti-landfill
	Economics	• Sound and reliable economic return

	The stick [Penalties?]	• More regulation • More enforcement • Community acceptance and ‘skin in the game’ when adopting new outcomes
	Design	• Mission toward biodegradability • Greater self-reliance (food mainly)
	Markets	• Mission toward biodegradability • Greater self-reliance (food mainly)

Following the activity described earlier, groups were asked to select their top 3 or 4 priority desirable features for the future of and rank current performance (out of 10) for each of these characteristics. These are presented in Table 21, with recurring themes grouped together in Figure 16.

Table 21. Ranking of priority visions

	Key feature wanted for the future	Assessment of current status Rank & additional comments
Group 1	Better data and decision making	0
	National policy and regulatory framework fully funded	2
	Education	2 (for education relating to both consumption and recycling)
Group 2	Data	The group's response was divided by level of government. Discussion included various jurisdictions. Local = quite good but variable, State = less good due to aggregation and still variable. National = not good.
	Policy based on true cost of waste	1 to 2 (iceberg approach – i.e. most of the problem is still unknown territory - 'under the waterline')
	Strategic integrated approach to waste	2
Group 3	Waste data	Varies from 2 to 7 depending on location (and noting that 'if you can't measure it you can't manage it'
	Policy planning	4
	Policy – direction Planning – how to get there?	rating varies
	Regulation and Enforcement	rating varies

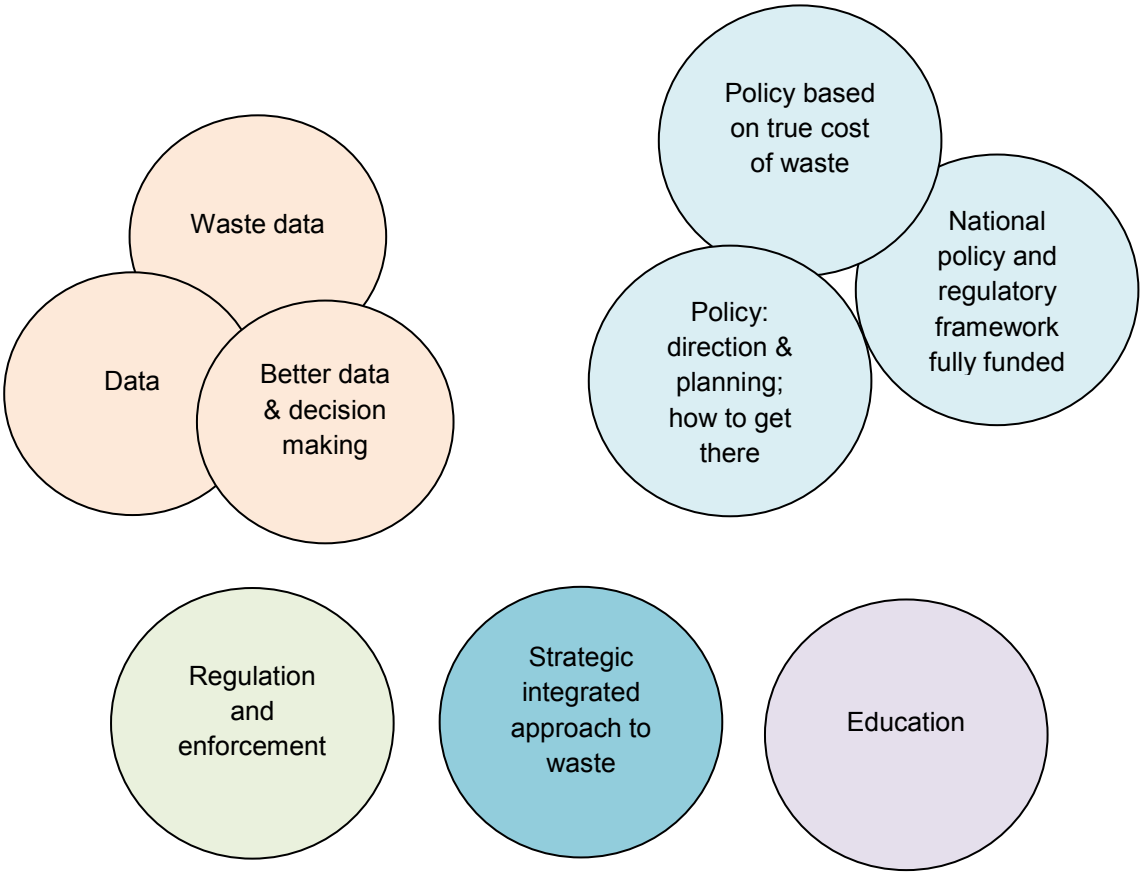

Figure 16. Key areas identified as priorities for the future of waste. Overlapping circles denote similar topics brought up by separate tables.

The results from the exercise prioritising broad areas for improvement revealed that priorities for everyone include data (inconsistency and availability) and policy (lack of depth, lack of linkage to planning and approvals and absence of addressing mitigation). The last point is emphasised by the following comment:

> 'We need honest and meaningful discussions – which politician will tackle consumption? No one will.'

Additional priorities identified were regulation and enforcement (carrot versus stick), strategic integrated approaches (for decision making, stakeholder engagement and planning and siting of facilities), and education for behaviour change (national campaign calling for a change in consumption and segregation at the household level as well as the workplace). This change, they suggested, would need to be supported by services:

> 'People should be able to recycle at work at least what they recycle at home'.

Activity 3: Futures roundtables

Central to the day's conversation was its implicit grounding in futures studies. Futures studies allow for the development of new insights via the application of innovative frameworks for understanding issues relating to the different dimensions of sustainability. ISF researchers applied futures studies techniques to assist experts to consolidate and reflect on what has been and what is, before moving to what could be. Futures research presents exciting opportunities for understanding and addressing sustainability challenges: as techniques used often allow us to anticipate trends, identify desirable futures and respond appropriately. Importantly however, the value of the futures approach in addressing complex challenges lies solely in the ability to turn the outcomes of these processes into decision and action.

As described in part 6, participants were invited to select a table to participate in discussions on the future of the following topics:

a) Integrated resources planning

b) Costing and pricing

c) Government relationships

d) Stakeholder and community engagement

e) Wildcard table: The importance of policy and planning

Roundtables were conducted in world café style, where after 15 minutes participants were invited to move to a different table, if they wished to contribute to more than one discussion. Guiding questions and discussion prompts were provided (see Appendix F), with raw answers reported back to the group and an additional synthesis of key themes described below for each group.

Table 22: Summary of responses in thematic futures discussions – afternoon roundtable session

Integrated Resources Planning
Points from group's report: Positive because IRP may bring avoidance/changes in consumption etc. options to the table for the first time, over a long period of time – supply and demand options on one page **Questions:** How can IRP show how early cheap options affect the options future down the track? How do we show how options can stand up to treasury scrutiny? Long-term investment cycle. **Synthesis of additional commentary:** Group members agreed on the potential of IRP as a future tool for the waste sector. There was concern over where the opportunities are to engage with stakeholders and how to sell costless or cost negative initiatives to treasury. IRP adds a time dimension to decision making – cost of deferring can be assessed holistically IRP appears to act as a springboard up into avoidance and reuse issues, where the traditional waste hierarchy doesn't work for dealing with supply and demand. Knowledge gaps make it difficult to identify opportunities. There is a need for a benchmarking study in assisting to overcome absence of information. Interest in how to apply IRP, e.g. apply to each level of the hierarchy and then apply to overall decision. Recognition of both the need for economic rationalism for treasury and translating value for community. Sustainability should support community, but it's needs to be measurable and confidence inducing. Policy needs to recognise diversity and it was questioned whether IRP can handle the diversity present in the waste sector that may be absent in water and energy sectors.
Costing and Pricing
Points from group's report: There is a framework for pricing, but the price is not high enough. Landfill is cheaper than recycling so we need to correct market future. **Questions:** what outcome should your price aim to achieve? E.g. difference between materials (asbestos versus organics). Need to be clearer on objectives first and need to ensure infrastructure and markets are in place first. Cost issues are important. E.g. discarded CRTs from Queensland, cost prohibitive to send to Adelaide for reprocessing Often we develop policies, drivers without determining the need or problem Strong community support for recycling, but should be as efficient as possible Instability in markets and inappropriate solutions undermines confidence

Levies should be location specific; different access to markets, industry. Levy is designed to change behaviour. Is the community getting a benefit from levy? Levy is only one tool amongst others e.g. regulations, education, legislative safety net, incentives, invest it back in programs, infrastructure. Levy should be used for developing markets e.g. organics for soil carbon in farms to improve market, based on policy

Questions: Do you have flat levy – same for all materials, or differential for hazardous, organics? If so how to decide levels?

If LG's could aggregate, they can get a good price for waste service, then get efficiencies

The need to recognise embodied energies, environmental impact of materials. Prices (waste charges) often does not reflect real costs, of either waste or recycling

Community perceptions, more from the idea of a tax to market support and investment

Price signal only works of behavioural change can influence it cost reflective, usage-based pricing needed. Price alone is not enough. It needs other measures as well. Pricing and costing measures can apply to front end (producers and consumers) as well as back end (landfill). Price signals can help encourage reuse an recycling/ERP

Can change volume of bins per m3 price change. Even though containers etc. only 10% of waste stream, high visibility. Pay by weight a good idea, but politically difficult

Need for regular engagement and education in the community regarding waste

Potential fines for contaminated bin drives appropriate sorting. Lack of awareness of actual costs by householders

Synthesis of additional commentary:

The current framework for pricing is too low as it does not reflect the real costs of waste or recycling. This reveals a market failure since it does not encourage waste diversion from the cheaper option of landfill, which although offering an important service can be a more expensive option when all internal and external costs are considered in relation to the costs and benefits of waste mitigation options.

While levies can be useful for developing markets (e.g. for organics), additional tools also need to be considered such as regulations, education, legislative safety nets, incentives, re-investment into programs and infrastructure.

Government Relationships

Points from group's report:

The relationships between levels of government are often antagonistic and political e.g. dependent on which party is in power

It's tricky for Federal Government to work with local government in Australia as it leaves out the state level

Need consistent, longer-term mechanisms between C&I and states to drive waste reform

Just tell local government what to do

$ or regulation (or both) to change in C&I and C&D

Synthesis of additional commentary:

Group members differed on several topics, coming from diverging backgrounds.

It was agreed that relationships between different levels of government differ around the country. Sometimes relationships between states and federal levels of government are antagonistic and political.

Discussion of inconsistent definitions, targets and rules across states revealed frustrations and group members agreed on the need for a consistent approach. However, the process of standardisation was questioned: what would the benefits to federal government be?

Commonwealth has more power to act but not the mechanisms to do so

Agreed need for the waste sector to be overhauled: similarity raised relating to the health and aging sector which had decades-long mechanisms to drive progress – persisting over time has delivered progress. Could the waste sector learn from this? Need persistence and a 'champion' to drive this kind of reform.

Local government is critical as a service provider – could do a lot more but lack funding, people, resources

Suggestion of amalgamating local governments into regional governments to overcome barriers. Waste is a problem that doesn't recognise boundaries – regulations on one side are different to the other e.g. Albury – Wodonga

Disagreement on the pros and cons of zero waste: some thought it a motivator, others thought it a distraction: 'If you're pitching something that's unachievable it's setting yourself up for failure'

Stakeholder and Community Engagement

Points from group's report:

National key messages overarching campaign of engagement

whilst also allowing tailored local messages – consistent approach between states

Redefine what is waste – understanding impact (domestic, C&I, etc.)

Community recognition of options and benefits in types of treatment – social license/acceptance/trusts

Identifying trusted and independent bodies to deliver messages

Involve community early e.g. after development of some options (see notes below)

Billing, transparency, pricing signals, discounts, incentives

Synthesis of additional commentary:

There was disagreement regarding the appropriate timing for community consultation. Some thought early in the process while others suggested giving firm options for people to choose between instead.

Different stakeholders have different drivers – industry is driven by cost, community is driven by philosophy, care for environment, values

Need to increase awareness in community of waste and increase dialogue about the issues

However, it's important not to advertise and get just the already committed people: It's the majority of people you need to get to.

Discussion around avoidance and communication / awareness of this. How can we make waste avoidance even easier than waste disposal – i.e. structural changes to make it easier to not buy things/ take things.

The group discussed the idea of social licence and how we've lost social license to even consider certain technology options because we've lost people's trust in the past – e.g. waste to energy / incineration. Trust is an issue for specific options. Need to identify who the trusted spokespeople are for the community for information about options

Wildcard: The Importance of Policy and Planning

Points from group's report:

Role of policy and planning instruments in finding a way forward. How can plans translate policy/vision into practice?

Other topics considered, though put aside in favour of the topic above included: Or future of Australia waste database – how to? Or education, capacity building, accreditation of waste managers, or management of organics/food waste in C&I (diversion/minimisation)

Discussion on the main topic (role of policy and planning) included: the dire need to link policy to planning; alongside the lack of planning case study particularly for Sydney.

Using Sydney as a talking point they raised that we need to plan how much landfill space is needed for 2030 based on population and waste generation predictions and plan backwards to meet this capacity.

In addition discussed the need to plan for aggregating waste (e.g. via putting NSW into four landfill zones), resulting in less truck movements.

Synthesis of additional commentary:

The group (3 participants) discussed what happens when good policy is mixed with poor planning and the effect this specifically has on landfill planning and future landfill capacity issues. Above all they agreed that good planning is the crux of everything else going smoothly e.g. Sydney is currently running out of landfill space in NSW and if well planned it wouldn't be. Experts also noted that more infrastructures should not be a business as usual planning mechanism and upward focus on household separation should be made as its cheapest source of labour and easiest location. They thought this approach would view waste as a resource instead of leaving waste to be dealt with when it's too expensive and hence too late to unwaste items at the landfill. They also called for more clarity around requirements for planning and approval.

Key themes across the conversation

At the end of the conversation, Prof Stuart White summarised the emergent themes which include:

- The urgent need for nationally consistent data
- Linkage between policy and planning – unless there's a link back to planning, policy doesn't do much
- The usefulness of futures methods including backcasting
- The usefulness of integrated resource planning: heartening to hear feedback. This gives us encouragement to take this idea to the next stage, helps us get clarity on how it might be used
- Pricing – clear support for cost-reflective pricing including the use of hypothecation to support programs
- In terms of education, do we need a national conversation on waste – what is it? Materials? Waste ain't waste, how to get this message across to people?, and
- How to engage the silent majority in decision-making?

5.7 Summary and conclusion

Notwithstanding important concerns raised by participants, when used alongside other mechanisms, the IRP tool was believed to hold promise. This is through its inclusion of a time dimension to decision making and potential application to embrace waste avoidance and consumption before it becomes waste. That is, incorporating supply and demand in the same context. It was seen to offer benefits as a decision making framework beyond currently available frameworks, as it attempts to go beyond existing cost benefit tools.

Participants agreed that current pricing is too low as it does not reflect the real costs of waste or recycling. This reveals a market failure since it does not encourage waste diversion from the cheaper option of landfill, which although offering an important service can be a more expensive option when all internal and external costs are considered in relation to the costs and benefits of waste mitigation options. Participants thought that while levies can be useful for developing markets (e.g. for organics), additional tools also need to be considered such as regulations, education, legislative safety nets, incentives, re-investment into programs and infrastructure.

The need for the waste sector to undergo major reform was agreed. Parallels with the reform in the health and aging sector were raised, noting they had decades-long mechanisms to drive progress. Participants noted the same mechanisms and architecture are absent in the waste sector which is characterised by a lack of consistent dialogue within the sector. Participants indicated the need for renewed persistence and a champion to drive the reform.

The concept of social licence to operate waste management facilities was discussed, and how the industry has lost the ability to consider certain technology options due to reduced

community trust through past disenfranchisement – e.g. when introducing technologies such as waste to energy and incineration. Trust building was agreed as central to introducing any new future options, and it was considered important to exploring the best agencies or organisations to provide independent and trustworthy information to the community on options. Experts shared their opinions regarding how and when the community should be engaged in decision making, revealing differing views on best practice. Some preferred community engagement from an early stage (to include the community in developing options), and others preferred externally identified options from which the community can select between.

The need to increase general community awareness and dialogue about waste, resources and mitigation was discussed and participants agreed on the importance of reaching beyond already engaged community members. It was noted that the majority of people remain disengaged and need an effective mechanism to participate in decision-making processes.

Participants discussed what happens when good policy is mixed with poor planning and the effect this specifically has on landfill planning and future landfill capacity issues. Using Sydney as a talking point, experts raised the urgent need to plan for waste. The preferred approach would be to estimate how much landfill space is needed for 2030 based on population data and waste generation predictions (including diversion rates) and plan backwards to meet this capacity. They also discussed the need to plan for aggregating waste (e.g. via putting NSW into four landfill zones) resulting in reduced truck movements and increased economic feasibility in waste processing. Above all they agreed that good planning is the crux of everything else going smoothly. Infrastructure gaps were raised in the morning session as a critical dimension of the current waste landscape. Experts also noted that infrastructure should not be a business as usual planning mechanism; rather, an enhanced focus on household-level resource separation should be encouraged as its remains the cheapest source of labour and easiest location to do so. They viewed this approach as being beneficial as its too expensive and too late to unwaste items once they have gone over the weighbridge. They also called for more clarity around requirements for infrastructure planning and approval.

Participants were asked to fill in a short reflections form at the end of the day (see Appendix G). Of the 12 participants who responded, all found the day useful in terms of connecting with people and extending or fostering networks.

The responses to the question: '*what was the most interesting idea that you heard or discussed today?*' were as follows:

- The IRP tool (8 responses)/that integrated resource planning might be developed
- The various yet consolidated/integrated views from the different participants, i.e. government, industry, consultants and academics
- Accreditation in waste management
- Deciding if we can answer treasury concerns about the net benefit to the community
- National conversation on waste – sounds very interesting

- Support from industry for a national standard for waste compositional auditing, and
- National engagement program on issues.

Additional feedback during the final closing session, on the evaluation forms and in subsequent emails from three participants included comments such as:

- Thanks – very worthwhile
- I'm encouraged by optimism and belief in the ability to change; negativity is a barrier itself. People do want to do things, and
- I thought the workshop was worthwhile, the time flew by very quickly. I enjoyed it.

The next steps were also discussed, which were to revisit the research's working papers to include the emerging themes and concerns raised during the day.

6. References

A. Prince Consulting Pty Ltd 2010, *ACT landfill audits: combined final audit report*, report prepared for ACT NoWaste, Canberra, Australia.

ACT Government 2006, *The no waste strategy: a waste management strategy for Canberra*, prepared by the Department of Territory and Municipal Services, viewed 1 June 2011, <www.tams.act.gov.au/live/Recycling_and_Waste/about_ACT_NOWaste/the_no_waste_strategy>.

ACT Government 2010, *Draft ACT Sustainable Waste Strategy 2010–2025*, Canberra, Australia.

ALGA 2008, *Inquiry into the Management of Australia's Waste Streams*, Australian Local Government Association, Canberra, Australia.

Allen Consulting Group 2003, *Benefit-cost analysis of Victoria's Towards Zero Waste Strategy*, report to Eco-Recycle Victoria, Australia.

ASK Waste Management 2010, *Alternative waste treatment (AWT) technologies establishment guidelines – discussion paper*, report prepared for WMAA, Western Australia, Australia.

Australian Bureau of Statistics (ABS) 2010, *National regional profile, 2006 to 2010*, report 1379.0.55.001, Australian Bureau of Statistics, Canberra.

Australian Council of Recyclers (ACOR) 2006, *Submission to inquiry into waste generation and resource efficiency*, Australian Council of Recyclers, Australia.

Barrett, A & Lawlor, J 1997, 'Questioning the waste hierarchy : the case of a region with a low population density', *Journal of Environmental Planning and Management*, vol. 40, pp.19–36.

Batten, DF 2002, *Converting our waste into wealth: the scope for eco-efficiency in Australian regions*, CSIRO Manufacturing and Infrastructure Technology, Melbourne, Australia.

BDA Group 2009, *The full cost of landfill disposal in Australia*, report prepared for the Department of the Environment, Water, Heritage and the Arts by BDA Group Economics and Environment.

BDA Group Economics and Environment & McLennan Magasanik Associates Pty Ltd 2003, *The potential of market based instruments to better manage Australia's waste streams*, Commonwealth of Australia, Department of the Environment, Water, Heritage and the Arts, Canberra, Australia.

Benns, M 2010, 'Trucks will exacerbate refuse crisis', *Sydney Morning Herald*, viewed 28 April 2010, <www.smh.com.au/nsw/trucks-will-exacerbate-refuse-cris-20100327-r457.html>.

Brunner, PH & Rechberge, H 2004, *Practical handbook of material flow analysis*, Lewis Publishers, Boca Raton, Florida, ISBN 1-5667-0604-1.

Carson, L & Hartz-Karp, J 2005, ‘Adapting and combining deliberative designs’, in J. Gastil & P. Levine (eds.), *The deliberative democracy handbook: strategies for effective civic engagement in the twenty-first century*, San Francisco CA, Jossey Bass.

Chancerel, P, Meskers, C, Hagelüken, C & Rotter, V 2009, 'Assessment of precious metal flows during preprocessing of waste electrical and electronic equipment', *Journal of Industrial Ecology*, vol. 13, iss.5, pp. 791–810.

Chien, J 2011, *Reduction of end-of-life impacts through design for disassembly (DfD)*, University of California, Berkeley, USA.

Collins, R 2011, *The AWT tender hook*, viewed 14 October 2011, <www.wme.com.au/categories/waste_managemt/feb7_2011.php>.

Commonwealth of Australia 2001, *Australian agriculture assessment 2001, National Land and Water Resources Audit,* Land & Water Australia, Canberra, Australia.

Cordell, D & White, S 2010, 'Securing a sustainable phosphorus future for Australia', *Farm Policy Journal*, vol. 7, no. 3, pp. 1–18.

Cordell, D 2010, *The story of phosphorus: sustainability implications of global phosphorus scarcity for food security*, PhD thesis, University of Technology, Sydney and Linköping University, Sweden.

Cordell, DJ, Rosemarin, A, Schroder, JJ & Smit, AL 2011. 'Towards global phosphorus security: a systemic framework for phosphorus recovery and reuse options', *Chemosphere*, vol. 84, iss. 6, pp. 747–758.

D’Sa, A 2011, *Integrated resource planning (IRP), part 1: recent practice for the power sector*, report for the International Energy Initiative, Bangalore, India.

Davis, G & Herat, S 2009, ‘Opportunities and constraints for developing a sustainable e-waste management system at local government level in Australia’, *Waste Management & Research*, vol. 28, pp. 705–713.

DECCEW 2010, *ACT sustainable waste strategy 2010–2015*, Department of the Environment, Climate Change, Energy and Water, Australian Capital Territory, Canberra, Australia.

DECCW 2011, *Reducing waste: implementation strategy 2011–2015*, State of NSW and Department of Environment, Climate Change and Water, NSW, Australia.

DEFRA 2003, *A study to estimate the disamenity costs of landfill in Great Britain*, Department for Environment, Food and Rural Affairs, London, UK.

DEFRA 2007a, *Landfill bans and restrictions*, Department for Environment, Food and Rural Affairs, London, UK.

DEFRA 2007b, *Report of the food industry sustainability strategy champions’ group on waste*, Department for Environment, Food and Rural Affairs, London, UK.

DEFRA 2009, *Waste strategy: annual progress report 2008/09*, Department for Environment, Food and Rural Affairs, London, UK.

DERM 2010, *Queensland's waste reduction and recycling strategy 2010–2020*, Department of Environment and Resource Management (Qld), Australia.

DEUS 2004, *Demand management for electricity distributors' code of practice*, Department of Energy, Utilities and Sustainability (NSW), Australia.

DEWHA 2010, *$23.0 million for the nation's new national waste policy*, media release, Department of the Environment, Water, Heritage and the Arts, Australia.

DPIWE TAS 2004, *Landfill sustainability guide 2004*, Department of Primary Industries, Water and Environment Tasmania, Hobart, Australia.

DTI 2005, *Waste electrical and electronic equipment (WEEE): innovating novel recovery and recycling technologies in Japan*, Department of Trade and Industry, UK.

Emery, A, Griffiths, A & Williams, K 2003, 'An in depth study of the effects of socio-economic conditions on household waste recycling practices in waste management and research, *International Solid Waste Association*, vol. 21, pp. 180.

Environmental Assessment Institute 2005, *Rethinking the waste hierarchy*, Environmental Assessment Institute, Copenhagen, Denmark.

Environmental Media Group 2010, 'Biowaste directive plans look set to be dropped,' 8 March 2010, viewed 1 June 2010, <www.letsrecycle.com/do/ecco.py/view_item?listid=37&listcatid=5504&listitemid=54791>.

EPA SA 2011, *Container deposit legislation FAQs*, EPA SA, viewed 14 October 2011, <www.epa.sa.gov.au/page.php?page=262>.

EPA VIC 2010, *Best practice environmental management: siting, design, operation and rehabilitation of landfills*, Environment Protection Authority Victoria, Australia.

EPHC 2009, *National waste overview*, Environment Protection and Heritage Council, Department of the Environment, Water, Heritage and the Arts, Australia.

EPHC 2009a, *National waste policy: less waste, more resources*, Environment Protection and Heritage Council, Department of the Environment, Water, Heritage and the Arts, Australia.

EPHC 2010a, *National waste report 2010*, report for the Department of the Environment, Water, Heritage and the Arts, Australia.

EPHC 2010b, *National waste policy implementation plan*, report for the Department of the Environment, Water, Heritage and the Arts, Australia.

European Commission 2010, *Being wise with waste: the EU's approach to waste management*, Luxembourg: Publications Office of the European Union, ISBN 978-92-79-14297-0.

Fane et al. 2011, *Integrated resource planning for urban water – resource papers, waterlines report*, National Water Commission, Canberra, Australia.

Foster, P 2010, 'New rules target commercial food waste', *BioCycle International*, pp. 31–32.

Franchetti, MJ 2009, *Solid waste analysis and minimization: a systems approach*, McGraw-Hill Companies, New York, USA.

Gertsakis, J & Lewis, H 2003, *Sustainability and the waste management hierarchy – a discussion paper on the waste management hierarchy and its relationship to sustainability*, report prepared for EcoRecycle Victoria, Australia.

GES 2002, *Estimating the social cost of carbon emissions*, working paper 140, UK Government Economic Service (GES), London, UK.

GHD 2009, *Waste technology and innovation study: final report*, GHD report for Department of the Environment, Water, Heritage and the Arts, Australia.

Giurco, D, Prior, TD, Mudd, GM, Mason, L & Behrisch, JC 2010, *Peak minerals in Australia: a review of changing impacts and benefits*, Institute for Sustainable Futures, UTS & Department of Civil Engineering, Monash University, Australia.

Golder Associates Pty Ltd 2011, *Whytes Gully new landfill cell: preliminary environmental assessment*, report submitted to Department of Planning and Infrastructure, NSW, Australia.

Gorecki, PK, Acheson, J & Lyson, S 2010, *An economic approach to municipal waste management policy in Ireland*, The Economic and Social Research Institute Dublin.

Government of Tasmania 2009, *The Tasmanian waste and resource management strategy*, report for Environment Division, Department of Environment, Parks, Heritage and the Arts, viewed 1 June 2010, <www.environment.tas.gov.au/file.aspx?id=5857>.

Government of Western Australia 2010, *Draft II: waste strategy for Western Australia*, Western Australian Waste Authority, viewed 21 August 2011, <www.zerowastewa.com.au/documents/waste_strategy_draft2_mar2010.pdf>.

Graedel, TE 1996, 'On the concept of industrial ecology', *Annual Review*, vol. 21, pp. 69–98.

Hansen, W, Christopher, M & Verbuecheln, M 2002, *EU waste policy and challenges for regional and local authorities, background paper for the seminar on household waste management: capacity building on European community's environmental policy*, Ecologic, Institute for International and European Environmental Policy, UK.

Hayashi, K 2009, 'State-of- the-art technologies for metal recycling', *Message from Nagoya, Japan, Asia to World Resources Forum*, Davos, Switzerland, pp.17.

Hirschhorn, J, Jackson, T & Baas, L 1993, 'Towards prevention – the emerging environmental management paradigm', in *Clean production strategies – developing preventative environmental management in the industrial economy*, CRC Press, USA.

House of Commons (Environment, Food and Rural Affairs Select Committee) 2010, *Waste Strategy for England 2007: Third Report of Session 2009–10*, January 2010, UK.

Howlett, P 2003, *'Waste watch – decisive game plan needed if we want to reach home base'*, WME Environmental Business Media, viewed 2 November 2011, <www.wme.com.au/categories/waste_managemt/nov2_03.php>.

Hyder Consulting Pty Ltd 2009a, *Australian landfill capacities into the future*, report for the Department of the Environment, Water, Heritage and the Arts, Australia.

Hyder Consulting Pty Ltd 2009b, *Waste and recycling in waste and recycling in Australia (amended report)*, report for the Department of the Environment, Water, Heritage and the Arts, Australia.

Inayatullah, S 1998, 'Causal layered analysis: post structuralism as method', *Futures*, vol. 30, iss. 8, pp. 815–829.

IPCC 1996, *Revised IPCC guidelines for national greenhouse gas inventories: reference manual (volume 3)*, Intergovernmental Panel on Climate Change.

ISF 2004a, *Beyond recycling: an integrated waste management, part A: developing an integrated waste management strategy and empowering the community*, Institute for Sustainable Futures, University of Technology Sydney, Australia.

ISF 2004b, *Beyond recycling: an integrated waste management framework for local government, part B: recycling in context – the current situation*, Institute for Sustainable Futures, University of Technology Sydney, Australia.

ISF 2011, *Integrated resource planning for urban water*, Institute for Sustainable Futures, University of Technology Sydney, Australia.

Kaufman, SM, Krishnan, N & Themelis, NJ 2010, 'A screening life cycle metric to benchmark the environmental sustainability of waste management systems', *Environmental Science and Technology*, vol. 44, pp. 5949–5955.

Kijak, R & Moy, D 2004, 'A decision support framework for sustainable waste management', *Journal of Indian Ecology*, vol. 8, iss. 3, pp. 33–50.

Larsen, K, Turner, G, Ryan, C & Lawrence, M 2011, *Victorian food supply scenarios: impacts on availability of a nutritious diet*, Victorian Eco-Innovation Lab (University of Melbourne), CSIRO and Deakin University, Melbourne, Australia.

Lee, P & Willis, P 2010, *Waste arisings in the supply of food and drink to households in the UK*, report by WRAP and Oakdene Hollins, UK.

LGAT 2007, *Local government response to draft waste management strategy for Tasmania*, Local Government Association of Tasmania, Australia.

Lim, JS & Missios, P 2007, 'Does size really matter? Landfill scale impacts on property values', *Applied Economics Letters*, vol. 14, iss. 10, pp. 719–723.

Lim, SR & Schoenung, JM 2010, 'Human health and ecological toxicity potentials due to heavy metal content in waste electronic devices with flat panel displays', *Journal of Hazardous Materials*, vol. 177, iss. 1–3, pp. 251–259.

Lovins, A 1976, 'Energy strategy: the road not taken', *Foreign Affairs*, vol. 55, iss. 65.

Makela, T 2009, *EU policies for sustainable resource management*, European Commission – DG environment, keynote presented at the World Resource Forum, 16th September 2009, Davos, Switzerland.

Mazzanti, M & Zoboli, R 2008, 'Waste generation, waste disposal and policy effectiveness: evidence on decoupling from the European Union', *Resources, Conservation and Recycling*, vol. 52, iss. 10, pp. 1221–1234.

McDonough, W & Braungart, M 2002, *Cradle to cradle: remaking the way we make things*, North Point Press, USA.

McDougall, FR, White, PR, Franke, M & Hindle, P 2001, *Integrated solid waste management: a life cycle inventory*, 2nd Edition, Blackwell Science, USA.

McKinsey and Company 2009, *An Australian cost curve for greenhouse gas reduction*, McKinsey and Company, Sydney, Australia.

McLennan Magasanik Associates 2007, *South Australia's waste strategy 2005–2010*, Ex-ante Benefit Cost Assessment, Volume 2: Technical Report, BDA Group, Australia.

Moore, C 2011, 'Getting on the garage sale trail', *ABC Environment*, viewed 8 April, <www.abc.net.au/environment/articles/2011/04/08/3185880.htm>.

Motamedi, L 2005, *Energy efficiency in California*, discussion with the EPA State Energy Efficiency/Renewable Technical Forum, April 11 2005, Division of Strategic Planning, California Public Utilities Commission, California, USA.

Moutavtchi, V, Stenis, J, Hogland, W & Shepeleva, A 2010, 'Solid waste management by application of the WAMED model', *Journal of Mater Cycles Waste Management*, vol. 12, pp.169–183.

NAPP-Utilities 2010, *Information on demand response*, North America Power Partners – Utilities, <www.nappartners.com/demand-response-for-utilities/>.

NCDD 2009, *Core principles for public engagement*, National Coalition for Dialogue and Deliberation, <www.ncdd.org/pep/> and <www.thataway.org/files/Core_Principles_of_Public_Engagement.pdf>.

Nelson, AC, Genereux, J & Genereux, M 1992, 'Price effects of landfills on house values', *Land Economics*, vol. 68, pp. 359–365.

Nolan-ITU Pty Ltd 2001, *Independent assessment of kerbside recycling in Australia*, report to the National Packaging Covenant Council, Nolan ITU Pty Ltd, Victoria. Australia.

NSW Government 2007, *Co-collection of domestic food waste and garden organics: the Australian experience*, report number DEC 2007/22, Department of the Environment and Conservation, New South wales, Australia.

NSW Government 2010, *Review of waste policy and strategy in NSW*, report by the Steering Committee for the Review of NSW Waste Policy and Strategy, Department of Environment, Climate Change and Water, NSW, Australia.

NT Government 2010, *Re-thinking Waste Strategy*, report by the Environment, Heritage and the Arts Division within the Department of Natural Resources, Environment, the Arts and Sport, Northern Territory, Australia, viewed 1 June 2010, <www.nt.gov.au/nreta/environment/waste/rethink/>.

OECD 1996, *Legal and administrative approaches in member countries and policy options for EPR programs*, Extended Responsibility in the OECD Area Phase 1 Report, Group on Pollution Prevention and Control, Environment Policy Committee, Organisation for Economic Co-operation and Development, Paris, France.

Pickin, J & Wardle, C 2009, *Peer review of the full cost of landfill disposal in Australia*, report prepared for the Department of the Environment, Water, Heritage and the Arts, Australia.

Pigneri, A 2006, *H2-IRP – Integrated resource planning for the development of hydrogenenergy infrastructures*, presented at the World Hydrogen Energy Conference, 13–16 June, Lyons, France.

Productivity Commission 2006, *Waste management*, report no. 38, Canberra, Australia.

Rabl, A, Spadaro, JV & Zoughaib, A 2008, 'Environmental impacts and costs of solid waste: a comparison of landfill and incineration', *Waste Management and Research*, vol. 26, pp. 147–162.

Rawtec 2009, *South Australian recycling industry: investment review*, Zero Waste South Australia, Adelaide, Australia.

Robert, KH, Schmidt-Bleek, B, Aloisi de Larderel, J, Basile, G, Jansen, JL, Kuehr, R, Price Thomas, P, Suzuki, M, Hawken, P & Wackernagel, M 2002, Strategic sustainable development-selection, design and synergies of applied tools, *Journal of Cleaner Production*, vol. 10, iss. 3, pp. 197–214.

RPM Pty Ltd, Kenny Lin & Associate & Energy Strategies Pty Ltd 2001, *The actual costs of waste disposal in the ACT*, report for ACT Waste Department of Urban Services, Canberra, Australia.

Schmidt, JH, Holm, P, Merrild, A & Christensen, P 2007, 'Life cycle assessment of the waste hierarchy – a Danish case study on waste paper', *Waste Management*, vol. 27, iss. 11, pp. 1519–1530.

Scott, J, Beydound, D, Amal, R, Low, G & Cattle, J 2005, 'Landfill management, leachate generation, and leach testing of solid wastes in Australia and overseas', *Critical Reviews in Environmental Science and Technology*, vol. 35, iss. 3, pp. 239–332.

Seadon, JK 2010, *Integrated resource management*, PhD Thesis, University of Auckland, New Zealand.

State of Victoria 2009, *Metropolitan waste and resource recovery strategic plan: part 3 – metropolitan landfill schedule*, Department of Sustainability and Environment, Victoria, Australia.

Stuart, T 2009, *Waste: uncovering the global food scandal*, Penguin Books, London.

Tellus Institute 1998, *Using WastePlan to enhance full cost accounting and integrated waste management in Wisconsin*, report for the University of Wisconsin-Extension's Solid and Hazardous Waste Education Centre, Boston, USA.

The Australia Institute 2009, *What a waste: an analysis of household expenditure on food*, Policy Brief No. 6, Canberra, Australia.

Turner, AJ, Willetts, JR, Fane, SA, Giurco, D, Chong, J, Kazaglis, A & White, S 2010, *Guide to demand management and integrated resource planning (update on original 2008 guide)*, Water Services Association of Australia (WSAA), Sydney, Australia, pp. 1–174.

UK Parliament 1998, *Sustainable futures: proposal for a council directive on the landfill of waste*, Seventeenth Report, Select Committee on European Communities, UK.

UNEP 2000, *Towards the global use of life cycle assessment*, United Nations Environment Programme, Nairobi, Kenya.

UN-HABITAT 2010, *Solid waste management in the world's cities*, UN-HABITAT, Nairobi, Kenya.

URS 2010, *Final report: pre-feasibility assessment of a thermal conversion facility for the Australian Capital Territory*, report for the Department of the Environment, Climate Change, Energy and Water, Australia.

US EPA 2006, *Global mitigation of non-CO_2 greenhouse gases*, United States Environmental Protection Agency, USA.

US EPA 2010, *Conserving resources, preventing waste, Waste Wise program*, Office of Resource Conservation and Recovery, United States Environmental Protection Agency, USA.

US EPA n.d.b *eCycle cell phones, waste, partnerships, plug into eCycle*, United States Environmental Protection Agency, USA.

van Haaren, R, Themelis, N & Goldstein, N 2010, 'The state of garbage in America', *BioCycle*, vol. 51, iss. 10, pp. 16–23.

WA Waste Authority 2010, *Waste strategy for Western Australia. Draft II*, WA Waste Authority Australia.

Waste Management World 2010, *Opportunities abound in Anaerobic Digestion*, viewed 1 June 2010, <www.waste-management-world.com/index/display/article- display/2813669772/articles /waste-management-world/volume-11/issue-1/features/opportunities-abound.html>.

Waste Management World 2011, *US e-waste strategy and voluntary commitment*, viewed 14 October 2011, <www.waste-management-world.com/index.html>.

Watson, R & Peterson, P 2011, *A brief survey of state integrated resource planning rules and requirements*, Synapse Energy Economics for the American Clean Skies Foundation, USA.

WCS 2008, *ACT No waste strategy and targets: review & assessment of options (revised final report)*, ACT NoWaste, Canberra, Australia.

WCS 2009, *Public review: landfill capacity and demand*, Report for the State Government of New South Wales, Australia.

WCS 2010, *Review of the application of landfill standards*, Wright Corporate Strategy Pty Ltd, Sydney, Australia.

White, S & Brennan, T 2010, 'Reframing urban transport decision making', *Rail Express*, vol. Nov 2010, no. 3, pp. 87–91.

White, S 2001, *Demand management and integrated resource planning in Australia*, presented at the Efficient Use and Management of Water for Urban Supply Conference, 21-23 May 2001, Madrid, Spain, <www.isf.uts.edu.au/publications/white2001demandmanagementAustralia.pdf>.

White, S, Aisbett, E, Awad, I, Bubna-Litic, K, Calvert, F, Chanan, V, Cordell, DJ, Hendriks, C, Lee, N, O'Rourke, A, Palmer, JM, Robinson, J, Young, E & Sarac, K 2001b, *Independent review of container deposit legislation in NSW – volume 2, costs and benefits of container deposit legislation in NSW*, Institute for Sustainable Futures, University of Technology Sydney, Sydney, Australia.

White, S, Calvert, F, Cordell, DJ, O'Rourke, A, Waters, SC & Young, E, 2001a, *Independent review of container deposit legislation in NSW – volume 1, extended producer responsibility: principles, policy and practice in NSW*, Institute for Sustainable Futures, University of Technology Sydney, Sydney, Australia.

White, S, Campbell, D, Giurco, D, Snelling, C, Kazaglis, A & Fane, S. 2006, *Review of the Metropolitan Water Plan: final report*, prepared by the Institute for Sustainable Futures for the Cabinet Office of NSW, Sydney, Australia.

White, S, Fane, SA, Giurco, D & Turner, AJ 2008, 'Putting the economics in its place: decision-making in an uncertain environment', in C. Zografos and R. Howarth (eds), *Deliberative ecological economics*, Oxford University Press, New Dehli, India, pp. 80–106.

WMAA 2008, *Bioreactor landfill technology*, *discussion paper for information and comment*, Waste Management Association of Australia, National Landfill Division, Australia.

WMAA 2009, *The national landfill survey results*, Waste Management Association of Australia, Burwood, Australia, <belenos.webcity.com.au/~wma49418/landfill_public/>.

WME 2011, *Waste industry report 2011/2012*, Chapter 4, Commonwealth Waste Management Frameworks, viewed on 16 October 2011, <www.wme.com.au/insidewaste/downloads/ch.4_IndustryReport_Preview.pdf>.

Worldwatch Institute 2011, *Opposition to waste-to-energy: a waste of waste?,* Climate and Energy Blog, pp.1–6, <blogs.worldwatch.org/revolt/opposition-to-waste-to-energy-a-waste-of-waste/>.

WRAP 2011, *Love food hate waste*, WRAP UK, London, viewed 1 June 2010, <www.lovefoodhatewaste.com>.

Wright, AG 2009, *Strategic review – putrescible landfill demand and capacity for the Sydney region*, Government of NSW, Sydney, Australia.

Xu, X, Rudolph, V & Greenfield, P 1995, *Measuring the environmental cost of landfill*, University of Queensland, Australia.

Xu, X, Rudolph, V & Greenfield, P 1999. 'Australian urban landfills: management and economics', *Waste Management Research*, vol. 17, p. 171.

Zero Waste SA 2006, *Alternative waste technologies: position paper*, Zero Waste SA, Adelaide, Australia.

Zero Waste SA 2010, *South Australia's waste strategy 2010-2015: consultation draft*, Zero Waste SA, Adelaide, Australia.

Zero Waste SA 2011, *Zero Waste and climate change*, Zero Waste SA, Adelaide, Australia, <www.zerowaste.sa.gov.au/>.

Zhao, GZ, Wang, H, Zha, D, Xu, J, Rao, KY, Ma, HMS & Wang, Z 2009, 'PBBs, PBDEs, and PCBs in foods collected from e-waste disassembly sites and daily intake by local residents', *Science of the Total Environment*, vol. 407, iss. 8, pp. 2565–2575.

APPENDIX A.

Project overview

This report

This sustainability costs report is one of six deliverables and forms part of the Landfill Futures project carried out by the Institute for Sustainable Futures (ISF) funded by CRC CARE.

Research objectives and approach

The aim of this research is to undertake a detailed analysis of the role of landfills in Australia in relation to other waste mitigation approaches. The research uses issues identification, situation analysis, review of existing literature, policy mapping and participatory stakeholder engagement methods. Strategic analysis of these outcomes will yield a suite of potential policy options, which will be peer reviewed in a policy forum.

This project takes a purposefully broad perspective on managing waste and resources, in line with international best practice.[23] That is, the system boundary includes the whole production and consumption value chain, rather than just post-consumption waste. Historically in Australia, disposal to landfill has been the dominant means for managing waste, however today there are a large range of measures in use that can be classified as disposal, recovery, reuse or avoidance measures. Intervention points can occur at all stages of the production and consumption chain. Further, this project takes a futures perspective (i.e. by asking how do we want to manage resources in 30 years?), while acknowledging the inertia of the past and challenges associated with the current context (such as sunk costs associated with existing landfill infrastructure). Finally, the project considers the current and future roles and responsibilities of all stakeholders.

This research seeks to provide support for improved decision making at the many levels of government who each have jurisdictions over waste. The project will also deliver potential policy options related to decision making processes themselves.

Figure A1 displays an overview of the project's research and the projects internal and external deliverable outputs.

[23] In this project, waste is defined as all waste that does or would otherwise be sent to landfills. This focuses on MSW, C&I and C&D waste. In all jurisdictions in Australia hazardous waste has specific disposal and treatment requirements and is governed by specific regulation, separate to that of general municipal waste, commercial and industrial and construction and demolition waste (EHPC 2009). For this project hazardous waste is considered to the extent that it is an identified waste stream, and historically may have been disposed of at landfill. However hazardous waste and its specific disposal, treatment or mitigation requirements is not a focus of this research or report. Mining, agricultural and other rural wastes that are typically managed onsite or via other means than landfilling are excluded from the scope of this project. Liquid waste is also excluded, unless explicitly stated otherwise.

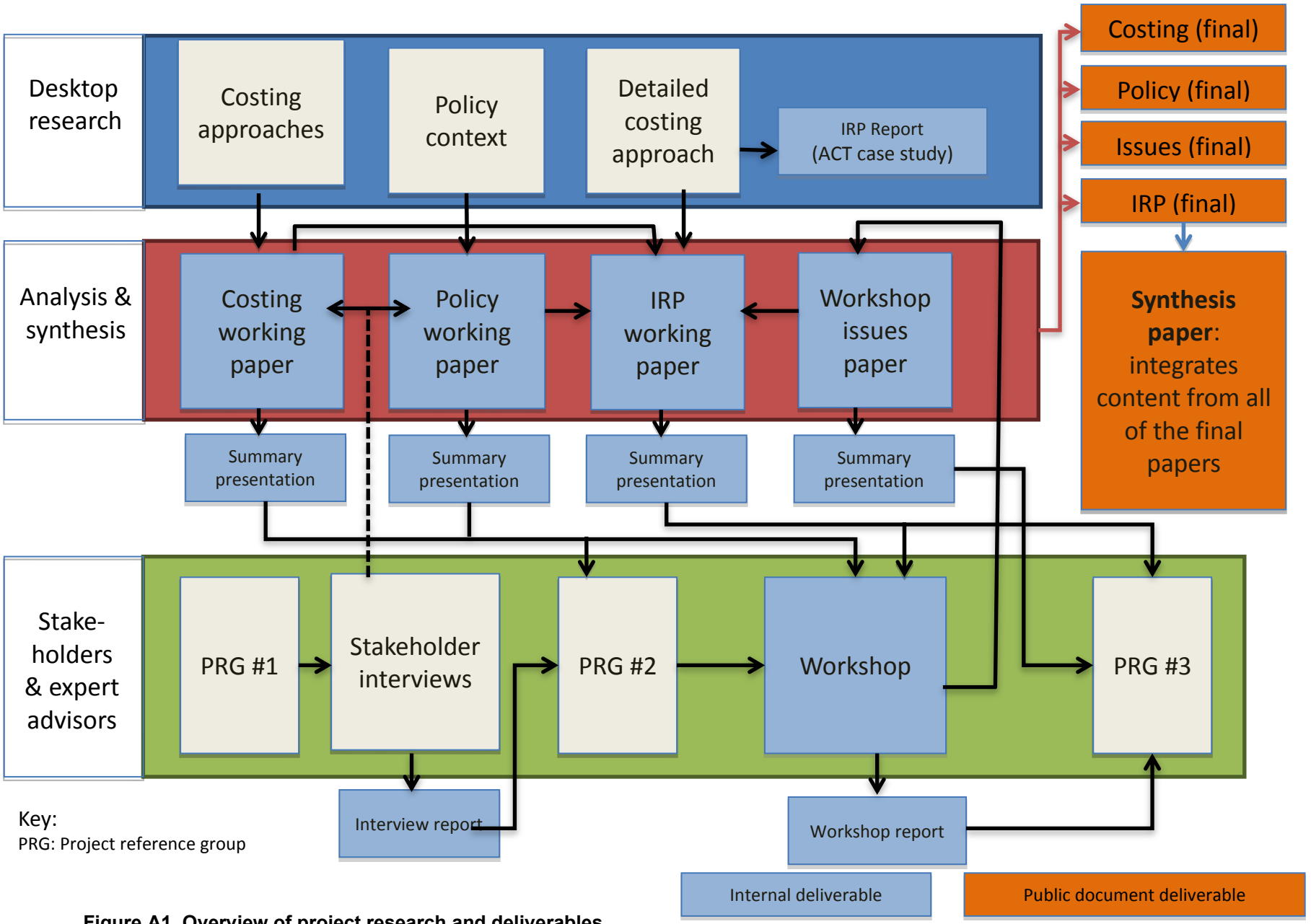

Figure A1. Overview of project research and deliverables.

APPENDIX B.

Interview methodology

The Institute for Sustainable Futures (ISF) conducted semi-structured interviews with key stakeholders in the waste management sector, as part of the Landfill Futures Project. A total of twelve interviews were carried out in August–September 2011. The interviews provided a range of views regarding current trends and future opportunities relating to landfills and waste management policy in Australia. Respondents were suggested and selected based on their knowledge, expertise and experience of waste and landfills. In addition, interview participants were chosen to ensure a broad geographic spread across Australia and a range of backgrounds across different sectors of the waste spectrum (e.g. government, industry, consulting and academic).

Key findings include the identification of a broad agreement on the relevance of environmental and social sustainability in waste management, and a range of different justifications for this view. Respondents also generally agreed that over time, community attitudes and awareness of waste issues have improved, however many stakeholders indicated that they believed further progress is needed in the area of behaviour change, and provided a number of examples of various barriers to change. The views of respondents from certain sectors (e.g. government) were varied, and highlighted the different situations and challenges relating to landfills and waste management across Australia's jurisdictions.

Prior to conducting the interviews, ISF obtained University of Technology, Sydney (UTS) ethics approval, and interview process was designed in line with the ISF Code of Ethics. All participants consented to participating in a recorded interview. Twelve individuals from different organisations were interviewed, covering a range of sectoral backgrounds including government, industry, consulting, academic research and non-government organisations. In addition, interview participants came from a range of jurisdictions. See Table B1 for details of the spread of participants.

Table B1: Interview participants' sector and geographical location.

	Government	Industry	Consulting	Research	NGO
NSW	1				1
Victoria		1			
Queensland		1			
SA	1				
WA	1				
Tasmania	1				
National		1	2	1	1

Participants were recruited with the assistance of the Project Reference Group (PRG)[24], who suggested key stakeholders in the field of landfills and waste

management across Australia. Interview questions were developed internally and reviewed by the PRG and consider the key objectives of the research (see Appendix A: Project overview). The goal was to frame the interviews as being focused on current pressures on landfill management, emerging issues and trends in landfill management but leave them open in relation to respondent's underlying views on what waste is, the management of waste and potential alternatives.

With one exception (face-to-face interview), all interviews were conducted by phone. All interviews were semi-structured, allowing the interviewer to guide the general theme of the interview around a series of predetermined core questions, and allowing participants to provide a rich array of comments related to the question and grounded in their own experience. Interviews lasted between half to one hour.

Recorded interviews were later transcribed and responses qualitatively analysed using NVivo software, a qualitative data analysis tool (Bazeley 2007). Using this software, the first level of analysis identified key themes and challenges, and illustrative quotes that highlighted particularly significant issues (see for example, text boxes in later sections). A second level of analysis involved the identification of similarities and differences in participant responses. Vertical dimensions (themes that span across the interviews) and horizontal dimensions (perspectives from each interview alone) were analysed to obtain an understanding of the depth and breadth of views and themes emerging from the interviews. Responses relating to key challenges, new ideas and opportunities, or issues relating to policy and significant gaps in understanding, have provided a firsthand account of issues that have been identified through literature reviews.

Some themes were pre-identified in the broader research methodology, while other themes and issues have emerged organically. An interview response matrix was also developed to encapsulate all participants' responses.

APPENDIX C.

Agenda

8:30 – 9:00 am	**Arrival and registration**
9:00 – 9:35 am	**Welcome** Introduction: Damien Giurco Getting to know each other: Sally Asker Project background: Stuart White
9:35 – 10:30 am	**The conversation** The conversation: Jade Herriman Conversation prompt speakers: Darren Perrin, Paul Starr & Stuart White
10:30 – 10:50am	**Morning tea**
10:50 – 11:20 am	**The conversation continued**
11:20 – 12:30 pm	**'Future of waste'** Group activity: Sally Asker & Jade Herriman
12:30 – 1:30 pm	**Lunch** in the Water Grill restaurant
1:30 – 2:40 pm	**Futures research & futures roundtables** Introduction – looking forward: Damien Giurco Futures roundtables
2:40 – 3:10 pm	**Report back** Working afternoon tea
3:10 – 3:30 pm	**Reflections & overview** Closing: Damien Giurco

APPENDIX D.

Participants

Potential participants from the following types of organisations were invited to take part in the workshop:

- local government associations and larger local government authorities
- waste management organisations (e.g. landfill operators and recyclers)
- waste management contractors
- waste management consulting firms
- industry associations
- policy and regulatory (i.e. government) bodies
- professional associations, and
- environmental NGOs.

Workshop attendees

Name	Organisation	State	Role
Colin Sweet	Thiess		Manager – AWT
Max Spedding	WMAA		Landfill division
Paul Perkins	Kimbriki Environmental Enterprises		
Ron Wainberg	WMAA	NSW	National president and Manager, Waste and resources section, Hyder Consulting
Val Southam	WMAA	NSW	CEO
Rebecca Walter	WMAAYP	NSW	YP committee
Ylva Engqvist	WMAAYP	NSW	YP committee
Tamara O'Shea	Department of Environment and Resource Management	QLD	General Manager, Waste reform
Karen Cosson	Sustainability Vic	VIC	
Dr Paul Starr	Department of Sustainability, Environment, Water, Population and Communities	ACT	Acting Director, Waste Reform and Reporting (economist specialising in significance of waste strategy data)
Mark McKenzie	City of Sydney	NSW	
Miranda Ransome	BioHazard Waste Industry Group	NSW	Deputy Chairperson
Darren Perrin	SKM	QLD	Waste group
Frank Klostermann	Thiess	NSW	Manager, Market development & engineering
Stuart Dever	GHD		Principal Engineer – Waste management
Stuart White	Institute for Sustainable Futures	NSW	Director
Damien Giurco Jade Herriman Sally Asker Dustin Moore Leah Mason Anna Gero	Institute for Sustainable Futures: *Workshop Organising Committee*		

APPENDIX E.

Speakers

Dr Darren Perrin: Dr Perrin has relocated from Manchester, UK to Brisbane, Australia. He is a chartered waste manager and currently works for SKM. Dr Perrin has worked in consultancy in the public sector on a wide range of waste projects, supporting local authorities, central government and their associated bodies with the production of national guidance documents, data research studies, strategic reviews, option appraisals and the procurement and implementation of waste collection and treatment systems. Dr Perrin was a trainer on a two-year project funded by DEFRA and Local Authority Recycling Advisory Committee providing advice and guidance on waste composition, strategy and the performance of different residual waste treatment technologies to local authorities across England. He has recently delivered waste strategy reform workshops on behalf of WasteMINZ in Wellington and Auckland and supported the Department of Environment and Resource Management in Queensland, on a review of their data collection system and reporting needs.

Dr Paul Starr: Dr Starr is the Acting Director, Waste Reform and Reporting, at the Federal Department of Sustainability, Environment, Water, Populations and Communities. Dr Starr is an economist and specialises in significance of data for waste strategy. He has been instrumental in developing the *National Waste Policy* which sets the direction for Australia over the next ten years to produce less waste for disposal and manage waste as a resource to deliver economic, environmental and social benefits.

Professor Stuart White: Prof. White has over twenty years' experience in sustainability research, and as Director of the Institute for Sustainable Futures, Professor White's work focuses on achieving sustainability outcomes at least cost for a range of government, industry and community clients across Australia and internationally. This includes both the design and evaluation of programs for improving resource use efficiency and an assessment of their impact. Through the Institute Stuart is currently involved with research on industrial ecology projects, Australian minerals futures and decision making frameworks for local government in relation to waste. Prof. White will introduce IRP as a possible tool for future waste decision making and policy formation. IRP is widely used in energy and water decision making, though there is limited research around it's adaptability to the waste context. This approach includes considering a full suite of costs of various waste management and mitigation options, as well as involving communities in setting objectives and the selection of options.

APPENDIX F.

Background material for participants

The future of waste – A conversation exploring pathways for a sustainable future

This workshop confirmation and background reading pack is for confirmed participants of the research workshop being held on 23rd November 2011 by the Institute for Sustainable Futures.

It contains venue and event details, a workshop overview, and more details about each of the four afternoon discussion topics.

This is the only background reading required prior to the workshop. For those interested, a series of more detailed draft research papers will be available for review & comment after the event. Participants of the workshop will be acknowledged in the final report and the final report will be sent to all interested participants.

We look forward to seeing you on the day.

Event and venue details

When: Wednesday, 23rd November 2011

8.45 registration for 9am start, close by 3pm

Where: Kirribilli RSL

11 Harbourview Crescent, Lavender Bay, 2060

Getting there: The venue is a few minutes' drive from the northern exits of the Sydney Harbour Bridge or a short walk from Milsons Point train station: www.131500.com.au/plan-your-trip Some limited car parking is available on site: www.kirribilliclub.com.au/wp-content/uploads/2011/05/Car_Parking_Facilities.pdf

Contact details: Venue: 02 9955 2245; Organisers: before the event: sally.asker@uts.edu.au or (02) 9514 4950 or 0450 638 363 on the day.

Make your valuable input on vision for pathways towards Australia's landfill future. Help inform greater collaboration between the broad range of stakeholders involved in waste management and mitigation in Australia.

Workshop overview

Scope and format

- The day will feature presentations by speakers; reflections on the current issues facing waste management and mitigation, and a session considering a range of futures associated with several key issues relevant to this piece of research.
- The workshop will involve key industry & government stakeholders and be used to explore the feasibility of a new decision making approach to waste, in the context of the current policy landscape. The workshop has a futures focus and a systems focus – 'what are the possible futures?' and 'what is our preferred future?'
- The workshop will both road test and feed into research being conducted by the Institute for Sustainable Futures.

Morning session

In the morning we will hear from speakers and discuss their presentations, as well as identifying on the current situation for waste management and mitigation.

Afternoon sessions

The afternoon session will involve roundtable discussions about key questions relevant to this research:

1. Could Integrated Resource Planning (IRP) be a useful tool in the waste sector? If so, what would be needed to make it work?
2. How do we design and obtain appropriate costing and pricing to reach desired change for the future?
3. How do the relationships between different levels of government affect decision-making with respect to waste?
4. How might we engage stakeholders and the broader community in waste decision making in the future? What role is there for more deliberative approaches?

Each topic will be explored on a roundtable. A fifth wildcard roundtable will be an option, with any key topic arising from the morning's discussion which people may also want to focus on.

Participants will be free to select a roundtable topic that aligns with their interests. People can also move tables if they wish to contribute to discussions at more than one table.

Please see the following 4 pages for a more detailed outline of each of the four afternoon roundtable discussion topics.

Futures roundtable topic A:

Could Integrated Resource Planning (IRP) be a useful tool in the waste sector?

And if so, what would be needed to make it work?

Background framing:

Research indicates that there is an absence of a high-level integrated frameworks or tools currently being used in the Australian context to support decision-making on sustainable waste mitigation strategies (from disposal through to avoidance and resource recovery options). Such a framework would allow for improved decision-making and policy development, by enabling a robust economic comparison of policy options for waste mitigation, taking into account sustainability aspects.

Integrated resource planning (IRP) or 'least cost planning' as it is also known, is an approach to planning which allows decision makers to choose between options based on their relative costs and delivery against objectives. Unlike cost benefit assessment IRP encourages decision makers to compare a full range of options (that is 'interventions' and the policy instruments used to support them).

Could it offer an overarching framework for how to proceed?

What stakeholders said:

Several respondents questioned the concept of waste itself, stating: '*If it's being avoided, reduced or reused, then it's not waste*' and '*Waste is a verb not a noun*' and '*We are in the business of resource recovery and avoidance. It's a different paradigm.'* Several respondents noted the importance of not creating waste in the first place, and reducing production and consumption as being the best options for sustainability in waste management. Product design, including packaging, was cited as a good avoidance approach. Others did not support avoidance as a practical concept, e.g. '*I don't think there's much we can do in terms of avoidance - we can recognise that waste is going to be generated and do more about recycling it*.'

Discussion prompts:

- Is IRP potentially useful beyond the existing cost benefit framework? Might it be useful in relation to developing strategies to meet targets?
- What are the key challenges and opportunities in applying the IRP framework to waste?
- Is IRP suitable for all of the objectives of stakeholders in the waste management system, or more suitable to some of these objectives?
- If we were to use this framework how would we make sure that IRP takes into account externalities – those costs and benefits not usually considered?

- Is there anything missing in our picture of how IRP and waste would interact?

For the group:

- What are three major shifts that might help create a future where an IRP approach was useful in waste decision making?
- What would it take to make these happen?

Futures roundtable topic B:

How do we design and obtain appropriate costing and pricing to reach desired change for the future?

Background framing:

Costing and pricing is an important issue that has at times been controversial in the waste management sector. Pricing has been used as a policy instrument and there is the potential to apply it further. Appropriate analysis of the real costs of waste management is important – and this relates to landfill, carbon pricing and markets for recyclables. How to account for costs and benefits that typically are not included in decision making remains an important question.

What stakeholders said:

Several respondents noted the changing landscape regarding costs, for example the increasing levy across several jurisdictions, increasing compliance requirements and the need for industry to employ stakeholder engagement officers in response to community demands. Hidden costs were also raised, for example from an NGO representative: '*We [society] don't pay the real price for anything… it's the same with landfills – the true cost is not charged*.'

For example, '*At the moment local government don't want to pay, and landfill is too cheap. The levy will keep going up at least for the next 3-4 years but it will still be too cheap… It needs to be about $180/tonne to incentivise alternatives.'* Most respondents agreed that South Australia had the most effective financial incentives, partly due to the ability to receive rebates on the levy and revenue being reinvested appropriately in waste management and avoidance projects.

Discussion prompts:

- What's currently not working in terms of costing and pricing?
- How does costing and pricing affect your ability to reach existing goals or targets?

- Are there significant differences in the way that costing and pricing affect the achievement of goals and targets for different waste types?
- How would you ensure that you brought the community with you with costing and pricing?
- What, in your view, would be game changing in terms of costing and pricing?

For the group:

- What are three major shifts that might help create a future where costing and pricing have been adjusted to help create our desired waste future?
- What would it take to make these happen?

Futures roundtable topic C:

How do the relationships between different levels of government affect decision-making with respect to waste?

Background framing:

There are many different roles and responsibilities and different levels of resourcing for different levels of government. How do we get the mix right? While the Commonwealth is responsible for creating a national vision and has opportunities in terms of legislation (especially related to production), state governments set targets and strategies, and devise programs targeting specific waste streams and sectors. Local government has dual roles of waste management service provision, education and often waste facility management. Local and state government also play key roles in land use planning decisions that affect waste treatment infrastructure.

What stakeholders said:

Respondents from across all sectors broadly agreed that regulatory tools are a necessary element of waste management, and that the state level is an appropriate scale at which to develop these approaches. Targets were mentioned by several respondents, however there was disagreement on their effectiveness. For example, a government respondent noted:

> 'I am a zero waste fan as a concept and target. It brings in a whole set of psyches than setting other arbitrary targets'

while another believed:

> 'There is debate about how good targets are – it becomes a bit arbitrary – reaching targets should be a signal that you can go further.'

A respondent from Zero Waste South Australia noted the benefits of:

> ‘Policies around adopting targets and putting in place implementation plans to achieve those targets’

and another reflected that:

> ‘The state government is probably the right level to be setting targets and initiatives’. They need to be developed in close consultation with local councils – councils can be a reality check about what can be achieved.’

In terms of local government roles, people observed that:

> ‘There is too much burden put on local government, not enough on producers of the articles which end up in the waste stream.’ and ‘[At the] local government level, there is a gap in understanding the technology’.

Discussion prompts:

- Are the existing relationships useful in achieving objectives and targets?
- What’s working that you’d like to see more of? What needs to change?
- What are the opportunities at different levels of government to improve decision making on waste /or work towards existing targets?
- Is there enough interaction between local government and state government on the subject of waste? Is there a greater role that state or federal government could play in supporting local government decision – support (data, decision making, or information).

For the group:

- What are three major shifts that might help create a future where relationships between government support effective waste decision making?
- What would it take to make these happen?

Futures roundtable topic D:

How do we engage stakeholders and the broader community in waste decision making?

Background framing:

There has been a lot of engagement and consultation. How can we make sure it’s best practice, and how can this sector learn from others engagement experiences to design effective processes? How can we hear from the perspective of citizens as well as stakeholders? How can communities be involved in both setting the vision or targets and in selecting strategies to work towards that vision? How can we use robust

processes (including deliberative processes) that involve representative array of community members?

What stakeholders said:

Several respondents noted the community's desire to close the loop on waste, and commented that more needed to be done to educate the community on wasteful behaviour and its impact on the environment. Behaviour change was noted as a way in which to avoid waste, with one respondent stating that:

> '[There are the] Usual challenges in achieving fundamental social change – a combination of regulatory and economic reform and social communication to shift attitudes.'

Discussion prompts:

- Who do you think should be more involved in decision-making, and what difference would it make?
- How do we better involve stakeholders and the broader community in waste management decisions?
- Are people being involved at the right time in the decision making process? What additional stages would it be useful to involve community in?
- How important are members of the public in improving your sectors ability to achieve objectives and targets?
- What role does government have in supporting meaningful engagement?
- How would engage all of the right people in decision-making?

For the group:

- What are three major shifts that might help create a future where stakeholders and citizens are more engaged in waste decision making?
- What would it take to make these happen?

NOTE: Quotes included in the 'what stakeholders said' section of this document are from initial stakeholder interviews carried out in the months of August–September 2011. The interviews provided a range of views regarding current trends and future opportunities relating to landfills and waste management policy in Australia. Respondents were suggested and selected based on their knowledge, expertise and experience of waste and landfills. In addition, interview participants were chosen to ensure a broad geographic spread across Australia and a range of backgrounds across different sectors of the waste spectrum (e.g. government, industry, consulting, academic).

APPENDIX G.

Workshop evaluation form

Your name:	Name of organisation/s you work for or are active in:	Contact details:

In a few words please describe your organisation's main business interests and/or services:

In a few bullet points can you identify any changes/transformations or innovations your organisation has undertaken, or is planning to undertake, to address the National/State waste policies and strategies or targets?

What was the most interesting idea that you heard or discussed today?

Was today useful in terms of connecting with people and extending or fostering networks?

Would you like to receive our final report for this project?

Yes/No

Would you like to go on the mailing list for our monthly e-newsletter?

Yes/No

Thank you

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