Background Research Project

Management of garden and food organics produced by municipal and commercial & industrial sectors in Australia and overseas

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1 Executive summary

1.1 Introduction

In Western Australia, and most states across the country, organic materials can make up 30 to 40% of the total waste stream disposed in landfill. Although gains have been made to recycle this fraction (comprising garden and food organics from households and businesses), organics still makes up a large part of the waste stream.

The Western Australian government through the *Strategic Direction for Waste Management in Western Australia* has set an action agenda for how we can move towards a waste-free society, embracing the vision 'towards zero waste by 2020' developed by the WAste 2020 Taskforce.

The *Strategic Direction for Waste Management in Western Australia* identifies that any move towards achieving the vision set out in the Waste 2020 strategy must target the organic fraction of the waste stream going to landfill as a priority. To achieve this vision, draft waste minimisation and resource recovery targets have been set for organics diversion from landfill.

This project provides a stepping stone on the path towards meeting the zero waste vision in Western Australia by providing an update on the current status of garden and food organics recycling in Australia. Issues that need to be addressed to reduce the generation and increase the recovery of organic materials from municipal and commercial & industrial sectors are also reviewed.

Importantly, a range of policy and program initiatives implemented across Australia, Europe, United States and Asia are reviewed to help inform the development of ideas and initiatives that may be suited for application in Western Australia to better manage the organic waste stream.

1.2 Status of organics recycling in Australia

In all states, data collection systems for measuring the amount of garden and food organics generated (recycled and disposed) by the municipal and commercial & industrial sectors are gradually being implemented.

Whilst the quantity and composition of organic materials generated varies from metropolitan to rural / regional areas, studies suggest that between 140 and 236 kg of garden organics are generated per person per year in Australia. For food organics, it has been estimated that the amount generated varies between 78 and 175 kg per person each year across the country.

In municipal waste, garden and food organics are usually the dominant component, and can make up to 60 or 70% of the waste stream. The proportion of food and garden organics in commercial & industrial waste is usually lower than municipal waste, and can make up 25 to 30% of this waste stream.

Recycling rates for garden and food organics vary between states, and comparisons are difficult because of the lack of data on organic material recycling and disposal. This is particularly the case for organic materials generated in regional areas. In Victoria, approximately 28% of garden organics are recycled, whereas 53% is recycled in NSW. Accurate figures for other states are not available.

Importantly, recovery rates for food organics in all states is believed to be low, and represents an area requiring attention.

1.3 Environmental impacts and benefits of organics recycling

Diverting organic materials from the waste stream can deliver important environmental benefits, including the recovery and conservation of resources and a reduction in the quantity of organics going to landfill. Production of a compost or similar material which can be used to enhance soil fertility, plant health, crop productivity and the environment are benefits from organics recycling.

Disposing of organic material in landfill is not only a waste of resources. It also has other environmental impacts, such as:

- Contributing to landfill leachate, which can pollute groundwater and surface water;
- Produces methane, a major greenhouse gas, and other gases which are a source of odour from landfills;
- Causes the production atmospheric pollutants and greenhouse gases from fuel consumed in waste collection;
- Landfills generate dust, odours, noise, attract vermin, birds and other disease vectors; and
- Can reduce the value of other potentially recoverable materials in residual waste, such as paper, cardboard and plastics.

A number of life cycle impact assessment studies conducted in Australia and overseas demonstrate the benefits of recovering organic materials from the waste stream.

1.4 Management of garden and food organics in Australia

In metropolitan and regional centres around Australia, and in overseas territories, garden organics generated at the household is collected by councils in periodic kerbside collections. This may involve containerized 120 - 240 L bins collected weekly or fortnightly, tied and bundled collections monthly, bimonthly or quarterly, or general cleanups held once or twice a year where residents place large woody garden organics separately on the kerb for pickup.

Commercial enterprises with landscaping also generate garden organics that need to be managed. This material is normally collected and transported directly to transfer stations or to reprocessing facilities by landscaping contractors.

The majority of garden organics generated by households and businesses are processed at centralised composting facilities, and manufactured into a range of horticultural and agricultural compost products. Collection and processing of garden organics is common in NSW, Victoria, South Australia and Western Australia.

Relatively little municipal food organics is collected for recycling in Australia, though there is a tendency for food organics to be collected with garden organics. Commercial food organics recycling takes place, though the extent of flows through different parts of the supply chain are unknown. Potential paths for this material include in-vessel composting; anaerobic digestion; vermiculture; mixed waste composting; in-sink disposal to the sewerage system; direct soil injection; direct animal feeding; and rendering for animal feed production. Potential benefits and possible impacts on human health, animal health, water quality and the environment from each of these treatment or disposal options is discussed.

1.5 Markets for recycled organics

Sustainable diversion of organics from landfill requires that markets for the products be available. Diversion of organics from landfill when markets are not properly developed has led to stockpiling and partial disposal of collected material, which is inconsistent with resource recovery policy.

Markets for recycled organics in most states are reasonably well developed for the urban and amenity applications, but less developed for high volume markets such as intensive agriculture, extensive agriculture, rehabilitation, enviro-remediation and biofuels. A number of state governments are currently undertaking marketing and research and development programs in partnership with the public and private sector to help build markets for recycled organics.

1.6 Issues affecting the management of garden and food organics

A variety of issues can impact on the generation, collection, processing, beneficial recycling and disposal of organic materials and processed products. Consideration of a range of common themes is important to assist in the development of appropriate and cost effective avoidance, recovery and recycling strategies across a broad range of communities and business in metropolitan and rural / regional areas of Western Australia.

Factors that can affect the management of organic materials following their generation at the municipal or commercial & industrial level and subsequent path through the supply chain are usually economic, technical, system / infrastructure, social or environmental. These are discussed in detail in the report, but are only briefly mentioned below:

- The potential for on-site avoidance options such as home composting, worm farming and 'grass cycling'[1] to reduce the amount of garden and food organics generated by households is not well understood;

- Need for source separation to maximise the value and potential usage options for processed organic material. Treatment of organics in the residual waste stream as the principal recovery strategy produces a low quality output which may harm soils, water quality, plants, animal health and human health;

- Well planned community education programs are required to achieve good source separation, high participation and low rates of contamination;

- Hidden flows exist in the supply chain for food organics produced by the commercial & industrial sector. These hidden flows often are not available for collection and reprocessing, as many of these activities are low cost and are not subject to licensing as are other types of waste activities. Losses of food organics from the supply chain need to be taken into consideration during facility planning. Hidden flows relating to direct soil injection and direct animal feeding are associated with possible risks to soils, water quality and animal health;

- Economics of collecting and processing organic materials, and relative cost of waste disposal and disposal levies has a large impact on the feasibility of collecting and reprocessing organic materials;

[1] Grass cycling is not well known in Australia. It involves the use of mulching mowers which deposits grass clippings on the lawn to break down in-situ, potentially providing organic matter and nutrients for improving soils and turf growth.

- Environmental planning and time required for project design, planning, approval and development can be a significant issue. Lead time between project tendering and construction can be a number of years;

- Trends towards the development of regional facilities can help achieve economies of scale, but transparent decisions need to be made to take fully into account the economic, social and environmental impacts of the development;

- Best practice environmental management at reprocessing facilities is required to ensure continuing support from the community;

- Product quality is a critical issue and has a large impact on market uptake of recycled organics. Poor or inconsistent product quality undermines the confidence of users, which can compromise the viability of a reprocessing operation; and

- Development of markets is a key issue facing increased diversion of organics from landfill. Without sustainable markets, few alternatives exist for managing organics, except for landfill.

1.7 Policies and programs to encourage better management of organics

A range of statutory instruments (legislation or regulation) and supporting statutory instruments (programs, plans, covenants and agreements) designed to encourage behavioural, institutional and technological change at various points in the supply chain for garden and food organics were reviewed. The instruments may be designed to influence generation at the household or business; presentation, collection and transfer; treatment and final disposal or beneficial use.

Generally, countries that have achieved success in reducing disposal and increasing the recovery of organic material from landfill have put in place one or more of the following policies. These policies tend to be more successful if they are enforced through legislation, with financial penalties for non-compliance:

- Requirements on householders and businesses to separate organic materials at source for collection;

- Introduction of user pays systems to take into account the full cost of waste disposal. Such approaches have been very successful in reducing the quantity of municipal waste generated;

- Municipalities to collect source separated organic materials for centralised processing in areas that it is viable to do so;

- Certain types of businesses to separate organic materials for collection and centralised processing;

- Requirements for municipalities and businesses to have waste management and resource recovery plans in place, in line with overall waste reduction and resource recovery objectives set by state or federal governments. Agreed targets may be negotiated via voluntary agreements or covenants;

- Programmed increases in waste disposal taxes or levies to fund research and development, incentives for introducing collection systems and the building of critical infrastructure to enable the processing of organic materials into quality products;

- Requirements for the pre-treatment of residual waste before disposal in landfill. This helps to capture organic materials that do not enter source separate collections;

- Clear and enforceable standards on the quality of recycled organics that can be applied to land for beneficial purposes; and

- Announcement of bans for selected types of organic materials with a medium term time horizon prior to implementation (e.g. 5-6 years).

Depending on how the above policy instruments are designed to influence different parts of the organic material supply chain, voluntary supporting instruments or programs may be required to support desired policy outcomes. Program initiatives that could be considered to support the above policies are summarised as follows:

- Provide training tools and resources for community groups and local councils to assist householders to home compost;

- Support a 'WasteWise' business program or similar initiative. WasteWise is a voluntary partnership with business to reduce waste and improve resource recovery;

- Greening of government program. Encourage government departments to lead by example and develop waste reduction plans and purchasing policies that encourage purchasing of recycled organic products;

- Develop best practice guidelines for kerbside collection of organic materials and residual wastes, and offer training in preferred service standards to local government;

- Develop tools and training to assist local councils to evaluate tenders for regional organics processing facilities using best practice triple bottom line assessment methodologies;

- Work with groups of rural councils to develop regional waste management plans, with a medium to long term strategy to establish better controlled regional landfills. Link performance with financial incentives;

- Encourage investment in collection systems and infrastructure by offering financial incentives from waste disposal levies to local government to establish well controlled regional processing facilities for organic materials;

- Conduct market research and assist in the development of markets for recycled organics in partnership with other government departments and industry;

- Fund a technical advisory service in partnership with a university or educational institution to provide support for the development of the recycled organics industry.

The above policies and programs are not specific recommendations for application to Western Australia. They are a collection of instruments that have been successfully used to reduce the generation of organics, and to improve organics recovery in Australia and overseas.

Should any of these instruments be considered for potential application in Western Australia, it is recommended that detailed assessments be performed to ensure that the differing needs and constraints of communities and businesses located in metropolitan and rural / regional areas of the state are met.

2 Background and purpose of the study

The Western Australian government through the *Strategic Direction for Waste Management in Western Australia* (Department of Environment, 2003) has set an action agenda for how we can move towards a waste-free society, embracing the vision 'towards zero waste by 2020' developed by the WAste 2020 Taskforce (WAste 2020 Taskforce, 2001a).

The transition to a zero waste society by 2020 is an integral part of the government's sustainability agenda, defined in *The Western Australian Sustainability Strategy* (WA Government, 2003). This is Australia's first comprehensive whole of state sustainability strategy, demonstrating Western Australia's commitment to being a world leader in waste minimisation and environmental sustainability.

In moving towards a waste free society, the *Strategic Direction for Waste Management in Western Australia* sets challenging goals, milestones and targets to be met for reducing waste and Western Australia's dependence on landfill. This includes the need to stabilise waste generation, and to increase resource recovery activities to prevent these materials being disposed of in landfill.

The strategic direction for managing wastes in Western Australia is based on four main principles:

- Decisions about waste streams are based on the Waste Management Hierarchy;
- Resource use, including waste management, follows an Industrial Ecology approach in accordance with the principles of sustainability;
- Management approaches are based on Resource Stewardship consistent with product life cycle management; and
- Laws, regulations and policies reflect the principles of Environmental Justice.

The *Strategic Direction for Waste Management in Western Australia* identifies that any move towards achieving the vision set out in the WAste 2020 strategy must target the organic fraction of the waste stream going to landfill as a priority. To achieve this vision, draft waste minimisation and resource recovery targets have been set for organics diversion from landfill. These are:

- 50% diversion of organics by 2005;
- 75% diversion of organics by 2010;
- 85% diversion of organics by 2015; and
- 95% recovery of organics by 2020.

Organic materials, including garden organics such as lawn clippings, leaves and branches from our home gardens, public parks and gardens and commercial precincts makes up a large portion of the waste going to landfill in Western Australia each year. Together with food organics produced as kitchen scraps from our homes and businesses, and production waste from food manufacturing enterprises, these two organic materials can make up to 30 or 40% of the entire waste stream going to landfill.

Recognising the need to reduce the amount of organic materials to landfill, the WAste 2020 Taskforce prepared a series of recommended actions for the 'green and organic sector' to help in achieving the zero waste vision for Western Australia (WAste 2020 Taskforce, 2001b).

Increasing the diversion of organics from landfill will not only help to meet the challenging targets for the period leading up to 2020, but will also help to reduce the environmental impacts of waste disposal on the environment.

Implementation of services and infrastructure to help divert organic materials from landfill is occurring world-wide due to the fact that this component of the waste stream can be easily recycled into beneficial products that can be used to enhance the environment.

Studies conducted worldwide have shown that the diversion of organic materials from landfill can enhance the sustainability of urban and regional communities by:

- reducing the impacts of waste disposal on the environment, through major landfill reduction savings; reduce the quantity and toxicity of leachate generated in landfills that can impact on ground and surface water quality; reduce greenhouse gas emissions and other atmospheric impacts and improve the recoverability of other materials disposed of in the waste stream.

- conserving natural resources by lessening the need for virgin "inputs" into horticultural and agricultural industries (e.g. agricultural fertilizers, water from river systems for irrigation, peat, sand and other materials sourced from forestry operations).

- maximising the life span of existing landfills and reducing pressures on scarce urban land required for the construction of new landfills.

- helping in the creation of new recycling industries and job creation in urban and regional areas.

Amongst some of the initial actions identified in the *Strategic Direction for Waste Management in Western Australia*, the Western Australian government recommended that initial policy development occur to ban the landfilling of 'greenwaste'[2] in Western Australia.

The purpose of the study is to therefore review in detail contemporary management approaches for garden and food organics produced by the municipal and commercial & industrial sector, by drawing on experience gained across a number of jurisdictions in Australia and overseas.

The study also presents a number of issues or themes that currently impact on the management of garden and food organics, informed through experiences obtained mostly in Western Australia, Victoria, New South Wales and South Australia.

The final task of this study is to review the suite of policies and supporting programs implemented by a number of jurisdictions, both in Australia and overseas, to help inform the development of appropriate policy and programs to support the vision and goals set out in the *WAste 2020 Zero Waste Strategy* and the *Strategic Direction for Waste Management in Western Australia.*

[2] The term 'greenwaste' is being phased out in most states and territories in Australia due to the lack of clarity offered by this term. Some states have used this term to refer to garden waste, food waste and wood waste, whereas others have used this term to refer to garden wastes only. Terminology being used in New South Wales, Victoria and South Australia is as follows: garden organics; food organics and wood/timber. The 'waste' suffix is not being used to reinforce the concept that organics are recoverable materials and not necessarily waste, unless they are incorrectly managed on land or disposed in landfill.

3 Management of organic materials in Australia

3.1 Quantity by sector

In most Australian cities and rural / regional areas, organic materials are produced in varying quantities by the three main urban waste generating sectors: municipal, commercial & industrial and construction & demolition.

The quantity of organic material generated (the amount recycled and disposed as waste in landfill) by the municipal sector (from households) and the commercial & industrial sector (from businesses) varies between metropolitan and rural / regional areas, but comprises mainly garden organics, food organics, wood/timber, biosolids, paper, cardboard and sometimes materials from agricultural and forestry operations (e.g. sawdust, manures, bark, woodchips, crop residues etc).

Whilst agricultural and forestry waste materials can be classified as 'organic wastes', these are not normally managed as part of the urban waste stream and are usually excluded by councils and state government agencies responsible for assisting in the recovery of organic materials from urban landfills.

Indicative figures on the quantity of garden and food organics disposed and recycled has been reported for NSW, Victoria, Western Australia and South Australia. These figures are mainly based on metropolitan areas. Figures are presented in Tables 1 and 2.

In NSW for the 2002/03 financial year, approximately 1,577,500 tonnes of garden organics was generated across the municipal, commercial & industrial and construction & demolition sectors, which is equivalent to about 236 kg/capita/yr. This compares to a generation rate of 691,700 tonnes/yr in Victoria, or 140 kg/capita/yr. Generation rates for garden organics in Western Australia is estimated to be at least 145 kg/capita/yr, and 176 kg/capita/yr in South Australia.

The variability in garden organics generation data may be due to the compositional surveys performed, varied response rates, reliability of waste audit data available and extrapolations which have invariably been made on limited data.

In NSW for the 2002/03 financial year, approximately 796,000 tonnes of food organics was generated across the municipal, commercial & industrial and construction & demolition sectors, which is equivalent to about 119 kg/capita/yr. This compares to a generation rate of 429,000 tonnes/yr in Victoria, or 87 kg/capita/yr and 175 kg/capita/yr in South Australia. The food organics generation rate is more than 78 kg/capita/yr in Western Australia, though this figure does not contain the amount of commercial & industrial food organics generated.

Despite the variability in per capita generation rates for garden and food organics, these figures can be used as a guide for monitoring the generation or production rates for these material streams over time, and to inform the development of appropriate policies and supporting strategy to improve the recovery of these materials.

However, it should be noted that little data exists on the generation rates (recycling and disposal) for garden organics, food organics and solid waste from all sectors in rural / regional areas of most states.

Trends on the recovery of organic materials from landfill in different states around Australia are discussed in Section 3.7.

Table 1. Generation[a] rate of garden organics by sector for selected states across Australia for the 2002/03 financial year (unless otherwise indicated).

State	Municipal		Commercial & industrial		Construction & demolition		Total generated	Generation per capita	Recovery
	Recycled	Disposed	Recycled	Disposed	Recycled	Disposed	Tonnes	kg/capita/yr	% (w/w)
NSW[b]	650,500	629,500	191,500	85,000	0	21,000	1,577,500	236	53
VIC[c]	84,685	370,440	106,400	86,700	6,514	36,960	691,700	140	28
WA[d]	54,520[e]	229,100[f]	ND[g]	ND	ND	ND	> 283,620	> 145	ND
SA[h]	118,000	72,160	ND	7,081	ND	ND	197,241	176	ND

[a] Waste generation includes waste recycled and disposed of to landfill. It does not include materials avoided, such as through on-site composting or home composting. [b] Estimated NSW population in June 2003 was 6.682 million (ABS, 2005). Data reported in Department of Environment and Conservation (NSW) (2004a). [c] Estimated VIC population in June 2003 was 4.911 million (ABS, 2005). Note also that calculated figures for recovery and disposal is based on Ecorecycle Victoria (2004) and Golder Associates (1999). [d] Figures presented here are for the Perth metropolitan area. Estimated Perth metropolitan area population in June 2003 was 1.952 million (ABS, 2004). [e] Note that the amount of garden organics reported is based on Resource Recovery Rebate Scheme (RRRS) data provided by the Department of Environment for 2003/04. [f] This is an estimate based on limited kerbside waste audit data provided by the Department of Environment. The amount disposed is based on 30% of municipal waste containing garden organics, and 763,958 tonnes of municipal waste disposed in 2002 in the Perth metropolitan area (Department of Environment, 2003). [g] ND, no data. [h] Waste disposal data is available for metropolitan Adelaide only. Data sourced from SA EPA (2002c) and Zero Waste SA (2004a). Estimated population in metropolitan Adelaide in June 2003 was 1,119,900 (ABS, 2004).

Table 2. Generation[a] rate of food organics by sector for selected states across Australia for the 2002/03 financial year (unless otherwise indicated).

State	Municipal		Commercial & industrial		Construction & demolition		Total generated	Generation per capita	Recovery
	Recycled	Disposed	Recycled	Disposed	Recycled	Disposed	Tonnes	kg/capita/yr	% (w/w)
NSW[b]	0	637,000	45,500	113,500	0	0	796,000	119	6
VIC[c]	8,250	332,640	10,370	78,200	0	0	429,460	87	5
WA[d]	0	152,790[e]	ND	ND	0	0	152,790	> 78	[f] ND
SA[g]	0	85,280	74,000	33,783	0	0	196,063	175	ND

[a] Waste generation includes waste recycled and disposed of to landfill. It does not include materials avoided, such as through on-site composting or home composting. [b] Estimated NSW population in June 2003 was 6.682 million (ABS, 2005). Data reported in Department of Environment and Conservation (NSW) (2004a). [c] Estimated VIC population in June 2003 was 4.911 million (ABS, 2005). Note also that calculated figures for recovery and disposal is based on Ecorecycle Victoria (2004) and Golder Associates (1999). [d] Figures presented here are for the Perth metropolitan area. Estimated Perth metropolitan area population in June 2003 was 1.952 million (ABS, 2004). [e] This is an estimate based on limited kerbside waste audit data provided by the Department of Environment. The amount disposed is based on 20% of municipal waste containing food organics, and 763,958 tonnes of municipal waste disposed in 2002 in the Perth metropolitan area (Department of Environment, 2003).[f] ND, no data. [g] Waste generation and recycling data is available for metropolitan Adelaide only. Data sourced from SA EPA (2002c) and Zero Waste SA (2004a). Estimated population in metropolitan Adelaide in June 2003 was 1,119,900 (ABS, 2004).

3.2 Composition by sector

The composition of urban solid wastes can vary significantly and is indicative of the modes of economic activity and drivers for waste generation in each urban centre.

Across the major capital cities, overall waste composition is as follows: 40% domestic waste, 23% commercial & industrial and 37% construction & demolition (Department of Environment and Heritage, 2001).

Despite the widespread introduction of municipal organics collection and recycling systems in a number of states around Australia, organic materials still make up to 30-40% of the total waste stream that is disposed of in landfill. This represents a large source of material that can potentially be recovered and recycled into a range of beneficial products (Ecorecycle Victoria, 2000; Resource NSW, 2003a).

In municipal waste, garden and food organics are usually the dominant component. The proportion of organic material in municipal waste is normally higher than in the total waste disposed of in landfill, comprising up to 60 or 70% of the waste stream (Department of Environment, 2003; Resource NSW, 2003b) (Figure 1).

The proportion of food and garden organics in commercial & industrial waste is usually lower than municipal waste, and can make up to 25 to 30% of this waste stream by weight (Figure 2). However, if wood/timber is classified as an ‘organic material’, the proportion of organic material in commercial & industrial waste can rise to 50% by weight (Ecorecycle Victoria, 2000; Department of Environment and Conservation NSW, 2003a).

Garden organics comprises vegetation from land clearing, public parks and garden maintenance, roadside maintenance and household gardens (Department of Environment, 2003). This stream includes: grass clippings, leaves, weeds, trees and prunings, stumps and root balls (Recycled Organics Unit, 2002a).

Food organics from households and commercial & industrial premises, such as supermarkets, restaurants, shopping centers, food manufacturing enterprises, hospitals and other institutions includes: fruit and vegetable material; meat and poultry; fats and oils; seafood (including shellfish, excluding oyster shells); recalcitrants (large bones >15mm diameter, oyster shells, coconut shells etc); dairy (solid and liquid); bread, pastries & flours (including rice & corn flours); food soiled paper products (hand towels, butter wrap etc); and biodegradables (cutlery, bags, polymers) (Recycled Organics Unit, 2002a).

It is important to note that trends indicating our increasing dependence on the use of landfills for disposing of organic wastes have only been occurring for the past fifty years or so.

Increasing urbanization and changing lifestyles has seen the majority of populations move from agricultural regions to urban centres. This has removed the once common practices of using organic wastes as organic fertilizers in agricultural production systems. Together with the increased reliance of agricultural production systems on chemical nutrient inputs, such as mineral fertilizers, this has reduced the once common practice of returning organic matter and nutrients back to soils, which is critical for maintaining soil fertility and plant productivity.

Figure 1. Typical composition of municipal waste disposed of in landfill (by weight). Data is based on kerbside audits of domestic waste bins in metropolitan areas of NSW (Resource NSW, 2003b). The composition of garden and food organics is often higher where kerbside collections do not exist (e.g. some rural / regional areas).

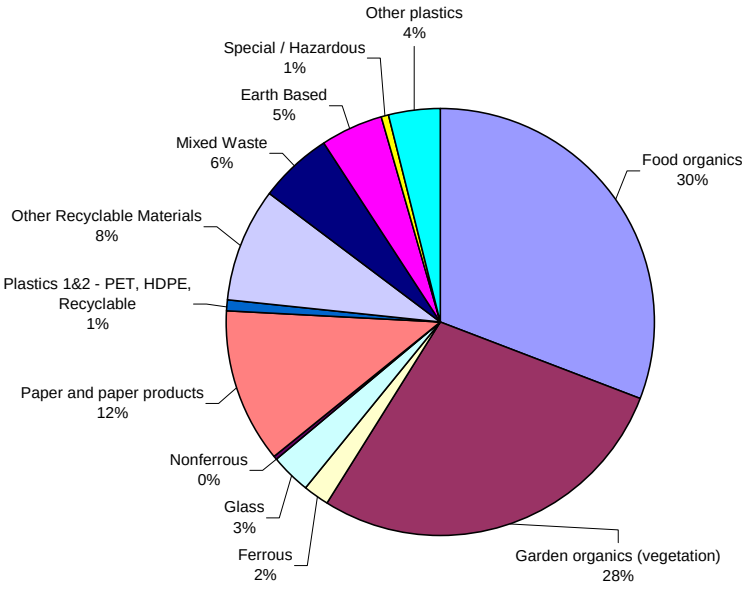
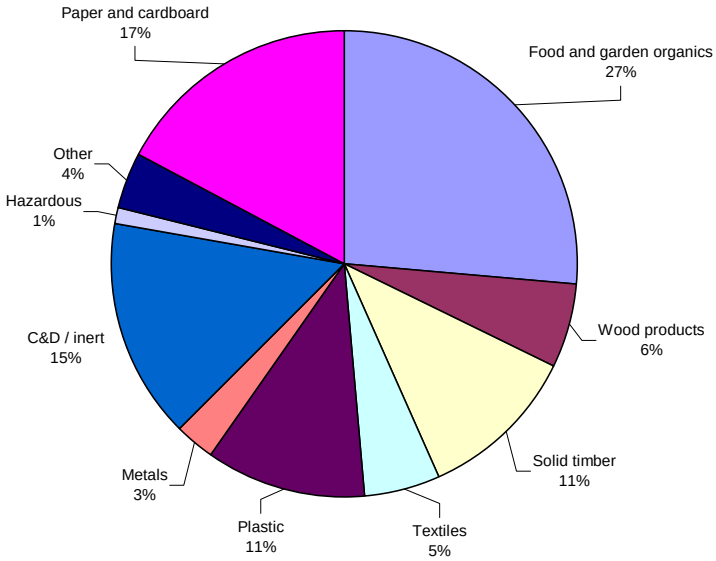


Figure 2. Typical composition of commercial & industrial waste disposed of in landfill (by weight) (Department of Environment and Conservation (NSW), 2003a).



3.3 Environmental impacts of organic waste disposal

Diverting organic materials from the waste stream can deliver important environmental benefits, including the recovery and conservation of resources and a reduction in the quantity of organics going to landfill (Department of Environment and Conservation (NSW), 2004c).

However, organic materials that are disposed in poorly managed landfills, and material that is reprocessed at poorly managed recovery facilities can impact on public health and the amenity of the community by causing disease, odours and attracting vectors (pests and vermin).

Although properly managed landfills can reduce the impact of organic waste disposal, existing landfill capacity in urban settlements is extremely scarce and proposals for new landfill sites often meet with community opposition (Department of Environment and Heritage, 2001).

Community resistance to the construction of new landfills, particularly near urban areas or on the urban fringe is a major driver for encouraging government at all levels to introduce policies and incentives which encourage waste avoidance and source reduction, waste reuse and recycling as an alternative to landfill disposal (NSW EPA, 1997a).

Tighter environmental regulation to improve the environmental performance of new and existing landfills by state environment agencies is reducing the number of landfills that exist, and has encouraged the closure of unlicensed landfills, particularly ones in environmentally sensitive areas. This has encouraged the development of regionalized landfills, which serve several communities and tend to be better located and managed, and comply with current environmental best practice.

The increasing cost of managing landfill sites, and policies that aim to reflect the full extent of environmental and social externalities of waste disposal, such as waste disposal taxes and levies, have significantly impacted on the cost of waste disposal in some states. Such policies have provided strong incentives to local government and communities to look at ways of recycling organic materials to avoid the cost of their disposal in landfill.

Disposing of organic materials to landfill is not only a waste of resources. It also has other environmental impacts, for example:

- Food and garden organics in the waste stream are the largest source of landfill leachate, which can pollute groundwater and surface water. This is especially important where communities derive potable water from underground water storages, such as the coastal plain in south-west Western Australia[3] (Russel and Higer, 1988; Borden and Yanoschak, 1990; Assmuth and Strandberg, 1993; Department of Environmental Protection, 1997a; Ecorecycle Victoria, 2000; Recycled Organics Unit, 2001a).

- Decomposing organics in landfill release methane, a major greenhouse gas, and other gases which are a source of odour from landfills. Food organics is the major source of methane production in landfills, and a significant contributor to climate change (US EPA, 1997; Recycled Organics Unit, 2001a).

[3] Many remote and rural landfills in Western Australia are unlined and are potentially polluting surface water and ground waters in an uncontrolled fashion. To date, monitoring suggests that this pollution is confined to contaminants such as nitrogen which can be assimilated in the environment by natural processes. However, increasing quantities of low hazard materials are being directed to landfill and this may eventually cause adverse environmental impacts unless action is taken to divert waste away from land disposal (WA Government, 1998).

- Transport of organic materials as waste to landfill results in emission of atmospheric pollutants and greenhouse gases from fuel consumed by collection vehicles.

- Landfills generate dust, odours, noise, attract vermin, birds and other disease vectors (Zero Waste SA, 2004a).

- Garden and food organics in residual waste can also reduce the value of other potentially recoverable / recyclable material, such as paper, cardboard and plastics.

It is now more widely understood that our tendency for disposing of organic materials in waste is significantly impacting on the balance of carbon and nutrient cycles that support the health of natural ecosystems and agricultural production systems we manage for the production of food and fibre for human consumption (European Commission, 2000; 2004).

Assisting in the return or organic material and nutrients back to agricultural production systems which produces our food and fibre is important to help in closing carbon and nutrient cycles which see the export of these resources from our agricultural soils to urban centres. The accumulation of organic matter and nutrients has significant environmental impacts in landfills, or when they are inappropriately applied to land. The appropriate reuse of these inputs in agriculture will help improve the sustainability of our urban and agricultural environments.

3.4 Environmental benefits of organics recycling

A number of life cycle impact assessment studies conducted in Australia and overseas demonstrate the benefits of recovering organic materials from the waste stream, and in many cases, processing this material into a compost output which can be used beneficially in landscaping, horticulture, agriculture and a number of other applications (SA EPA, 2002a; Ecorecycle Victoria, 2003; Department of Environment and Conservation (NSW), 2003b; Department of Environment and Conservation (NSW), 2005).

These studies have characterized the avoided landfill impacts created when organics are diverted from landfill, and importantly, the environmental benefits that follow on from applying the processed material, such as compost, as a soil amendment in landscaping, horticulture and agriculture.

In 2002, the South Australian EPA commissioned a study to quantify and evaluate, as far as possible, the broad economic, environmental and social costs and benefits of existing and potential organic waste collection, processing, and product development industries to the welfare of South Australia; so that government, industry and the community can make informed decisions on organic waste management.

The study found that greatest economic benefits to the state were derived from source separated organic collections and composting. The benefits are due to downstream agricultural flow-on benefits and high labour requirements. Environmental benefits were maximised when residual waste after source separation is treated prior to landfilling (SA EPA, 2002a).

In a study for the Department of Environment and Conservation (NSW) (2003b), the Recycled Organics Unit conducted further work to fully characterize the life cycle impacts of windrow composting of garden and food organics. The study found that compost applied to agriculture has significant environmental benefits, as measured by a number of environmental impact categories.

The study revealed environmental benefits from organics recycling and application of compost to agriculture, largely due to the reduction in use of fertilisers, herbicides, water, and electricity resulting from compost applications, and therefore reducing release of greenhouse gases, nutrients and toxic chemicals to environment (air, water, and soil) during production and use of

these avoided inputs. These beneficial impacts offset the greenhouse gases, nutrients and toxic substances released into environment during production and use of diesel and electricity required for production and application of composted products.

Life cycle impact assessment showed either a negligible or a small net detrimental environmental impact from the composting system for impact categories such as ecotoxicity potential (marine water), photochemical oxidation potential and abiotic resource depletion. The oxides of nitrogen, sulfur, and carbon (that produce photochemical oxidants) released during production and consumption of diesel fuel and electricity used in compost production and transport are currently calculated to be greater than the reduction in release of these oxides during production and use of fertilisers, herbicides, and electricity resulting from post compost application to agriculture (Department of Environment and Conservation NSW, 2003b).

In a detailed study undertaken by Ecorecycle Victoria (2003) by RMIT and Nolan ITU, a life cycle assessment of different waste and recyclables options was undertaken to better understand the full environmental impacts and benefits of different waste management scenarios.

In all scenarios modeled, net environmental benefits were maximised where organic materials were separated from residual waste and processed either through windrow composting, anaerobic digestion, and relatively new and commercially unproven thermal technologies such as gasification and pyrolysis. As in previous studies, a significant proportion of the environmental benefit was associated with the beneficial application of organic material to land. Environmental benefits were maximised in cases when residual waste was treated prior to disposal.

Similar findings were reported by the Department of Environment and Conservation (NSW) (2005) in a study by Nolan ITU on the management of garden organics. Overall financial and environmental benefits of organics recycling were generally greater when source separate collection services are provided, with treatment of the residual waste prior to landfilling through mechanical-biological treatment or thermal approaches.

In an Australian first, the study consisted of an environmental and economic valuation of different ways of managing garden organics. The study found that the combined financial and environmental benefits were maximised (for metropolitan councils with a high garden organics generation rate) in cases where fortnightly source separate collection of garden organics is provided, including the mechanical-biological treatment of residual waste. This scenario provided an average net benefit of $70.70 per household per year. A similar benefit was obtained on a per household benefit under this scenario for the generation and recycling of garden organics in regional NSW.

The study also revealed the environmental value of garden organics recycling is estimated to be Eco$114 per tonne of source-separated garden organics. This value is comprised of resource savings as well as the full range of environmental impact categories associated with avoided product credits, including air and water pollution and global warming potential. The estimate is based on extensive data analysis using the method of life cycle assessment and environmental economic valuation (Department of Environment and Conservation NSW, 2005).

It is clear that the separate collection of organic materials and conversion into products suitable for improving soils and agricultural production systems is the preferred strategy for managing organic materials generated from metropolitan and regional areas. Studies reviewed also clearly support policies requiring the source separate collection and recycling of organic materials from the waste stream, which have been implemented in Western Australia, Victoria, South Australia and New South Wales.

3.5 How organics are typically managed in Australia

3.5.1 Garden organics

Garden organics generated by the municipal and the commercial & industrial sectors in Australia is mainly collected separately from households and commercial premises and processed into composted products at centralized composting facilities. This material is generally easy to collect and process as it is not highly putrescible, like food organics.

However, there are four plants in Australia that process mixed residual municipal and commercial waste containing a proportion of non-woody garden organics (and food organics), producing a compost of varied quality. These reprocessing facilities are the exception to the norm in most urban and regional centres around the country.

The supply chain for garden organics is shown in Figure 3. This figure shows how garden organics flows from the generator, to transporters, reprocessing facilities (council or commercial facilities), markets and residuals for landfill disposal. Whilst the principal flow path in the supply chain may vary from region to region, all the main paths for the flow of garden organics are presented in this figure.

Note that for simplicity, mixed waste composting plants which process the organic component of residual waste are classified as a 'commercial reprocessing facility' in Figure 3.

3.5.1.1 Municipal garden organics

In many metropolitan and regional centres around Australia, and in overseas territories, garden organics generated at the household is either collected by councils (funded by fees from the domestic waste management charge levied on ratepayers) in periodic kerbside collections. This may involve containerized 120 - 240 L bins collected weekly or fortnightly, tied and bundled collections monthly, bimonthly or quarterly, or general cleanups held once or twice a year where residents place large woody garden organics separately on the kerb for pickup.

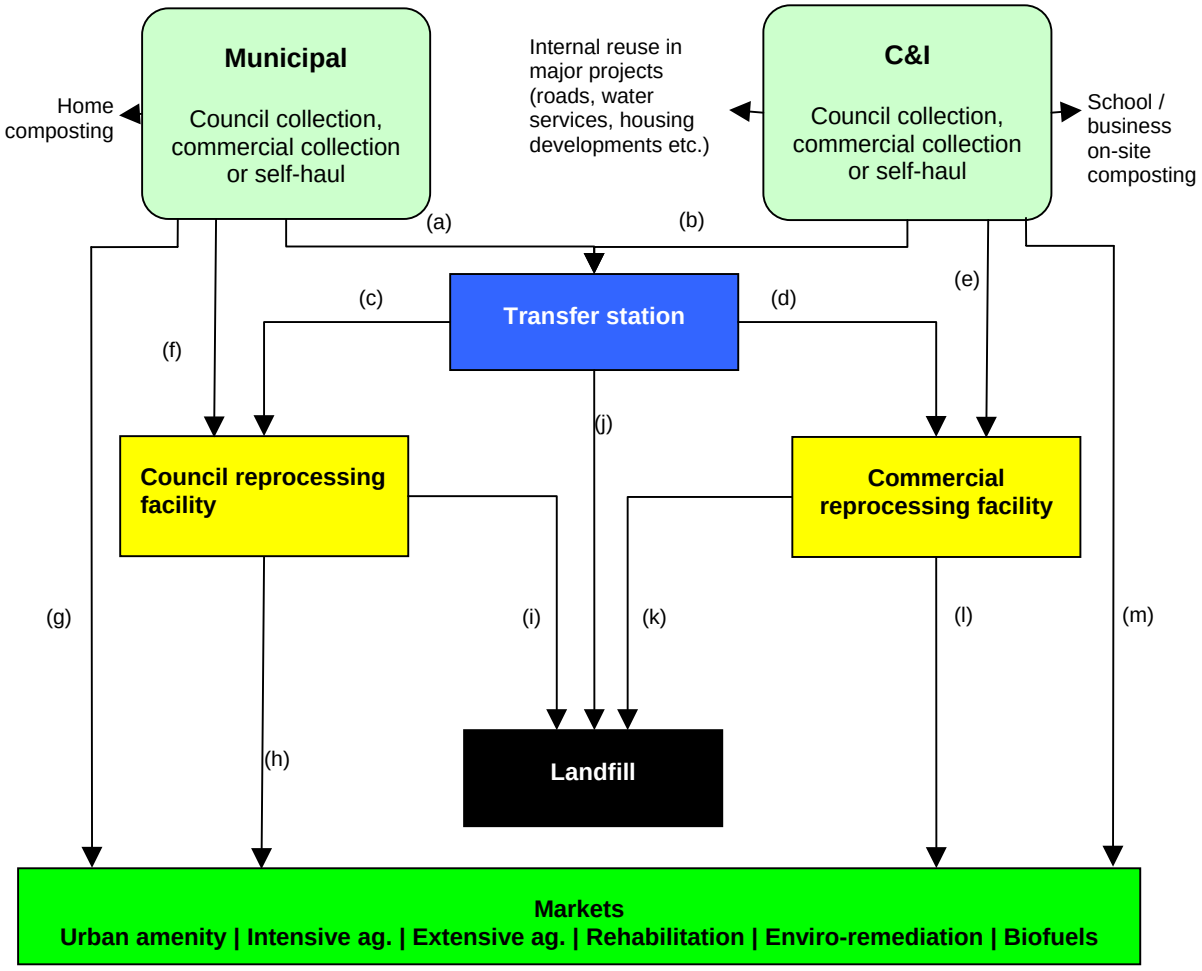
Biodegradable or compostable bag-based collections of garden organics from the kerbside are rare in Australia, though they are common in some parts of Europe and North America.

Alternatively, garden organics may be collected from the household by commercial companies, such a skip bin operators (e.g. when large quantities of garden and/or building waste is produced) or commercial landscaping and garden maintenance enterprises. Businesses providing landscaping and garden maintenance will often take the prunings and grass clippings away for recycling, and may not use the council service where they exist (due to the quantity of material generated). This material may be taken to transfer stations (flow [b], Figure 3) or directly to reprocessing facilities (flows [c] or [e], Figure 3).

Figure 3. Overview of typical flows of garden organics through the supply chain in Australia. The flow chart includes garden organics generated by the municipal and commercial & industrial (C&I) sectors. Flows from the construction and demolition (C&D) sector[4] are not shown, though material

[4] Garden organics generated by the construction and demolition sector includes vegetation removed as a part of clearing for new housing developments, roads, other major infrastructure projects and in the demolition of old residential homes and commercial premises.

from this sector is usually only a small component of the overall flow of garden organics within the supply chain.



Self-haul of garden organics is widely practiced, and drop-off facilities exist at many transfer stations and landfills where composting operations tend to be based. Home owners may generate a significant quantity of garden organics, such as during removal of trees or large garden clean-ups. The quantity of material generated often exceeds the limited collection capacity of council provided services, so this material may be self hauled to a transfer station (flow [a], Figure 3) or to a reprocessing facility (flows [f], Figure 3).

Keen gardeners who have their own compost bin on-site may avoid the use of waste collection services. Generally, worm farms are not used for garden organics as the material is woody and is not susceptible to rapid breakdown through the action of worm populations.

Some councils provide on-site collection and processing services, such as kerbside collection and on-site chipping (size reduction) (flow [g], Figure 3). In some cases, raw mulch is provided back to the householder for use on their own garden, though the material may pose a plant health / environment risk due to the presence of weed propagules and plant pathogens, such as *Phytophthora*. Phytophthora is a soil-borne pathogen that commonly causes die-back in eucalypts (NSW EPA, 1997b). Some councils take the chipped garden organics away and use it

in their own park and garden maintenance programs. The use of this low quality mulch poses similar risks as outlined above.

3.5.1.2 Commercial & industrial garden organics

Commercial enterprises with landscapes requiring maintenance also generate garden organics that needs to be managed. This material is not often collected by council services, and is often collected and transported directly to transfer stations or (flow [b], Figure 3) or to reprocessing facilities (flow [e], Figure 3).

Major projects such as new roads, highways, housing developments, sewerage services and other types of infrastructure projects often need to remove trees and vegetation to allow for construction works to take place. Within these projects, garden organics are size reduced, stockpiled and later used as a landscaping mulch to offset the need to import other mulch products to the site following completion of civil and construction works.

The flow of unprocessed garden organics from the commercial sector directly to markets can occur through tree lopping and arboricultural service providers. Trees that may be damaged in storm events or trees that need to be removed for safety reasons are often chipped on-site, and the unprocessed mulch, potentially containing wed propagules and plant pathogens, can be sold to domestic and commercial users (flow [m], Figure 3).

Following receipt at transfer stations, some decontamination may take place, such a hand picking or by mechanical means, such as a bobcat. Rejects are sent to landfill (flow [j], Figure 3). The cleaned material is then hauled in a compactor vehicle to reprocessing facilities (flows [c] and [d], Figure 3). The material may undergo further contaminant picking (flows [i] and [k], Figure 3), then size reduced, mixed with other feedstock materials, watered, placed in windrows or into composting vessels, and composted to manufacture a range of products. Further product refining, screening and blending may be performed to meet market specifications or standards.

In some cases, such as council reprocessing facilities, garden organics may be size reduced and made available for little or no cost. This raw material poses a number of plant health and environmental risks outlined previously.

Finished composted products are then sold into a range of markets (flows [h] and [l], Figure 3). These markets are further described in Section 3.6.

3.5.2 Food organics

Recovery of food organics generated by the municipal sector and the commercial & industrial sector in Australia is very much in an early developmental stage. Compared to garden organics, relatively small quantities are known to be recovered in most states (e.g. see Table 2 for recovery figures for NSW and VIC), though data is very limited for a number of flows of this material through the supply chain (Figure 4).

Limited proven recovery options exist for food organics, due to the difficulty of collecting and processing this material that minimises impacts on public health, public amenity and the environment. Food by its very nature is high in readily degradable organic material, such as protein, carbohydrates, fats and oils. Microbial breakdown of these constituents typically occurs at a high rate, leading to excess oxygen consumption and the development of anaerobic conditions. Anaerobic conditions in aggregated collections of food organics generates odours, and attracts pests and vermin. Due to the high moisture content, poorly managed aggregate collections of food can generate odorous leachate, high in soluble organic matter and pathogens such as

Salmonella spp. and *Shigella* spp., which can impact on waterways and public health (NSW EPA, 1997b).

As a consequence, collection and processing systems for garden organics have naturally been implemented by municipalities and the commercial & industrial sector before attempting the recovery of food organics. Most progress in the recovery of food organics has been made in Europe where controlled environment processing facilities tend to be more prevalent, though such facilities are starting to be considered by local government and the commercial sector around the country.

3.5.2.1 Municipal food organics

In the municipal sector, food organics generated in the kitchen from household meal preparation is more commonly managed on-site through home composting or worm farming, though this tends to be restricted to keen gardeners who have an on-site use for compost or vermicast for their gardens (Figure 4).

Some municipal authorities collect source separate food organics combined with garden organics in 80 L – 240 L wheelie bins, and is collected weekly, fortnightly or monthly. As most states around the country tend to experience mild, warm to hot summers, collection of source-separate food organics alone in kerbside bin collections is problematic. Odour, leachate, vermin and pest problems tend to be exacerbated under warm to hot conditions, which promotes increased microbial breakdown of food.

As a result, kerbside collections of food tend to be combined with garden organics collections in Australia (sometimes referred to as 'biowaste collections'), as the woody nature of this material can offer structure when combined with food in a wheelie bin, and is less likely to compact, generate leachate and become anaerobic. Some case studies have been published on collection trials in the past (Ecorecycle Victoria, 1997; Willoughby City Council, 1999; ACT No Waste, 2001).

Some municipalities are trailing or have recently implemented a type of ventilated wheelie bin, or 'biobin' for the collection of combined garden and food organics. This technology has been developed in Europe, and trials with various proprietary bins or inserts into retrofitted wheelie bins demonstrate some advantages. This includes improved moisture loss, reduced leachate generation, less odour, weight loss and the possibility of less frequent collections (Institute for Horticultural Development, 2001).

In Europe, cooler conditions has permitted a number of municipal authorities to introduce source separate food only collections over the last ten years. This includes Austria, Denmark, Ireland, Spain, France, Germany, Italy, Netherlands, Norway, Portugal, United Kingdom and Sweden (European Environment Agency, 2002a).

In Australia, combined food and garden organics collected at the kerbside is hauled to a transfer station (flow [a], Figure 4) or directly to a reprocessing facility (flow [b], Figure 4). Transfer stations that receive food are usually enclosed and treatment systems for air within buildings usually exists. This minimises the potential for odours to move beyond the premises and impact on sensitive receptors.

Food and garden organics may be commercially processed in a range of facility types, such as in-vessel composting (e.g. Natural Recovery Systems, Dandenong), anaerobic digestion (e.g. Earthpower, Camellia, NSW[5]), vermiculture (e.g. Tryton Waste Services, Lismore, NSW), mixed

[5] Note that this facility processes mainly commercial & industrially sourced food organics.

waste composting (e.g. Southern Metropolitan Group of Councils, Perth, WA), and in a very minor number of cases, windrow composting facilities (not shown in Figure 4).

Outputs from these processing facilities include composts, soil conditioners and organic fertillsers which can be used in urban amenity and agricultural markets (flow [e], Figure 4). Biogas produced by anaerobic digestion facilities (flow [g], Figure 4) is normally converted into 'green' electricity. Whilst some heat and electricity derived from the methane may be consumed within the plant, a proportion is normally available for export to the electricity grid. These markets are reviewed in more detail in Section 3.6.

During the processing of food and garden organics, contamination may be removed by an upfront sorting process, with contaminants normally sent for disposal in landfill (flow [d], Figure 4).

Although their use in Australia is limited, in-sink disposal units for food organics in residential homes and apartments are common in some highly populated urban centres, such as California and New York in the United States. In this process, food organics (excluding hard material such as large bones, oyster shells etc.) are placed into the in-sink unit and a grinder macerates the food with potable water and directs the aqueous slurry into the municipal sewerage treatment system (flow [f], Figure 4).

At the municipal sewerage treatment plant, food combined with sewerage normally undergoes primary treatment (sedimentation), secondary treatment (aerobic / anaerobic digestion) and tertiary treatment (chemical treatment for pathogens) prior to reuse or the disposal of wastewater into aquatic or marine environments (flow [k], Figure 4). Biosolids generated by the primary and secondary treatment processes may be recovered, stabilised (e.g. lime addition) and beneficially land applied as a soil amendment on farms in accordance with state-based biosolids guidelines[6] (e.g. Department of Environmental Protection, 2002).

3.5.2.2 Commercial & industrial food organics

In-sink disposal units are also used to a limited extent in the commercial & industrial sector, such as hospitals and institutions. It is understood that the use of in-sink disposal units as a partial disposal / recovery option for food and other liquid food wastes is problematic in some towns and cities around the country. This is due to the aging nature of sewage infrastructure and the lack of surplus capacity in municipal sewerage treatment plants to cope with large pulses of food organics. Life cycle studies on this technology have been undertaken (CRC for Waste Management and Pollution Control, 2000).

Diversion of commercial and industrial food organics, such as unspoiled food which is suitable for human consumption occurs to varying levels nationally, with a number of services commonly referred to as 'Foodbanks' (Figure 4). Ends of manufacturing runs and unsaleable stock from wholesalers and retailers can be donated to these not-for-profit organisations for redistribution to local charities and industry (NSW EPA, 1998c). Use of food organics in this manner is considered to be a waste avoidance option.

Limited on-site composting and vermiculture is performed on food organics produced by the commercial & industrial sector, due to the costs and labour requirements involved. A few examples exist which process food organics into compost and vermicast, such as at The University of New South Wales which uses a Vertical Composting Unit for food organics

[6] In states and territories that do not have in place their own guidelines setting out the proper management of biosolids the national biosolids guidelines given in Department of Agriculture, Forestry and Fisheries (2002) takes effect.

generated on the Kensington campus. On-site processing options for commercial & industrial food organics are reviewed in Recycled Organics Unit (2000a).

Source separate collections of commercial & industrial food organics occurs mainly for pre-consumer material such a food generated by commercial kitchens and food manufacturing enterprises in mobile garbage bins. In other cases aerated skip bins with odour control are used for containing the material (SA EPA, 2002b). Successful case studies and strategies for collecting and processing source separated food organics from a range of business types have been documented (e.g. Ecorecycle Victoria, 1995; Central Coast Waste Board, 1999; Southern Sydney Waste Board, 2001a,b,c,d).

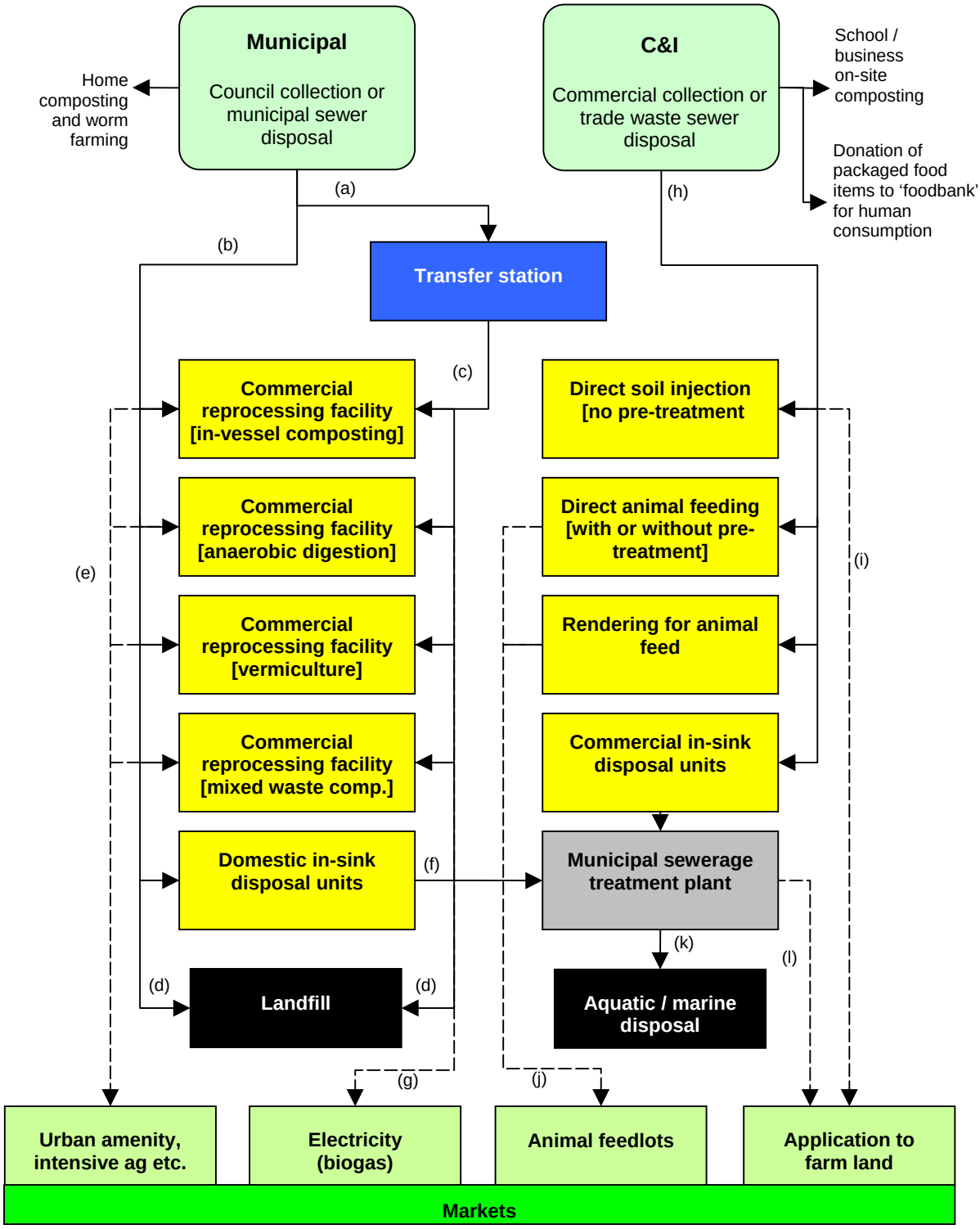
Source-separate post-consumer collections of food organics (e.g. food court waste in shopping centres) which tends to be contaminated with plastic, glass, metals and other material is not common. This material in a few cases can be processed by mixed-waste composting plants.

In some states, commercial & industrial sector food organics may be stored on-site in storage tanks and pumped out by liquid waste collectors which transport the material for soil injection without pre-treatment on farms as a purported means of improving soil conditions (flow [i], Figure 4). This practice is understood to be growing in some states that have higher landfill levies, and many operations are generally not licensed by state environment protection agencies. No statistics are available regarding this practice. The environmental risks and potential impacts on human and animal health have been highlighted in Recycled Organics Unit (2001a).

Commercial collections of source separate food organics and direct animal feeding (with or without pre-treatment) is also known to occur in some states, but statistics again on this practice are lacking. Whilst most states have legislation prescribing allowable feed materials for animals, an absence of visible regulation has stimulated the development of this practice in some cases. Potential impacts on animal and human health from direct animal feeding of food organics are discussed in Recycled Organics Unit (2001a).

Rendering of meat and fat off cuts from butchers, abattoirs and meat processing plants for animal feed production is well established in most states, though this material is not normally classified as a waste material as it does not enter the solid waste stream.

Figure 4. Overview of typical flows of food organics through the supply chain in Australia. The flow chart includes food organics generated by the municipal and commercial & industrial (C&I) sectors. In some cases, particularly in the municipal sector, garden and food organics may be collected and processed together at a centralised facility. Note that the supply chain does not include flows from large C&I sector businesses that may operate their own waste water treatment facilities to recover organic material.



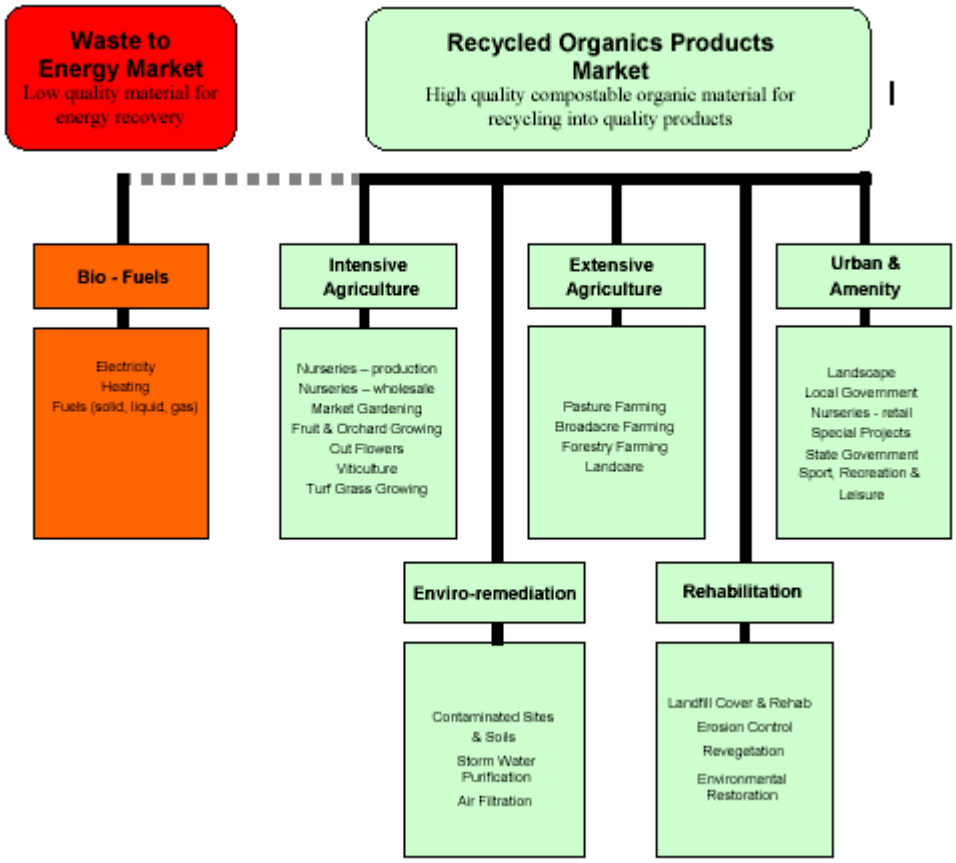
3.6 Markets for recycled organics in Australia

Markets for recycled organics have been studied extensively to inform the development of resource recovery policy and programs to increase the diversion of organic material from landfill.

Sustainable diversion of organics from landfill requires that appropriate markets for the products be available. Diversion of organics from landfill where markets are not properly developed has led to stockpiles and partial landfill disposal of collected material, which is inconsistent with resource recovery policy.

The structure of the recycled organics product market has been developed by NSW Waste Boards (1999a), and later refined in Environment Australia (1999) and Recycled Organics Unit (2002b). The market structure shown in Figure 5 provides an overview of the range of possible markets for recycled organics in metropolitan and rural / regional areas. The market structure includes markets that are considered to be reasonably well developed, or 'existing markets', and those that are developing, or 'emerging markets'.

Figure 5. Structure of the recycled organics product market, including both existing and emerging markets that exist across the country (Recycled Organics Unit, 2002b).



The market structure for the recycled organics products market shown in Figure 5 consists of five individual markets, including: intensive agriculture, extensive agriculture, urban amenity, enviro-remediation and rehabilitation. These markets can be segmented into sub-markets, defined as groups of potential customers with similar characteristics who are likely to exhibit similar purchasing behaviour. In the recycled organics product market, twenty-three (23) market segments have been identified in New South Wales (NSW Waste Boards, 1999, 2000; Recycled Organics Unit, 2002b).

The waste to energy market is considered to be quite separate from the recycled organics products market (Recycled Organics Unit, 2002b). This market generally supports the use of low grade and contaminated compostable materials to recover some energy prior to disposal, consistent with environmentally sustainable development principles. Recovery of energy from compostable organics prior to disposal is considered to be a lower value resource recovery option than recycling (as in the recycled organics product market sector). Nevertheless, waste to energy is considered to be a potentially viable option for recapturing some intrinsic value in these materials before they are disposed of in landfill, and is preferable to the direct disposal of such material (Recycled Organics Unit, 2002b).

Anaerobic digestion and ethanol producing technologies in the fuels market segment within the waste to energy market, however, are not combustion or incineration-based processes and generate two main products — one being energy (in the form of methane or ethanol) and the second being an organic residual which can be used to manufacture a soil conditioner via composting. This market segment, therefore, overlaps to some degree with the recycled organics product market sector, as some technologies in the fuel market segment require high quality compostable organic material inputs similar to the recycled organics product market sector, and in turn result in products that conserve both material and energy.

3.6.1 Existing markets

The urban and amenity market is reasonably well developed in most metropolitan areas, given that it has traditionally been a high value market close to sites of compost production.

The urban and amenity market consist of a number of market segments, such as landscaping, local government (i.e. parks and garden operations), retail nurseries, special projects (e.g. major development projects, roads, highways etc.), state government (e.g. state government major projects) and sport/ recreation / leisure (e.g. playing fields, community gardening etc.).

3.6.2 Emerging markets

A number of additional markets have been identified in previous studies, though they are in a varying state of development around the country. A number of these are maturing in their development as governments and industry invest in research and development to better meet market needs.

These markets include segments that are categorised under:

- Intensive agriculture
- Extensive agriculture
- Enviro-remediation
- Rehabilitation
- Waste to energy (or the ‘Biofuels’ market).

A thorough assessment of these markets is outside the scope of this study. Further information on these markets can be found in Environment Australia (1999), Recycled Organics Unit (2002b) and Department of Environment and Conservation (NSW) (2004d).

3.7 Current rates of organics recovery

Recovery rates for garden and food organics varies from state to state across the country. Some states and territories do not collect detailed data on recovery and disposal rates for individual waste streams, so recovery rates in some states are unknown.

It should be noted that data on recycling and disposal rates in rural / regional areas in most states is not known.

NSW and Victoria have maturing data collection systems for the recovery of garden and food organics from the municipal and commercial & industrial sectors, though the quality of this data is considered to be improving so it is difficult to make valid comparisons between recovery and disposal rates from year to year.

Nevertheless, indicative recovery figures for garden and food organics from the municipal sector and commercial & industrial sector is given in Tables 1 and 2, respectively.

Currently, NSW is recovering approximately 53% by weight of all garden organics generated. This compares to a recovery rate of approximately 28% in Victoria.

Recycling rates for food organics is significantly lower than garden organics in all states, as most states across the country have targeted garden organics as a starting point for the diversion of organics from landfill.

Food organics recycling rates are considered to be very approximate as the quantities of some flows of residual food organics in the supply chain from the commercial & industrial sector are difficult to determine. In some cases, food organics may not enter the waste stream and be used as direct feed to animals or for rendering for animal feed production. In other cases, food organics may be directly land applied through unlicensed activities, and systems for collection of such data do not exist (Figure 4).

Neverthess, it is estimated that approximately 6% of all food organics generated in NSW is recycled, and approximately the same (5%) in Victoria (Table 2).

Improved data on current recovery rates for organics across the country are currently being compiled through an industry survey being conducted by Compost Australia (a division of the Waste Management Association of Australia) in partnership with state-based environmental protection or resource recovery agencies.

It is envisaged that this combined government and industry survey will provide an ongoing update on current levels of organics diversion from landfill, and will assist state government agencies in the developing policies and strategies to help in improving the management of organics in the future.

3.8 History of organics management policy in Australia

3.8.1 Evolution of waste management policy in Australia

In Australia and overseas, the key waste management consideration for government has historically been disposal. Government has primarily provided waste collection and disposal, with costs met through broader revenue collections. As budget costs increased, cost-recovery was sought largely through flat-fee pricing systems with cross subsidies prevalent and failure to fully recover costs was common. Consequently, increasing waste volumes impacted on public budgets (Environment Australia, 2003).

More recently, significant reforms in landfill regulation, technology and management practices have reduced externality impacts associated with landfilling. These improvements and cost-economies have also seen a dramatic reduction in the number of landfills, reducing local amenity impacts. By increasing the size of new landfills, the available capacity has in many instances increased despite the fall in landfill numbers. This has acted to allay fears of a landfill scarcity crisis that some proponents have postulated to support the case for continued reductions in waste disposal volumes. Governments have also acted to improve budget positions through either the privatisation of major parts of the waste collection and disposal system, and / or through the introduction of full cost pricing strategies (Environment Australia, 2003).

A reduction in landfill availability has encouraged communities to pursue further improvements in reducing waste to landfill, and to improve the sustainability of urban and regional communities. As a result, a number of state governments across the country have much broader waste management policies that reflect upstream life-cycle impacts, such as resource conservation and environmental impacts arising from the use of virgin materials.

Environment Australia (2003) reports that current policy interventions focus primarily on reducing the volume of waste rather than environmental impacts per se, and policy intervention to date has taken place late in the supply chain, primarily when consumers are disposing of waste or when the waste reaches the landfill.

Although it is recognised that for a range of waste materials the majority of environmental impacts occur early on when virgin materials are used and processed during production, few opportunities exist for managing organic materials at source, except for food organics produced as by-products from food and food preparation industries (such as re-use as human / animal feed, cleaner production etc.) or at home through on-site composting.

As the generation of organic materials that enter the waste stream are not necessarily driven by consumer trends (e.g. as is packaging waste), most policies addressing the management of organic materials in Australia have traditionally been at the end of the supply chain.

A brief review of major government policies affecting the management of organic materials in Australia is given in Section 3.8.2.

3.8.2 Organics management policy in Australia

Prior to 1990, relatively few coordinated services were in place to recover organic materials generated by the municipal and commercial & industrial sectors.

In 1992, the Australian and New Zealand Environment and Conservation Council (ANZECC) produced a National Kerbside Recycling Strategy incorporating a set of targets to be achieved by the year 2000, which aimed for (ANZECC, 1992):

- a 50% reduction in the total quantity of solid waste going to landfill (based on weight per capita from the 1990 baseline); and

- a 50% reduction in the quantity of domestic waste going to landfill (based on weight per capita from the 1990 baseline).

Most states and territories around the country adopted these goals and implemented a range of state-based policies and programs designed to assist local government, industry and the community to meet these targets.

In November 1995 ANZECC acknowledged that given organic materials can make up over one third of the waste stream, it will be difficult for states to meet national targets by the year 2000.

To address this issue, the ANZECC Industry Waste Reduction Task Force in November 1995 agreed to further develop the national waste reduction framework for organic materials. The Western Australian Department of Environmental Protection took the national lead on this task and produced a draft organic waste policy for Australia, which was endorsed in 1996 (ANZECC, 1996).

Since then, the development of legislative and policy instruments to reduce the disposal of organics in landfills has been a state government responsibility, with local government and industry providing a key role in delivering systems and services to improve the management of organic materials.

Some notable initiatives implemented across the country to improve the management of organics emerged in the 1990s, and have been further refined based on experience since 2000.

- In 1992, Victoria introduced a levy on waste disposal in metropolitan and provincial centres to better reflect the environmental and social cost of landfilling waste and to provide incentives for recycling;

- In 1994, NSW introduced a similar levy on waste disposal. This was implemented to better reflect the environmental and social cost of landfilling waste, introduced into the Sydney Metropolitan Area and later into the area immediately surrounding Sydney (Extended Regulated Area). The levy was set at $4.20/tonne (NSW EPA, 1995);

- In 1995, the NSW Government introduced the *Waste Minimisation and Management Act* 1995 and set a target of 60% reduction of waste to landfill by 2000 (based on 1990 figures). The waste reform legislation also established a 'waste hierarchy' to help guide waste management decisions. Regional waste boards were also established in 1996 to assist regions of councils in waste reduction and recovery activities;

- In 1996, the WA and NSW Governments released draft plans for managing green wastes. Priorities for action were established. Regulatory bans prohibiting the disposal of green waste in landfill proposed in WA and NSW were a significant milestone;

- In 1996, a new Victorian State Government Agency (Ecorecycle Victoria) was established under the *Environment Protection Act* 1970 to work in partnership with business and industry, community, schools and government to meet the challenge of reducing waste;

- In 1996, the ACT Government released its *No Waste by 2010 - A Waste Management Strategy for Canberra*. The strategy establishes a framework for sustainable resource management and lists broad actions which are needed to achieve the aim of a waste-free society;

- In 1998, the WA Government introduced a levy on waste disposal under the *Environmental Protection (Landfill) Levy Act* 1998;

- In 2000, the Victorian Government released a Green Waste Action Plan describing targets for reducing the disposal of green waste to landfill by 15% by 2003/04 (Ecorecycle Victoria, 2000);

- In 2001, the NSW Government repealed the Waste *Minimisation and Management Act* 1995 and replaced it with the *Waste Avoidance and Resource Recovery Act* 2001. A new agency, Resource NSW, was created to develop a state-wide waste strategy;

- In 2002, the Western Australian Government announced the establishment of an eight member Waste Management Board (the Board) to help set out a sustainable framework

for dealing with waste in Western Australia. The Board's activities are funded through a levy on waste disposal;

- In 2002, the NSW Waste Avoidance and Resource Recovery Strategy was released, with a number of actions and targets to reduce waste in municipal, commercial & industrial and construction & demolition sectors;

- In 2003, the South Australian Government announced the establishment of Zero Waste SA, created under the *Zero Waste SA* Act 2004. Zero Waste SA is charged with the creation of a state-wide waste strategy;

- In 2003, the WA Government released *the Strategic Direction for Waste Management in Western Australia* (Department of Environment, 2003). The strategy sets out priorities for action to meet the Government's vision of zero waste by 2020; and

- In 2004, Zero Waste SA released its draft waste strategy, 2005 – 2010.

Across a number a states, policies promoting improved management and recycling of organic materials from landfill tend to be reasonably consistent. These major policy initiatives are as follows. Policies in place in Australia and overseas are discussed further in Section 5.

- Material and sector specific recycling targets to provide a broads means of goal setting, which tends to be underpinned by a number of supporting strategies;

- Implementation of levies on waste disposal, which serve as an economic incentive to avoid, reduce / reuse and recycle materials before they become waste and need to be landfilled;

- Implementation of waste avoidance measures, such as home composting and worm farming where practicable;

- Promotion of at-source separation to ensure organic materials are low in chemical and physical contaminants to ensure maximum recovery options and to ensure high quality of the reprocessed output;

- Treatment of residual waste prior to disposal in landfill, to reduce the quantity and environmental impacts of this waste when landfilled;

- Supporting the development of collection and processing infrastructure to permit the cost effective and environmentally appropriate processing of organic materials;

- Research and development to assist in growing markets for recycled organic products;

- Government leading by example through revised procurement processes to increase the use of recycled organics;

- Development of guidelines for the design, operation and management of composting and related processing facilities;

- Development of best practice guidelines and preferred service standards for the collection and processing of collected organic materials; and

- Supporting the adoption of cleaner production practices to reduce the generation of organic materials by commercial & industrial enterprises.

4 Issues that need to be considered to reduce landfill disposal of organics

A variety of issues can impact on the generation, collection, processing, beneficial recycling and disposal of organic materials and processed products. Consideration of a range of common themes is important to assist in the development of appropriate and cost effective strategies across a broad range of communities and businesses in metropolitan and rural / regional areas of Western Australia.

Factors that can affect the management of organic materials following their generation at the municipal or commercial & industrial level and subsequent path through the supply chain are usually economic, technical, system / infrastructure, social or environmental.

A combination of these factors commonly exists in different metropolitan and rural / regional centres across Australia, and this partly describes the numerous approaches used to manage of organic materials generated by households and businesses.

Whilst this section presents a reasonably comprehensive review of themes or issues affecting the management of organic materials, there will always be additional issues that relate to specific circumstances that need consideration.

The issues identified in this section are therefore a guide to “common themes” that need to be considered to assist communities and businesses reduce the loss of organic matter to landfill.

In Section 4.1, common themes which affect the management of garden organics from the municipal and commercial & industrial sector are presented together, given that the material follows similar pathways through the supply chain after being generated (Figure 3, page 21).

Sections 4.2 and 4.3 address common themes that impact on food organics management at the household and commercial & industrial enterprise level.

4.1 Garden organics

4.1.1 Generation

The generation of garden organics from households and from the gardens of businesses varies from season to season, with more garden organics generated and presented for collection and recycling in summer compared to winter. In Sydney, garden organics generated in summer usually comprises 32% of that generated across the year, compared to 23% in autumn, 16% in winter and 29% in spring (NSW Waste Boards, 1999b).

Garden organics generated in spring and summer tend to be higher in nitrogen (and more putrescible) than material generated in winter, due to the presence of lawn clippings. Odours can be generated in kerbside bin collections from lawn clippings, and at reprocessing facilities when the contents of collection vehicles are emptied.

Generation rates of garden organics varies between inner metropolitan areas, to middle / outer suburbs and rural / regional areas. Generally, garden organics generation is lowest in inner metropolitan areas, due to limited land available for gardening, and increases with property size.

4.1.2 On-site avoidance options

On-site avoidance options for garden organics, such as home composting are supported to varying degrees by different jurisdictions. Advocates for home composting argue that recycling this material provides benefits to home gardens and reduces the cost incurred of managing this stream as a part of the municipal waste management system (US EPA, 1999a,b).

Others argue that it is difficult for home owners to compost properly, with compost bins having the potential to generate leachate and impact on groundwater, generate greenhouse gases (methane) and creates odours which attracts and breeds pests. Centralised processing allows for the processing to be better controlled with less overall environmental impact.

Changing patterns of work and leisure time, urban consolidation, and reduced garden sizes is understood to be limiting interest in home composting in Australia. Whilst this may not be suitable for densely populated inner metropolitan areas, it is often a useful waste avoidance or prevention solution in middle / outer metropolitan and rural / regional areas where properties associated with residential dwellings are larger.

Home composting can work well when supported by local government, where there is a subsidised bin provision program and where educational programs are made available to the community (European Environment Agency, 2002a).

'Grass cycling', or the use of specially designed mulch mowers have been supported extensively in the United States (US EPA, 1999b) as a waste avoidance strategy for grass clippings. Grass cycling involves the re-application of grass clippings on the lawn where they can break down and provide nutrients and organic matter to lawns. This may save water, fertiliser and improve lawn quality. This practice is not well known in Australia and could warrant further consideration.

The USA EPA has developed a 'Compost Strategies Savings Curve' to illustrate the benefits of a suite of strategies for diverting organics from landfill (Figure 6). This figure only takes into account the costs of different avoidance and off-site processing measures, and not other social and environmental considerations. It also assumes the avoidance measures shown are managed well by home owners, without substantial impacts on other residents or on the environment.

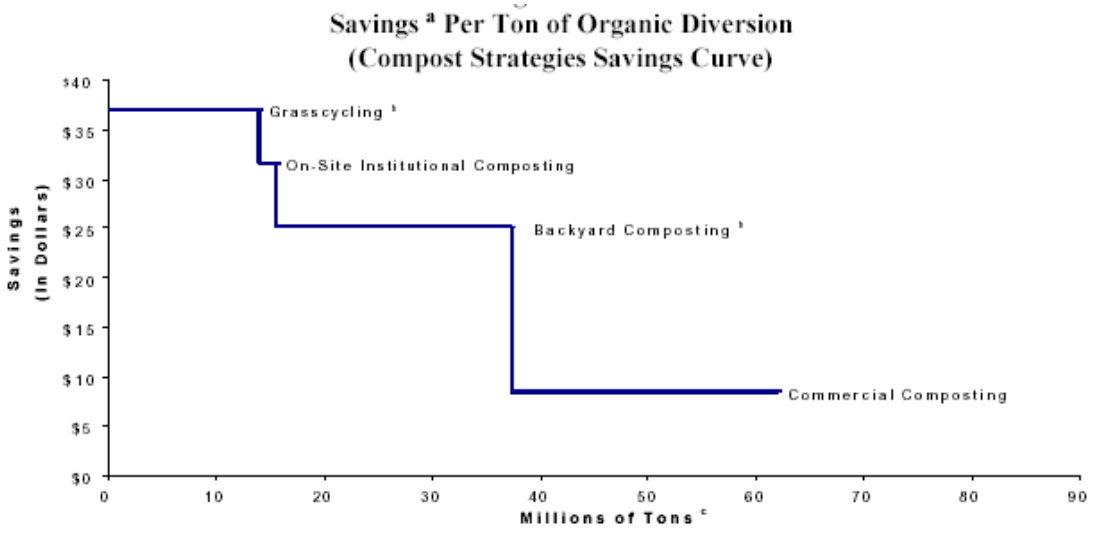
Existing data on rates of home composting and diversion rates on a per household basis in Australia should be treated with caution. The Australian Bureau of Statistics (1998) reported in a study titled 'Australian Social Trends 1998 – People and Waste Management: Household Waste Management' that 53.8% of households in Australia conduct home composting.

The ABS (1998) home composting figures are significantly higher than levels previously determined in a study in the Greater Sydney Region of NSW (population weighted average of 29%) (NSW Waste Boards, 1999b). Ecorecycle Victoria (2000) estimated that up to 5 kg of organic waste per household per week is home composted. This is equivalent to approximately 260 kg / household / year.

No rigorous studies have been performed in Australia to demonstrate the landfill diversion potential and avoided waste disposal costs of on-site grass cycling and home composting[7].

[7] It is understood that a review of the Southern Sydney Waste Board's 'Waste Not Want Not' home composting program was undertaken in 2001, but the results of this study were not publicly reported.

Figure 6. Compost strategies savings curve, illustrating the potential for on-site avoidance measures (grass cycling and backyard [home] composting) for reducing organic waste (garden and food organics) to landfill compared to other options such as (centralised) yard trimmings (garden organics) composting and commercial composting (commercial & industrial sector organics) (US EPA, 1999a).



Notes:
[a] These savings are from the viewpoint of local government and assume that any additional labor required from citizens is donated at no cost to society.
[b] To be conservative, we assume no savings in collection costs. The tonnage in these composting programs is not reduced significantly enough to affect the cost of collection.
[c] Based on the applicable portion of the organic waste stream available for composting using existing strategies and technologies.

4.1.3 Source separation

In Europe, the United States and increasingly world-wide, separation at source is the preferred strategy for recovering garden organics. When separated at source, garden organics can be kept separate from other contaminants in the waste stream, and options for reprocessing the material as compost or for energy recovery can be maximised (European Commission, 2000; 2004; European Environment Agency, 2002a).

Given the importance of source separation as an integral part of resource recovery systems, some countries in Europe have introduced legal requirements, presentation by-laws and fiscal instruments to encourage the separate collection of organic materials from the municipal and sometimes the commercial & industrial waste stream.

For example, in Austria, since 1995, there has been a legal obligation on municipalities to separately collect and treat organic waste from households. Similarly in Spain, since July 1999 municipalities with more than 5,000 inhabitants must carry out separate collection of the organic fraction of municipal solid waste. In Denmark, municipalities are legally obliged to collect 40–55 % of newspapers and magazines for recycling. The Danish municipalities are also required to establish collection systems for food waste from canteens and restaurants that generate more than 100 kg of food waste per week.

Since January 1994, all municipalities in the Netherlands have been required to separately collect food and garden waste from households. Dutch municipalities are also required to collect paper and paperboard and textiles separately (European Environment Agency, 2002a).

Separation at source for recyclable material is central to resource recovery policy in NSW (Resource NSW, 2003a), Victoria (Ecorecycle Victoria, 2000), Western Australia (Department of Environment, 2003) and South Australia (Zero Waste SA, 2004b), and is consistent with international best practice.

In Europe and the United States in the 1990's, some municipalities moved away from maintaining source separate collections for garden organics, dry recyclables and residuals, and favoured one-bin solutions which invariably involved mechanical sorting of recyclables, with pre-treatment of the remaining waste (mainly organic material) in variously configured mechanical-biological treatment plants.

A major output of these facilities can be classified as a 'compost-like output', of low quality compared to source-separately collected organic materials. Significant difficulties were experienced in marketing the material, due to the presence of reasonably high concentrations of heavy metals, pesticides, toxic organic compounds, household hazardous waste residues and man-made inert materials such as glass, plastic and metal fragments. This has led to a reduction in this use of this technology for recovering garden organics, given that markets are unwilling to accept the compost like output.

In some countries, compost-like outputs cannot be applied to land for food production given product quality and contaminant concerns, and potential for harm to soils, water quality, plants, animals and human health (Bardos, 2004; Juniper Consultancy Services, 2005).

The use of mixed waste treatment or mechanical biological treatment plants is more suited to being a residual waste treatment option, to reduce the organic matter content, volume and biodegradability of residual waste when landfilled. Germany has a policy of all residual wastes to be pre-treated by mechanical biological treatment by the 31st May 2005 (Schnurer, 2005; Federal Environment Ministry and the Federal Environmental Agency, 2005).

4.1.4 Collection systems

A number of councils across the country have more than ten years experience in providing a range of kerbside collection services for garden organics. These collection systems vary in their ability to recover material, and some experience more contamination than others. The collection systems can be categorised as follows:

- Low yield collection systems:
    - quarterly, six-monthly or yearly loose or tied / bundled kerbside collections
    - on-call cleanup services (loose or tied / bundled)
    - kerbside mulch-back or kerbside chipping services
    - self-haul or public drop off facilities
- High yield collection systems:
    - containerised mobile garbage bin collections using a 120 L or more commonly, a 240 L plastic bin which may be collected weekly, fortnightly or monthly
    - containerised 'ventilated' mobile garbage bin collections using a 'Biobin' suitable for collecting both garden and food organics.

In NSW, a study on the costs of managing garden organics across the state found that the recovery rate in low yield collection systems varies from 26 – 117 kg/household/yr and can increase to between 154 – 351 kg/household/yr for a high yield collection system (Department of Environment and Conservation (NSW), 2003c).

Clearly, containerised collection systems provide higher yields and increased organics diversion potential than loose or tied and bundled systems. Bin systems allow for the collection of lawn clippings, leaves, weeds and other potentially putrescible organic materials, which is not possible in tied and bundled systems.

However, enclosed bin collections can suffer from inappropriate use, and foreign contaminants such as plastic bags, hard plastics, glass and metals can significantly impact on the quality of the reprocessed products and markets for these materials. Experience has shown it is critical that community education occur prior to, during and periodically after the introduction of any new kerbside collection service to ensure appropriate bin usage and low rates of contamination.

Transfer stations and pubic drop off facilities in metropolitan and rural / regional areas tends to capture oversize garden organics difficult to place on the kerbside for collection (e.g. large branches, storm damaged materials etc.).

A trend in some metropolitan areas is the use of commercial garden maintenance companies for managing lawns and gardens associated with households and businesses. Instead of garden organics generated from lawn mowing and pruning being directed into the municipal garden organics collection system, this material is often recycled or disposed of directly by the garden maintenance company. However, this is the principal means of recovering garden organics from the commercial & industrial sector as this sector is generally not serviced by councils.

In metropolitan centres with high landfill disposal fees, it is important that programs be in place to reduce illegal dumping.

It is also problematic if this material is size reduced and marketed as a raw mulch, as the material may have a high probability of spreading weed propagules, diseased soil and plant parts in the environment.

4.1.5 Community education

The design of educational programs for residents in the community when introducing a new collection system for garden organics is often a focus of local government, sometimes in partnership with a collection contractor.

Achieving behavioural change in the community is critical during the initial stages of introducing a new collection system. Deficiencies in community education relating to the provision of a new service may result in low participation rates and high contamination levels. Often, high contamination rates occur because members of the community are unaware of their actions of disposing of rubbish in their organics bin.

Continued community education is usually behind the success of most source separate garden organics collection schemes. Notices in letterboxes, radio advertising, fridge magnets and other reminders serve an important role in maintaining the level of awareness in the community on how to use their organics bin (or other service) properly. This is particularly important in areas that experience high turnover or seasonal holiday makers.

4.1.6 Economics of collecting and processing garden organics

Householders in most municipalities pay for the collection and processing of garden organics as a part of their rates to council. A domestic waste management charge comprises a percentage of rates paid, and includes the cost of providing recycling, waste disposal, community education and other environmental services.

However, flat fee charging for waste and recycling provides little incentive for householders to separate and recycle garden organics, as all households pay the same for recycling and disposal.

Some councils have trialled variable user charges, or 'user pays' systems to encourage households to better separate and recycle materials. The concept here is households that reduce the amount of waste being disposed in general waste, and increase their rate of recycling should pay less than households that separate little for recycling and place the majority of material in the residual waste bin. These schemes have been established to: reduce domestic waste going to landfill; improve the equity of domestic waste charges; and to provide financial signals in regard to the value of protecting the environment (Environment Australia, 2003).

Such schemes require considerable effort in their establishment, and usually require the bar coding of residual waste bins, configuration of collection vehicles to take the weight of residual waste being disposed during automatic lifting, and a data storage and processing system that logs waste disposal and charges households accordingly in their rates.

Atech (1999) reported that in an analysis of variable user charges for municipal waste collection across Australia, most have been successful in achieving waste reductions reportedly of up to 50% in some cases.

Despite the environmental benefits of recycling garden organics, some critics have argued in the past that source separate collection services cannot be justified based on economic grounds.

To address this issue, the Department of Environment and Conservation (NSW) in 2003 conducted a study into the costs of managing garden organics by local government, followed by a triple bottom line assessment of garden organics management (Department of Environment and Conservation (NSW), 2003c; 2005).

The study found that the financial cost of providing a garden organics collection and processing service was between $31 - 45/household/yr. However, when the net financial cost of providing a combined garbage, recyclables and garden organics service (240 L MGB fortnightly) to households, the net financial cost of providing a garden organics collection service reduce to $5/household/yr for metropolitan areas and $11/household/yr for a similar service in rural areas.

The difference between the financial cost of providing a garden organics collection service, and the net cost of providing a garbage, recyclables and garden organics collection service is due to the fact that significant savings in landfill disposal is achieved with a separate garden organics collection service. These savings almost completely offset the additional costs of providing a garden organics collection service.

The slightly higher net financial cost of providing a garden organics collection service in rural areas is due to reduced financial savings in avoided disposal costs.

It is important to note that most garden organics reprocessing facilities around the country operate on a gate fee. The fee varies from state to state, but these fees are normally significantly lower than landfill disposal. In NSW, the median gate fee for processing and recycling garden organics in 2003 was $44/tonne in metropolitan areas and $14/tonne in rural areas (Department of Environment and Conservation (NSW), 2003c).

It is important that adequate gate fee structures be put in place to ensure the economic viability of garden organics processing facilities, given that significant investment in capital and equipment is required to process the material into a usable product.

Traditionally, gate fees have kept pace with landfill disposal fees, which have been gradually rising in NSW, Victoria, South Australia and Western Australia since the introduction of statutory waste disposal levies in the 1990's. In states where landfill disposal fees are low, gate fees for processing garden organics have been very low and insufficient to cover the costs of processing and marketing of the products.

A temporary crisis occurred in Victoria between 2002 and 2004 where significant stockpiling of garden organics was occurring due to inadequate financial resources to efficiently process and market the material. Assistance in re-negotiating gate fees with councils and Ecorecycle Victoria is understood to have resolved this issue. The fact that this event occurred indicates that the true cost of processing garden organics was not being recovered from ratepayers by councils.

Given that the economics of collecting and processing garden organics is sensitive to landfill disposal prices, policies that attempt to encourage improved recovery and recycling of garden organics should also influence the cost of landfilling.

The collection and reprocessing of garden organics in rural / regional areas has proven to be problematic in the past, due to small volumes available for recycling and the difficulty in attracting the commercial sector to establish reprocessing facilities. Some councils in rural / regional areas are collaborating to achieve economies of scale, and installing efficient transfer stations to aggregate material and to reduce per tonne transport costs to regional processing facilities.

In other cases, councils have been seeking novel solutions for recycling their garden organics by negotiating agreements with the agricultural sector. In NSW, some small regional councils are planning to send their municipal and commercial & industrial garden organics to feedlots that operate their own composting facilities.

4.1.7 Cost of waste disposal and disposal levies

The rising cost for disposing of residual waste over the past ten years in some states has been an important driver for councils and waste management contractors to divert increasing quantities of garden organics from landfill.

Increases in waste disposal costs have been due to increasing financial allocations to on-going post-closure environmental management of landfill sites, and the addition of waste disposal levies by state governments. Levies are paid as part of landfill charges by the council or waste management contractor and are recovered through rates and waste management charges.

The rate of garden organics recovery and recycling is highest in states where the cost of waste disposal is highest. For example, in metropolitan Sydney, the cost of municipal waste disposal is ~$77/tonne, which includes a state government levy of $19.80/tonne.

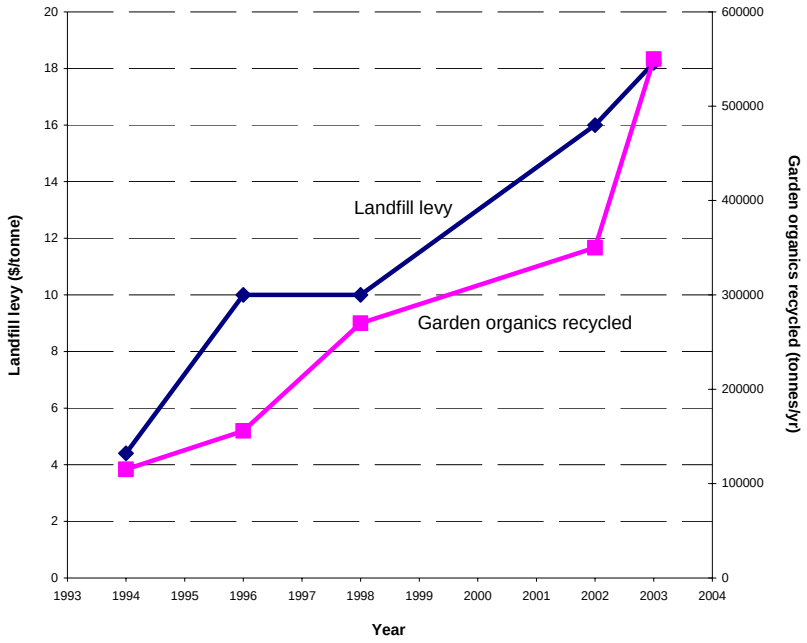
In other states, the cost of landfill is significantly lower, and ranges between $35/tonne up to the levels seen in NSW (Environment Australia, 2003). A landfill levy also exists in Western Australia (Perth only); South Australia and Victoria.

The landfill levy in Victoria currently ranges between $4-7/tonne in rural areas and $6-9/tonne in metropolitan areas. In Perth, the levy is currently $3/tonne and $10/tonne in Adelaide.

Since the introduction of the landfill levy in the Sydney Metropolitan Area in 1994, the levy has been steadily increasing from $4.40/tonne to $19.80/tonne in 2004. Garden organics recovery

has followed increases in the landfill disposal levy, from as little as 115,000 tonnes in 1994 to over 550,000 tonnes in the Greater Sydney Region in 2003 (Figure 1).

Figure 1. Changes in the landfill disposal levy and recovery of garden organics from the Greater Sydney Region between 1994 and 2004.



4.1.8 Environmental planning

Historically, organics processing facilities have been sited on agricultural or rural zoned land on the urban fringe of metropolitan centres, or they have been sited on existing or pre-existing landfill sites.

As most processing facilities for garden organics are based on the outdoor windrow composting method, significant odour generation can occur if the process is not correctly managed or if management fails to maintain process control.

Uncontrolled off-site odour, noise, dust and bio-aerosol emissions can significantly impact on the amenity of the community, and as such, facilities need to have strict environmental controls in place as a part of the environmental protection license conditions.

However, in some cases, land use planning changes facilitated by councils or state government agencies in response to developers has made it possible for urban development to impact on pre-existing separation distances or buffer zones between the facility and neighbouring land uses. In these cases, community opposition has developed and has encouraged some processing facilities to relocate at significant expense.

A clear resource recovery and environmental planning framework is needed at a state government level to allow for the development of appropriate resource recovery facilities, and to provide proponents with land use security necessary to encourage significant investment in

infrastructure. A strategic framework with a medium to long term time horizon is considered to be a critical part of encouraging the development of sufficient infrastructure to allow for organics recycling to take place in line with state government targets.

The development of reprocessing infrastructure can be affected by the complexity of planning regulations and the number of consent authorities that need to be consulting in the development and planning approvals process. To address this issue, particularly in NSW, guidelines were produced to provide an overview of the key issues that need to be addressed in the facility development process, and this has assisted prospective developers, councils and state government planning and environmental protection authorities to provide advice on appropriate resource recovery infrastructure development and potential issues with sites selected (e.g. NSW Department of Urban Affairs and Planning, 1996; Recycled Organics Unit, 2001b).

4.1.9 Regional tendering and contractual issues

It is becoming more common in some parts of Australia for councils to work collaboratively to procure a separate or combined solution for treating their organic and residual waste streams.

Whilst significant economies of scale can be achieved with this approach, it is important that guidance be available to these regional groups and a clear waste management and resource recovery policy framework be in place to guide decision making.

The time line and investment costs for the private sector to invest in developing a tender response is considered to be a significant issue impacting on the viability of large, centralised organics processing facilities.

To avoid unnecessary delays in the procurement and planning stages of facility development, it is important that councils have a clear framework and guidance available to ensure that as much pre-planning is done before an expression of interest or request for tender is issued to the private sector. Local councils should develop a clear set of outcomes required from a regional approach, and a preferred strategy for achieving these outcomes, consistent with state-government policy.

The quantity and quality of garden organics suitable for reprocessing is an issue which is arising in some states (e.g. NSW) where significant gains have been made in resource recovery. Given that the financial viability of a reprocessing activity is dependant on gate fees for accepting material, and a certain minimum quantity of material, it is important that councils have reasonably accurate data on the type, quantity of potential quantity of material available for reprocessing.

Poor data on the quantity and quality of garden organics available in a given area has led in some cases to insufficient feedstock being available, and as a result, the financial viability of a small number of facilities has become an issue. Council liability in relation to data provided to support the business case for the establishment of a reprocessing facility has also been raised in a few cases.

4.1.10 Technology selection and life cycle assessment

The selection of a particular type of technology for use at a centralised processing facility has an important bearing on the processing capacity of the facility, environmental impacts and costs to the community.

Traditionally, the assessment of competitive tenders for the provision of processing services to councils has largely been based on subjective processes, such as multi-criteria analysis. Such an analysis may consider various financial, social, environmental and technical criteria of proposals.

Arbitrary indicators are chosen and a subjective assessment of each proposal is made against these indicators.

However, this approach may not take into account the full life cycle impacts of a reprocessing facility, such as resources and energy required in construction, and energy, water, atmospheric and wastes emitted by the facility over its operational lifespan. The facility will also generate downstream environmental impacts (and benefits in some cases) when the outputs of these facilities are applied to the environment (e.g. compost to farm land) or are consumed through a variety of processes (e.g. co-firing in power plants or dedicated facilities such as fluidised bed combustion, pyrolysis or gasification).

Contemporary approaches to evaluating and selecting an appropriate solution to reprocessing garden organics, within the financial constraints of the project, involve the use life cycle assessment to evaluate the proposal. Life cycle assessment can take into consideration the full environmental impacts on a proposal and over the life time of the project, which assists in the selection of an appropriate solution which meets the ongoing needs of the community. When combined with a social and financial assessment, a robust analysis of the contribution a proposal can make to the community can be assessed.

The provision of a recommended framework or suite of tools to local government is considered necessary to assist in transparent and technically sound decision making. Given the capital cost and duration of contracts required to establish reprocessing facilities, it is important that correct decisions be made as they can have a large and ongoing financial and local environmental impact (or benefit) on the community. These decisions also need to be made in line with preferred resource recovery policies.

An example of a decision making tool developed to assist in evaluating tenders by local government, based on life cycle assessment, has been developed by the Department of Environment and Conservation (NSW) (2003d).

Although decision making tools can help in evaluating processing infrastructure proposals, they are not a substitute for a local or regional resource recovery plan. It is critical for these plans to be consistent with resource recovery policies to ensure that state government priorities for resource recovery and environmental protection are achieved.

4.1.11 Environmental management

Provision of environmental guidelines for the organics processing industry from state-based environmental agencies is important to assist facilities implement well controlled environmental management systems. A number of states have developed these guidelines, and has assisted in the development of well controlled facilities. Some examples of these guidelines are given below:

- EPA Victoria (1996). Environmental guidelines for composting and other organic recycling facilities. Published by EPA Victoria, Melbourne.

- Department of Environmental Protection (1997b). Guidelines for the storage, processing and recycling of organic wastes. Draft for public comment. Printed by the Department of Environmental Protection. December 1997.

- Department of Environment and Conservation (NSW) (2004c). Environmental guidelines: composting and related organics processing facilities. Published by the Department of Environment and Conservation (NSW), Sydney South, NSW.

Regular auditing of environmental management systems in place at licensed reprocessing facilities is performed by most environment protection authorities around the country. Continuing

compliance with license conditions is important to minimise impacts on nearby land uses, and to ensure the continuing support for such facilities is received by the community.

4.1.12 Product quality

Experience in Europe, North America and in Australia over the past 15 years has clearly shown that the quality of reprocessed organic materials, or recycled organic products, is a critical issue which can affect the financial viability of a reprocessing facility.

Good quality, uncontaminated feedstock is necessary to produce a quality product that may be suitable for use in domestic landscaping, horticulture and agriculture. Source separation and continuing community education is paramount.

Experience has also shown that the quality of feedstock material entering a facility largely determines, in part, the quality of material being manufactured by a facility. Poor process control, contaminated feedstock, and lack of on-site environmental management can cause significant environmental impacts and low quality products may pose harm to the environment. Environmental impacts may be in the form of noxious weed transfer, plant pathogen distribution and phytotoxic effects on trees and plants.

To assist centralised composting facilities develop process control and quality management systems to ensure that good quality products are manufactured which meet recognised industry standards (e.g. Australian Standard AS 4454 (2003). Composts, soil conditioners and mulches), Victoria and NSW in the late 1990's funded the development of best practice guidelines for the commercial composting industry. Examples are given below:

- Ecorecycle Victoria (1998). Guide to best practice - composting green organics. Manual prepared by the Institute for Horticultural Development, Knoxfield, Victoria.

- Recycled Organics Unit (2000b). Producing quality compost. Published by the Recycled Organics Unit, the University of New South Wales, Sydney.

- Recycled Organics Unit (2002c). Guide to developing a process control system for a composting facility. Published by the Recycled Organics Unit, the University of New South Wales, Sydney.

Despite the development of a baseline environmental, health and safety standard for composts and related products, experience has shown that products complying with the requirements of this standard may still not meet market needs, and products may still be classified as 'low quality'.

An example which is currently an issue being addressed across the country is light plastic films (i.e. from shopping bags) in final composted products. Invariably, some garden organics received at composting facilities in kerbside bin collections may have lawn clipping, leaves etc in a plastic bag. Whilst attempts are made to remove as much of this contamination as possible, some plastics are not detected. Following size reduction, these plastics and reduced into a large number of smaller particles which can be very difficult to remove from the coarser fraction of composted products based on conventional separation technology (e.g. screening and air classification).

Light plastic films in these products can be an environmental contaminant, potentially impacting on waterways and fauna. The allowance for light plastic film in AS 4454 (2003) is generous and is problematic in some applications. Recent experience in NSW has found that composted mulches applied through blower semi-trailers bring the light plastics to the surface of the mulch when applied to roadside environments. This plastic is then mobile and may accumulate in waterways (Department of Environment and Conservation (NSW), 2004e).

The development of quality products complying with market specifications has been identified as a key issue from the recent Waste Management Association of Australia (Compost Australia) conference series, which aims to develop a national strategic plan for the composting industry[8].

4.1.13 Development of markets

A number of markets for recycled organics have been identified to date, and these markets vary in their demand potential, technical requirements, capacity to pay and geographical location.

The major output from garden organics reprocessing operations – composted mulches, soil conditioners and manufactured soils – have traditionally been absorbed by urban and amenity markets in metropolitan areas. As volumes of recovered garden organics has increased, so too has the need for markets to absorb products manufactured by these facilities.

It is critical that viable markets exist for recycled organics be developed prior to any new major initiatives to encourage supply of garden organics from households and commercial businesses for reprocessing. Failure to develop sustainable markets will see significant reductions in market value for recycled organics, and possible leakage of the material back to landfill for disposal. Falling prices for recycled organics may also affect the financial viability of organics reprocessing facilities.

State governments in Australia have invested significantly in assisting industry develop markets for its products, and major gains over the past five to ten years have been made in NSW, Victoria, South Australia, Western Australia and Queensland.

In developing markets for recycled organics, it needs to be recognised that transport costs can comprise a major portion of the delivered price for product. As mulches and soil conditioners are bulky, low density products, they tend to be expensive to transport per unit weight. As a result, markets for recycled organics have developed firstly near sites of compost production. Markets located at moderate distances from urban or regional centres (e.g. intensive or extensive agriculture) have developed much more slowly due to the lower capacity to pay in these markets, and the higher transport costs.

Also, markets vary in their technical requirements, and generic products which meet existing quality standards (e.g. AS 4454, 2003) may not meet their needs. Research and development being undertaken across the country in a range of market segments is attempting to develop a range of product specifications and cost/benefit data for recycled organics so that products can be used with confidence by markets.

Generally across Australia, resource recovery policies are not tied or linked to sustainable agricultural policies. This is seen as a barrier to rapid growth in the recovery of organic materials, as this depends on the development of markets, particularly in horticulture and agriculture. Given that the use of recycled organics in horticulture and agriculture has been shown to improve the sustainability of these operations (e.g. Department of Environment and Conservation, 2003b), a recognition of the role of recycled organics could help create market demand and stimulate further resource recovery (Waste Management Association of Australia, 2005).

Other markets such as biofuels involves the use of organic materials for electricity, heating and fuels for combustion, or as a feedstock for anaerobic digestion processes.

[8] More information on the WMAA Compost Australia Roadmap project can be obtained from: http://www.wmaa.asn.au/roadmap/compost.html

Oversize garden organics and woody residues from composting facilities are being used as fuel sources for co-firing with coal in power stations or for heat / steam generation in boilers at paper mills to a limited extent in NSW (Department of Environment and Conservation, 2004d). These markets are a reasonably low value market for recycled organics, with interest in using this material for fuel created by financial incentives offered through the federal renewable energy credit scheme.

Strict specifications required by waste to energy facilities, together with low amounts paid is likely to provide a barrier to the growth of this market (Recycled Organics Unit, 2005).

4.2 Food organics generated by the municipal sector

4.2.1 Generation

The generation of food organics from households is caused mainly from food preparation in the kitchen, together with unconsumed food which may or may not be spoiled. Food organics tends to be very high in moisture (>80%, w/w) and high in readily biodegradable organic matter. As a result, food organics rapidly degrade through microbial action, can attract pests and vermin, generate leachate and can cause nuisance odours.

The proportion of food organics in municipal waste is usually higher in inner metropolitan areas, and decreases towards outer metropolitan areas. Whilst few studies have characterised food organics generation profiles, it is believe that the quantity and composition of this material would largely be consistent during the year.

4.2.2 On-site avoidance options

Home composting and worm farming have traditionally been supported by local government to encourage householders to recycle this material at home, and avoid placing it in residual waste. However, in many jurisdictions, home composting of wastes of animal original is not recommended to avoid possible impacts of disease on human health (European Environment Agency, 2002c).

The European Environment Agency (2002c) recommends that a minimum of 1 m^2 of garden area per 10% of organic material generated per person in the household being home composted is needed to avoid over-fertilisation of soil with nitrogen and phosphorus. Over-fertilisation of soil with compost can lead to surface and ground water pollution. Typically, 5 m^2 of garden area is required per person in a household to home compost 50% of organic materials generated.

Therefore, for a household of three that recycle approximately 50% of their food and garden organics through home composting, this would require a minimum garden area of ~15 m^2 to avoid over fertilisation with nitrogen and phosphorus. Most suburban homes would have at least this amount of area under planting in gardens that could be used for compost application.

To assist home owners select appropriate compost bins or worm farms, performance studies on various proprietary products has been undertaken, with guides being written to inform purchasing decisions (e.g. Ecorecycle Victoria, 1999a).

Although many jurisdictions support home composting of food organics, few studies have focused on the success of these programs, and where studies have been undertaken, they have been based on a limited sample of participating residents in a given community.

4.2.3 Source separation

See Section 4.1.3 for a discussion on this issue.

4.2.4 Collection systems

Poor rates of recovery for municipally generated food organics is due to its highly putrescible nature, and difficulty in handling during collection, transport and reprocessing at a centralised composting or related facility.

Separate food collections, and more commonly, combined food and garden organics collections are relatively widespread in Europe. Separate collections of these materials is economic to do so given the relatively high density urban environments, feedstock density (amount of food organics per unit area of metropolitan centre) and where enclosed and tightly controlled processing facilities exist to reprocess this material into compost (via in-vessel composting) or organic fertiliser and biogas (via anaerobic digestion) (European Environment Agency, 2002a).

Significant thought needs to be directed towards the design of a separate food or food / garden organics collection service given the potential for environmental and social impacts through pest and vector attraction, odours and possible leachate.

In the European Union, the majority of member states provide to a varying degree separate collections of food from households that generally involve either:

- 'Biobins' which are plastic mobile garbage bins, 40 – 120 L in volume collected at the same time as residual waste, usually weekly;
- Paper bags collected from the kerbside. The advantage here is that the bags do not need to be separated before composting as they break down during the process;
- Plastic bags collected from the kerbside. However, plastic bags need to be separated prior to composting;
- Biodegradable bags collected from the kerbside. Although used to a limited extent, due to cost, these are a convenient alternative to paper bags as they do not disintegrate when wet.

During summer, separate collections of food may need to occur more frequently than weekly, to prevent odours from occurring (European Environment Agency, 2002a).

In most metropolitan centres in Australia and less so in regional centres, it is likely to be more economic to collect food combined with garden organics. This would avoid the need for additional transport vehicles and associated noise and atmospheric impacts on the community.

Increasing interest in a new type of ventilated wheelie bin, or 'biobin' for the collection of combined garden and food organics is being displayed by councils. This technology has been developed in Europe, and trials with various proprietary bins or inserts into retrofitted wheelie bins demonstrate some advantages. This includes improved moisture loss, reduced leachate generation, less odour, weight loss and the possibility of less frequent collections (Institute for Horticultural Development, 2001). This type of collection receptacle may become more popular for the collection of food organics in future in Australia.

A barrier which is preventing the implementation of food organics collections by local councils is the availability of processing infrastructure licensed to accept the material. The majority of

licensed reprocessing facilities across the country for organics are outdoor windrow composting facilities, where management of odours and vermin can be problematic when food is composted in windrows.

Strategies to increase the recovery of source separate food organics need to consider incentives for the development of enclosed on in-vessel reprocessing facilities that can tightly control the breakdown process and can contain odours, leachate and exclude pests and vermin.

Given that higher cost technology is required to successfully recover food organics from the municipal sector, food recovery is likely to only occur in metropolitan centres initially where landfill disposal fees are highest.

4.2.5 Other issues

Other issues the affect the recovery of municipal food organics are similar to those for garden organics. See Sections 4.1.5 to 4.1.13 for more details.

4.3 Food organics generated by the commercial & industrial sector

4.3.1 Generation

The quantity and composition of commercial & industrial food organics varies considerably across different industry groups. For example, food processors and manufacturers can be expected to generate relatively homogeneous food organics streams with low levels of contamination while organisations which serve prepared meals (e.g. cafes and restaurants) have mixed waste streams including both pre- and post-consumer food organics that are disposed with other materials (Southern Sydney Waste Board, 2000a).

Relatively little work has been performed to better understand the sources and quantities of food organics generated by a very large range of businesses in the major metropolitan centres of Australia. Regional centres have received little attention, perhaps as the majority of food organics generated occurs in metropolitan areas where significant food manufacturing, processing and retailing is performed.

Examples of commercial & industrial sector food organics generation and compositional studies conducted in NSW and Victoria include Maunsell Pty Ltd and Ratio Consultants (1998), Waste Audit and Consultancy Services (undated) and Southern Sydney Waste Board (2000a).

Previous studies have categorised groups of businesses exhibiting similar characteristics to in a bid to quantify the likely rates of food organics generation based on limited sets of disposal based audit data. As a result, data on generation rates are approximate and may vary considerably. General categories of businesses that generate food organics is as follows (Southern Sydney Waste Board, 2000a):

- Food retailing (supermarkets / grocery stores; fresh meat / fish / poultry retailing; fruit and vegetable retailing; liquor retailing, bread and cake retailing; takeaway food retailing; milk vending; and specialised food retailing);

- Accommodation, cafes and restaurants (accommodation; pubs / taverns/ bars; cafes and restaurants; and clubs;

- Educational and health institutions (pre-, primary, and secondary schools; higher education; TAFE; hospitals; and nursing homes);

- Food manufacturing and processing (meat; poultry; smallgoods; ice cream; dairy; fruit and vegetable; oil and fat; flour mill products; cereal foods / baking mix; bread; cake and pastry; biscuit; sugar; confectionary; seafood; animal and bird feed; and food manufacturing); and

- Remaining businesses (e.g. corporate offices, miscellaneous retailing etc).

The Southern Sydney Waste Board (2002a) study found that for the South Sydney region, food retailing and accommodation / cafes / restaurants accounted for more than 75% of total food organics generated. The study identified that food manufacturing and processing enterprises were not large generators of food organics as solid waste, as most food material is discharged to sewer as liquid trade waste or subject to other arrangements (e.g. direct soil injection on farms or animal feed).

An absence of quality data on food organics generation, and a good understanding of the extent of material flows within the supply chain have acted as significant barriers to the development of strategies for increasing the recovery of this material for reprocessing in most states across Australia.

4.3.2 Avoidance options

Preventing or avoiding the generation of food organics in the first place is the most cost effective way of reducing a businesses waste management costs. Three main options have been identified to assist businesses avoid the production of food organics. This includes avoidance through cleaner production measures; treatment through on-site processing systems (e.g. in-vessel composting or vermiculture); and donation of food to charities.

Depending on the business type, many types of businesses, particularly in the food retailing and food manufacturing sectors already practice cleaner production and have systems that avoid the generation of food organics (Southern Sydney Waste Board, 2002a).

Many food retailers, for example, carefully match food procurement with projected demand. A number of guides have been developed in the past to help businesses better manage production scheduling, procurement, minimising spoilage and numerous other measures to reduce food organics generation as waste (e.g. NSW EPA, 1998a,b; Ecorecycle Victoria, 1999b). Encouraging the adoption of cleaner production practices is considered to be an effective tool to assist in reducing food organics generation.

On-site treatment through in-vessel composting or in-vessel vermiculture is not practiced widely, due to the labour costs involved in managing the system, costs of the technology, and little to no need for compost or vermicast produced by the systems for managing on-site gardens or landscaped areas.

Substantial research has been undertaken to evaluate the range of on-site technologies available, processing capacities and best practice guidelines for the management of these systems (e.g. Recycled Organics Unit, 2001c; 2002d,e).

Despite the attractiveness of on-site systems as a solution to food organics, these types of processes may be more appropriate in remote locations, such as holiday villages and other settlements where small quantities of commercial food organics are generated, and where controlled disposal options for this material do not exist. Treatment of post-consumer food in

these systems may be problematic, due to the tendency for contamination with containers, cutlery, glass, plastic wrap and other foreign materials.

Donation of unspoilt food from end of production runs or unsold food is relatively common in metropolitan centres. 'Food banks' are usually not-for-profit organisations that work in partnership with wholesalers and retailers to salvage food that would other be disposed of as waste (NSW EPA, 1998c). Whilst such services provide an important social and economic benefit to the community, the quantity of food that can be accepted by these organisations is limited by business participation rates and quality of food available for human consumption.

4.3.3 Source separation and collection

As for garden organics, separation at source is the preferred strategy for recovering food organics (see Section 4.1.3). Source separate collection maximises recovery options, such as a feedstock for in-vessel composting into quality products, or production of energy through anaerobic digestion (European Commission, 2000; 2004; European Environment Agency, 2002a).

Two significant feasibility studies have been conducted in Australia to evaluate the viability of establishing source separate collection and processing schemes for food organics (Ecorecycle Victoria, 1997a; Southern Sydney Waste Board, 2001). These studies are complimented by a very limited number of food organics collection trials across a range of business types to inform these plans (e.g. Ecorecycle Victoria, 1995, 1997b, 2001).

For commercial collections, the choice of container size is restricted by the space available in most waste docks, user comfort, manoeuvrability, and collection vehicle type (Ecorecycle Victoria, 1997a). Usually, 120 or 240 L mobile garbage bin are used for the collection of food organics. Bins over 120 L in volume, however, can be an occupational health and safety hazard to staff as food organics can have a very high density, making bins extremely heavy to move.

Given the weight of collected food organics, side-loading compaction vehicles which are common for municipal collections can be problematic. When compacted, the weight of a side-loading compaction vehicle can exceed the legal road limit, and can generate significant volumes of leachate that needs to be managed.

Fully sealed, non compacting front loading collection vehicles are usually preferred for the collection of food organics, as they have a better weight distribution, they compact and are more manoeuvrable in difficult to access areas where bins are usually stored, such as in rear lanes of businesses (Ecorecycle Victoria, 1997a).

Unlike the municipal sector, food from businesses are normally collected alone, and not combined with garden organics, as the latter is generated only by a small number of businesses that have grounds. Furthermore, garden organics generated by these businesses are normally taken off site and managed by commercial garden maintenance companies who are engaged on a periodic basis to maintain lawns and landscaped areas.

Experience has been variable on the feasibility of establishing good source separate collection systems in commercial businesses. In food retailing and accommodation, cafes and restaurants, the provision of in-house training on new waste collection systems and management support is critical for obtaining a clean, uncontaminated material suitable for reprocessing. Staff turnover, existing practices and the fact that waste disposal is usually a minor overall business cost have been responsible for variable success in source separation from this sector.

Bin hygiene is an issue that is commonly raised in the collection of commercial food organics. As food organics are highly putrescible and have a very high moisture content, they can generate odourous leachate if the bins are not emptied regularly. As a result, plastic bin liners are usually

preferred as the bags can contain most of the leachate, and prevents food contact with the walls of the bin, requiring significant cleaning. If bins are stored indoors, for public health and food hygiene reasons, these bins need to be thoroughly cleaned and sterilised to avoid pathogen transfer.

Where bin liners are not used, it is critical that collection service providers provide a bin cleaning service, which often involves a high pressure water jet. As the waste water cannot be discharged to stormwater and a sewer connection is often not available in the waste dock of most businesses, some collection contractors provide a bin exchange service. This, however, can impact on the cost of providing a food organics collection service.

Economic issues that affect the viability of establishing source separate collection systems for food organics are discussed in Section 4.3.4.

4.3.4 Economics of food organics collection

The majority of waste removed from commercial enterprises is performed by commercial waste collectors. Collectors transfer waste from the site of generation and dispose of the material at licensed landfill facilities. A barrier preventing the introduction of source separation systems for food organics is the way that waste services are structured and marketed to businesses by commercial collectors.

In most metropolitan centres, competition for the provision of waste removal services to business enterprises is high, and is driven by cost. Waste collection companies are usually reluctant to offer separate collection services due to the potential for increased costs to the customer, and the risk of losing their continued business. In theory, however, total costs for residual waste removal / disposal and food organics collections should be similar to normal waste disposal costs. This is because the increased cost of providing a separate collection service for food organics should be largely offset by the avoided waste disposal costs.

The feasibility of collecting source separate collections of food organics from commercial precincts is affected by feedstock density (quantity of food organics per unit area within a region), and the economics of establishing a ‘commercial run’.

Usually, a certain number of businesses that generate a minimum amount of food organics available for collection is required to make it feasible to economically collect and transport this material to a reprocessor. However, collectors rarely have the opportunity to collect food organics in sufficient quantities from a series of their own customers within a certain geographic area to make a separate run economically viable. As a consequence, collectors tend to be unwilling to offer separate collection services, as increased costs may be incurred in collecting smaller quantities of material.

In addition, the service cost per customer usually increases with the introduction of a separate collection system for food organics. This is because the collection company often has to provide new bins and support for staff to introduce the new system. Monitoring of source separation performance and follow up contact will also increase costs.

It is also important to note that businesses that have their waste removed by collection companies are not charged on the weight of waste produced, though the collection company pays on the weight of material disposed at the landfill disposal site. Businesses are charged on the volume capacity of their bin, regardless of whether the bins are empty, partly full or completely full at the time of collection. This provides increased financial returns to collectors, by receiving payment for material not collected and disposed.

If additional bins are provided to a business for collection of food organics, most will expect that the volume of bin space they require for disposal of residual waste will be reduced. In some cases, recommendations to reduce the residual waste bin capacity for a business may not be made, due to the potential for loss in revenue to the collection contractor. This inevitably means that the business will pay more in waste removal when a separate collection system is introduced.

These economic impediments are largely responsible for the lack of food organics processing by centralised facilities in Australia. Although businesses surveyed in the past have displayed willingness to source separate food to benefit the environment, one study indicated that they will not unless the service is provided for free (or if their total waste management costs do not change) (Ecorecycle Victoria, 1995).

The reluctance of the commercial & industrial sector to embrace food organics recovery, despite the obvious environmental benefits and environmental marketing opportunities, countries such as Denmark have introduced legislation to require canteens and restaurants that generate more than 100 kg of food organics per week to establish collection systems for food organics (European Environment Agency, 2002a).

4.3.5 Economics of food organics processing

As food is highly putrescible, specially designed, centralised facilities are generally required to reprocess the material to minimise impacts on the environmental and the amenity of the community.

In Europe, North America and Canada, infrastructure is being developed rapidly to enable the processing of food organics to avoid the disposal of this material in landfill. Examples of facilities well suited for processing food organics are principally in-vessel or enclosed composting; anaerobic digestion and in-vessel vermiculture.

There are relatively few in-vessel vermiculture facilities in operation, and are not usually adapted to processing large volumes of food organics like in-vessel or enclosed composting and anaerobic digestion. A thorough overview of in-vessel or enclosed composting and anaerobic digestion is given in Recycled Organics Unit (2001a) and European Environment Agency, (2002c).

The investment cost for establishing these facilities, however, can be substantial. The capital costs of some recent Australian projects for food organics and their annual processing capacities are given in Table 3.

A critical issue which affects the viability of such large capital intensive projects is long term feedstock security and predictable gate fees. The availability of feedstock and the revenue facilities receive through accepting material for processing is crucial to the economic viability of these plants.

Unlike the municipal sector, commercial businesses that generate large quantities of food organics are usually unwilling to enter into long term supply agreements with food reprocessing facilities. These types of arrangements are inflexible from the waste generator’s point of view, and preclude the option of considering less expensive alternatives when they become available. As a result, developers of capital intensive plants suitable for processing food and other organic materials have preferred to enter into long term contractual arrangements where supply of material for processing can be guaranteed.

Given the large capital investment and ongoing operational costs, relatively few projects have proceeded past the planning stage for the processing of source separate commercial food

organics in Australia. In most states, the price of landfill is still relatively low, and these types of processing facilities may not become viable until the price of waste disposal increases. The progressive increase in state government levies on waste disposal over the next few years may create further incentives for developers too consider options for the development of infrastructure to target this resource stream.

Table 3. Approximate reported capital costs and annual processing capacities of some recent Australian projects for source separate food organics.

Company	Facility type	Location	Year built	Capital cost ($AUD)	Annual processing capacity (t/yr)	Capital cost / tonne processing capacity ($AUD/t)
Earthpower Technologies P/L	Anaerobic digestor	Camellia, NSW	2002	30,000,000	82,000	365
Biowise	Aerated static pile composting	Kwinana, WA	2002	-	35,000	-
Remondis P/L	In-vessel composting	Port Macquarie, NSW	2001	7,000,000	35,000	200
Natural Recovery Systems P/L	In-vessel composting	Dandenong, VIC	2000	-	35,000	-
Tryton Waste Services	In-vessel vermiculture	Lismore, NSW	2001	4,600,000	7,000	657

4.3.6 Hidden flows in the supply chain

The actual quantity of food organics available in the waste stream for recovery is not well understood. The uncertainty regarding the quantity of food organics potentially recoverable and available for diversion through a range of processing technologies is partly due to the fact that very few comprehensive waste audits have been performed on a range of business types. In addition, we know that there are significant flows of food occurring which are 'hidden' and do not enter the solid waste stream (see Figure 4, Section 3.5.2.2).

Some of these hidden flows are extremely difficult to quantify as the materials are managed in ways that avoid solid waste management and existing licensing systems controlling the processing of organic materials. The three main hidden flows of food organics from the commercial & industrial sector are: direct soil injection on farms; direct animal feeding; rendering and in-sink disposal into the sewerage system.

A review of food organics processing options in 2001 by the Recycled Organics Unit highlighted the risks to human health, animal health, water quality and the environment through direct soil injection on farms. Environmental impacts include excess loading of soils with nutrients, contamination with heavy metals, and transfer of animal and human diseases. Excess nutrients in soils beyond that which can be taken up by plants can move into surface and ground water bodies. Heavy metals and other contaminants can also be absorbed by crops grown in these soils, enter the food chain and potentially impact on human and animal health.

Whilst states such as Western Australia and New South Wales have introduced or are proposing the introduction of regulations controlling or banning the application of industrial wastes to land as fertiliser (Department of Environment, 2004; Department of Environment and Conservation (NSW), 2004f), these instruments do not control the direct injection of unprocessed food on land.

Improved regulation, enforcement and guidelines are required to protect animal health, human health and the environment from the potential negative impacts of feeding food organics to

animals and land applying this material as a fertiliser on farms. Such activities will assist in directing food organics down preferred paths in the supply chain.

4.3.7 Other issues

Other issues the affect the recovery of commercial & industrial food organics are similar to those for garden organics. See Sections 4.1.7 to 4.1.13 for more details.

5 Review of Australian and overseas policies and programs to encourage better management of organics

5.1 Introduction

Diversion of organic materials from the municipal and commercial & industrial waste stream is being pursued worldwide to reduce overall waste reduction to landfill. Few countries have attempted to implement policies and supporting programs to achieve a reduction in waste to landfill without addressing options for the improved management of organic materials.

A range of statutory instruments (legislation and regulation) and supporting statutory instruments (programs, plans covenants and agreements) have been developed to achieve behavioural, institutional and technological change at various points in the supply chain for garden and food organics. These instruments may be designed to influence (European Environment Agency, 2002a):

- Generation at the household or business;
- Presentation, collection and transfer;
- Treatment; and
- Final disposal or beneficial use.

This section reviews a range of formal government policies and programs that have been implemented in a range of jurisdictions to better manage organic materials. This review includes a number of national and state-based initiatives, and also some from overseas countries. A broad selection of countries and states has been chosen to highlight the diversity in approaches taken, and to demonstrate results achieved. Initiatives in the following countries and states have been reviewed:

- Australia – federal;
- New South Wales, Victoria, South Australia, Queensland and ACT;
- European Union and selected member states: Austria, Belgium, France, Germany, Italy, Netherlands, Spain, Sweden and United Kingdom;
- Canada – province of Alberta;
- United States and selected states – California; Indiana and New Jersey;
- Asia – Taiwan and Japan.

To assist in developing an appreciation of the range of initiatives implemented in the jurisdictions reviewed, formal government policies such as legislation and regulations are reviewed in Section 5.2 and supporting instruments are reviewed in Section 5.3.

5.2 Legislative and regulatory policy instruments

Legislative and regulatory instruments are formal laws and regulations made by government to achieve desired policy outcomes across the community, government, business and industry. In many countries, formal legislative and regulatory instruments have been developed to provide an overall framework for achieving a reduction in the disposal of organic materials to landfill, or in some parts of Europe and the United States, for disposal via incineration.

The variety in legal instruments developed reflects the different social, economic, environmental and political settings in each jurisdiction. The range of legislative and regulatory instruments implemented in countries and states identified in Section 5.1 are grouped according to where they are directed in the supply chain for garden organics and food organics, and are discussed below. A list of these instruments in provided in the Appendix.

It is important to note that countries achieving waste reduction in excess of 70% from landfill over the past decade have rarely relied on a single instrument at one place in the supply chain. A mix of instruments strategically chosen to influence certain actions and behavioural change at a number of locations in the supply chain is needed to achieve large scale diversion of waste from landfill (European Environment Agency, 2002a).

5.2.1 Generation

Generation (or production) of organic materials at the household or business level have traditionally been the preferred point of the supply chain for dealing with wastes. Preventing and minimising wastes in the first place avoids the need for these materials to enter the waste management system, requiring management to ensure their safe disposal or beneficial use.

However, few instruments have been developed to target early points of the supply chain, and most are directed at later points in the supply chain that tend to be easier to measure and enforce.

Waste prevention and minimisation instruments for businesses have been introduced in Austria under the *Austrian Sustainable Waste Management Law* 2001. Since 2001, it is a legal requirement for businesses that employ more than 20 staff to have a waste management plan in place. In these plans, cleaner production initiatives that focus on preventing the generation of waste, with subsequent financial returns to businesses, appear to be the focus of these plans.

Prescriptive legal requirements for the separation of materials in homes and businesses occurs to a limited extent across Europe. Mandatory separation of garden and food organics at source is required in Netherlands and Sweden. In the Netherlands, compulsory source separation required under the *Environmental Management Act* 1994 has been in place since 1994. In 2001, Section 8.40 of this Act was amended to require certain businesses to separate food organics at source. This includes hotels and catering; sport and recreation; retail sector; and other trades; residential & amenity buildings; textile cleaning; motor vehicle establishments; and storage depots.

Economic instruments are available to municipalities to encourage householders to reduce the amount of waste they generate. The European Environment Agency (2002a) supports EU member countries to introduce ‘polluter pays’ legislation to require municipal authorities to charge residents on how much waste they produce. This provides a strong incentive for householders to reduce waste generation. A number of European countries have introduced legislation requiring municipalities to introduce user pays systems for waste disposal. These countries include: Austria, Denmark and Sweden. In Sweden, the domestic waste management charge is reduced further if home composting is performed or if the household participates in a communal composting scheme.

Polluter pays systems for municipal waste disposal can vary in application. Some councils may charge for the volume of waste bin required; or councils may charge householders depending on the mass of waste produced which requires disposal.

In reviewing policies and plans for waste management and resource recovery as a part of this project, it was evident that a number of jurisdictions are considering the introduction of user pays systems as a useful economic instrument to reduce the generation of waste by households. User pay systems for municipal waste disposal are in their infancy in Australia, and warrant further investigation given the potential of this instrument to reduce waste generation in the short to medium term.

5.2.2 Presentation, collection and transfer

In Europe, there is strong evidence to suggest that countries with good source separation systems for a range of materials, including organics, tend to have the least dependence on landfill. In Belgium (Flanders), more than 70% of all municipal waste is separately collected and processed, and only 20% of the total waste generated is landfilled. Therefore, how organic materials are presented for collection has a significant impact on a region's overall dependence on landfill (European Environment Agency, 2002a).

A number of countries in Europe have introduced legislation requiring municipalities and businesses to use source separate collection systems for garden and food organics.
For example in Denmark, councils are legally required to collect food organics from canteens and restaurants that generated more than 100 kg per week. In the Netherlands, councils are required to collect food and garden organics separately since 1994. In Spain, municipalities with more than 5,000 residents are legally required to provide separate organics collections to households. In New Jersey, USA, the *Mandatory Source Separation and Recycling Act* 1987 requires municipalities to recover at least 25% of municipal solid waste through the provision of source separate collection systems.

Japan and Taiwan have recently introduced laws to require food manufacturers and restaurants to separate and recycle food organics. In a number of highly populated metropolitan centres in Japan and Taiwan, food organics is often the major component of the municipal and commercial & industrial waste stream. To reduce the quantity of food organics presenting in waste, Japan has introduced the *Food Recycling Law* 2001. This Act requires a cut in food organics disposed by food manufacturers and restaurants by over 20% by 2006. In Taiwan, the *Waste Disposal Act* requires mandatory recycling of food organics from restaurants and households by 2006.

In countries where mandatory separate collection laws exist, adequate attention must be paid to the quality and level of contamination occurring in the organic fraction; otherwise significant problems can be experienced in developing and maintaining reliable markets for recycled organics. In addition, the introduction of this type of policy depends on the existence of developed markets for recycled organics. If markets do not exist, material collected may have no other management option except for landfill.

Legislation requiring the provision of mandatory collection systems for organic materials is not common in United States, Canada, or Australia. However, many governments have policies that encourage the use of source separation and centralised processing where economic to maximise resource recovery and environmental benefits to the community.

5.2.3 Treatment

Few countries have introduced legislation to require separately collected garden and food organics to be processed into beneficial products using a certain type of treatment technology,

such as anaerobic digestion or centralised composting. However, life cycle environmental assessments, social impact impacts assessments and economic studies have generally found that these technologies offer superior triple bottom line benefits over alternatives, such as incineration.

As communities become more aware about the externalities caused by landfills, long after they have been closed and rehabilitated, some governments have recognised a need to improve the quality of material being disposed of in landfill so it has lower environmental impacts. Pre-treatment of residual waste, such as mechanical biological treatment is a useful approach to reduce the organic matter content of waste, with some recovery of dry recyclables, before it is disposed of in landfill. By reducing the organic matter content, the waste landfilled is more biologically stable, less likely to generate greenhouse gas and contribute to leachate problems.

The *Ordinance on the Environmentally Sound Disposal of Municipal Solid Waste* introduced by the German Government requires mandatory pre-treatment of all municipal waste before landfill disposal by 2005. *Commercial Waste Ordinance* 2003 stipulates that a minimum of 85% recovery of commercial waste is required, and source separation and pre-treatment of residuals is required. To ensure that the mandatory pre-treatment of residuals meets the necessary stabilisation requirements, Germany has also introduced the *Landfill Ordinance* 2002, which requires the total organic carbon level remaining in waste to be less than 5% w/w.

Under the *National Waste Management Law* (Decree 22/97) established in 2001, Italy has banned the landfill disposal of untreated waste. Similarly in the Netherlands, a ban has been introduced on the landfilling of unsorted and untreated municipal solid waste under the *Environmental Management Act* 1994.

At this point in time, no formal legislative measures have been introduced in Australia to require the pre-treatment of residual waste before disposal. However, NSW, Victoria and Western Australia report in their respective waste and recovery strategies that the treatment of waste prior to landfilling is a preferable option over disposing of unsorted and untreated waste in landfill.

5.2.4 Final disposal and beneficial use

The final link in the supply chain for garden and food organics where legislative or regulatory instruments can be used to improve their management is final disposal, or on how the reprocessed materials are beneficially used. The final destination and end use of material at this point is largely determined by the way in which the material is collected.

Traditionally, government policy has focused on the deployment of instruments which affect the disposal of waste. Since the 1980's, most governments in Europe, United States, Canada and Australia have established waste disposal reduction targets to provide an incentive to reduce the amount of waste generated and disposed. The majority of these targets created by governments have been non-statutory, meaning that there were no legal means for enforcing compliance or applying penalties when targets were not reached. As a result, most states have not met their goals in waste reduction by relying on notional non-statutory targets alone.

To address this issue, a number of US state governments and EU member countries have introduced bans on the disposal of various proportions of the municipal and commercial & industrial waste stream. In the EU, the EU Council Directive 1999/31/EC on the landfill disposal of waste (the landfill directive) places targets on Member States to reduce the quantities of biodegradable municipal waste (BMW) going to landfill over a period to 2016.

Given the beneficial use options for recycled organics, the majority of state or national governments have firstly banned untreated municipal solid waste, or individual fractions such as garden organics, and in some cases, food organics as well from landfill. Examples are as follows:

- 21 US States now have bans in place on the disposal of garden organics (yard trimmings) in landfill. For example:
    - Indiana, as early as 1994 banned the disposal of garden organics (leaves, brush and woody vegetation > 3 ft in size) in landfill;
    - New Jersey's ban on garden organics is on the disposal of leaves only (Kaufman *et al.,* 2004).
- 11 EU member states have bans or are in the process of introducing bans this year on the disposal of various fractions of garden, food organics or municipal waste in landfill (European Environment Agency, 2002a). For example:
    - Belgium (Flanders) has a ban on landfilling of separately collected food and garden organics and municipal waste, and on the landfilling of unsorted commercial & industrial waste.
    - Denmark, Germany, Netherlands and Sweden all have bans in place on the disposal or unsorted or untreated municipal solid waste.

Given the difficulty of determining whether waste still contains organic material, which precludes it from being landfilled in states where bans are in place, most state governments have prescribed types of organic materials which cannot be landfilled. Examples include:

- Arkansas, USA: leaves and grass;
- Maryland, USA: separately collected loads of garden organics;
- Connecticut, USA: grass clippings;
- Nebraska, USA: leaves and grass; and
- Pennsylvania, USA: truckloads comprised mainly of leaves (Kaufman *et al.,* 2004).

Bans on the landfilling of waste or certain fractions of the waste stream need enforcement to be effective. In most jurisdictions, however, the concept of a ban on the disposal of waste in landfill has sent a strong signal to municipalities, in particular, to introduce new collection services and processing systems to recycle garden and food organics.

Bans on the disposal of unsorted commercial & industrial waste exist in Belgium (Flanders), Germany and Italy, though individual material bans are less common (e.g. for food organics). This is because it is administratively difficult to enforce a ban when commercial waste is managed primarily by commercial waste companies, and not centralised municipalities. Tracking waste back to its source can be difficult when commercial waste collectors carry loads of material from multiple businesses.

To help in providing a strong legislative basis for reducing the disposal of food organics from the commercial & industrial sector, Belgium and the Netherlands legally require businesses over a certain size to separate food organics for recycling.

Bans are considered to be very effective tools when they come in force over a medium to long term time frame to allow for municipalities and the private sector to plan and develop the appropriate infrastructure and markets to absorb outputs from these facilities. Statutory bans that are put in place with insufficient lead time can result in poor planning, insufficient market development and failure to comply with the requirements of the ban when it comes into force.

Bans preventing the disposal of garden organics have been considered in NSW and Western Australia for possible implementation between 1997 – 1998. Both bans did not proceed to the implementation stage. It is believed the NSW ban did not proceed due to the perceived risk of oversupplying immature markets for compost in the Greater Sydney Region, reducing prices and possible failure of reprocessing enterprises. The lack of lead time provided to councils to develop collection systems and plan the necessary infrastructure is believed to have been a major issue which prevented the introduction of the ban.

Despite the failure of non-statutory targets in achieving large scale reductions in waste disposed in many jurisdictions world wide, some successes have occurred with targets established by governments.

In 1998, the government of California introduced a mandatory reduction of 50% of municipal waste to landfill by 2000, which was one of the first mandatory targets put place in the USA. Under the *Integrated Waste Management Act* 1994, penalties of US$10,000 per day would apply to municipalities for non-compliance with the statutory target. Given the reasonable time frame for instituting change, and the significant penalties for non-compliance, the state of California largely met its target and is leading the country in waste reduction.

Waste taxes, or landfill levies are common throughout Europe, United States, Canada and Australia. Taxes on the disposal of waste are an important economic instrument to encourage generators of waste to reduce the amount of waste produced, and where waste is produced, to ensure it is directed to resource recovery facilities.

All the jurisdictions reviewed invest a proportion of the revenue back into supporting policy initiatives, such as providing incentives for infrastructure development, service provision, market development and providing support to councils and businesses for reducing waste and improving resource recovery. These programs or supporting policy instruments funded through taxes on waste disposal are reviewed in Section 5.3.

5.3 Supporting instruments (programs, plans and agreements)

In states and countries that have waste disposal taxes or levies in place, state or federal governments normally have funding systems in place to reinvest a proportion of the waste tax revenue into instruments that aid in the achievement of waste prevention and resource recovery policy.

Supporting instruments, like statutory instruments, can influence the supply chain for garden and food organics at different points. Choice of instrument will depend on the regional context and drivers required for change to meet policy targets or overall resource recovery objectives. Supporting instruments will also differ in their design and delivery when applied to the municipal and the commercial & industrial sectors.

This Section reviews a number of different programs, plans and agreements developed by governments to support waste prevention and resource recovery policy initiatives in place in Australia and overseas (see Section 5.1 for the list of states and countries included in the review). Generally, these supporting instruments can be categorised as follows:

- Information, persuasion and awareness;
- Technological and institutional change;
- Arrangements between governments and organisations; and

- Economic instruments.

This Section presents a summary of the range of supporting instruments reviewed in Australia and overseas, and categorises them into the four main parts of the supply chain for garden organics and food organics, as in Section 5.2. More detail on each supporting instrument reviewed can be found in the Appendix.

Again, it is worthwhile noting that there appears to be significant differences in the use of legislative and supporting instruments in Europe, United States and Australia. Europe traditionally has favoured the use of legal instruments to drive waste prevention and resource recovery, whereas the United States and Australia have had more of a focus on the use of voluntary supporting instruments to achieve change.

5.3.1 Generation

Home composting schemes are perhaps one of the most common types of programs supported by governments to help in avoiding the production of municipal food and garden organics that needs to be managed as a part of the waste stream. Programs may involve a mix of educational initiatives to support home owner's to compost properly, through to bin subsidy schemes. Guides to compost bins and worm farms have been produced (Ecorecycle Victoria, 1999a).

In NSW, the Earth Works training program has been in operation since 1997 by the NSW EPA, and focuses on providing skills to homeowners to reduce their impact on the environment by recycling organic wastes at home, and using more environmentally friendly gardening approaches. Similar programs have operated in Victoria, and the delivery of a program of this type is planned for South Australia by Zero Waste SA.

Increasingly, the provision of support to homeowners for home composting is being delivered by local government instead of state or federal governments.

To better manage municipal waste in Belgium, in 1992 voluntary 'Environmental covenants' were established between the national government and volunteering municipalities to encourage the establishment of source separation collection and processing infrastructure in exchange for subsidies. Since the introduction of the covenant, 300 of the 308 municipalities are now signatories and are participants of the 'third generation' covenant which contains new and upgraded environmental targets.

Reducing waste in the commercial & industrial sector in Europe, United States and Australia have depended on cleaner production initiatives, such as the internationally recognised 'Waste Wise' type of voluntary partnership between government and industry.

First developed in the early 1990s by the US EPA, Waste Wise is a free, voluntary, EPA program through which organizations eliminate costly municipal solid waste and selected industrial wastes, benefiting their bottom line and the environment. Waste Wise is a flexible program that allows partners to design their own waste reduction programs tailored to their needs

Waste Wise business support programs (or similar programs) also exist in Victoria, Queensland and the ACT, and are delivered through Ecorecycle Victoria, Queensland EPA and No Waste ACT. Some of the programs help business set targets and develop strategies for waste reduction, with some providing funding incentives to assist in program implementation. The ACT program encourages businesses to participate in the 'Ecobusiness Workshop'. Programs vary in their cost, level of technical support and funding provided to participants. Costs per tonne of waste prevented and/or diverted from landfill is an important measure of the effectiveness of these voluntary programs.

Reducing waste in state government is supported via a number of individual programs currently in operation in Victoria, South Australia, NSW and Queensland. Ecorecycle Victoria participates in a partnership program that assists government agencies to achieve waste reduction through sustainability packages. Zero Waste SA has developed a program titled 'Greening of Government Operations (GoGO) Framework' with the objective of helping government agencies reduce waste. The Department of Environment and Conservation (NSW) has a 'Waste Reduction and Purchasing Policy' program, which requires state government agencies to develop and implement waste reduction plans and 'buy recycled' purchasing policies. Agencies currently report on waste reduction every two years. Queensland conducts waste auditing of government departments through the Queensland EPA.

5.3.2 Presentation, collection and transfer

The cost of providing collections services to households for separately collected organic materials has been suggested as a major barrier preventing the uptake of organics collections and recycling systems in some municipalities.

To address this issue, studies on the actual costs of providing collection services have been undertaken to better inform council decision making on behalf of their communities. In NSW, studies have been completed on the costs of providing garden organics collection services in a range of metropolitan and rural / regional situations.

Programs such as these are important tools to help in capacity building and decision making in local government. Similar capacity building programs have been undertaken in NSW to provide training on triple bottom line assessment of resource recovery approaches to help in tender evaluation.

Programs which focus on the provision of best practice guidelines for collection and processing of organic materials are commonly developed by state governments to aid in the design of resource recovery solutions provided by local government. Preferred service standards and best practice resource recovery guidelines have been developed in NSW and Victoria for local government. Voluntary agreements with local governments have been made to ensure that progress towards state-wide strategy targets is made.

Programs designed to reduce contamination in containerised collection systems for municipal garden and food organics are common in Australia and overseas. As physical and chemical contaminants can have a large impact on the quality of reprocessed materials (e.g. compost), ensuring good source separation by households is critical for efficiently recycling organic materials. Tools and best practice guidelines for local government, model collection contracts and community education programs are quite common.

To aid in the development of organics recycling initiatives in rural and regional areas, a program has been operating in NSW for three years to develop regional organics management plans (ROMPs) in partnership with regional groups of councils. Given that the quantity of municipal and commercial & industrial garden and food organics available for collection are usually insufficient to make a processing facility economically viable, the project has attempted to develop inventories of other organic materials available (e.g. agricultural and forestry materials) that could also be used as feedstocks. Economies of scale may be achievable to make the construction of a regional organics processing facility viable. In other cases, municipal and commercial & industrial organic materials could be directed towards agricultural composting operations to recycle this material.

The provision of rebates or economic incentives to local government from revenue collected from waste disposal taxes or levies are common in Australia and overseas to encourage the development of collection services and processing infrastructure. For example in NSW and

Victoria, grants are provided to regional groups of councils or regional waste management groups to fund the implementation of approved regional waste management plans.

In Victoria, unlike NSW, an infrastructure investment program exists to encourage local government to plan and develop preferred infrastructure for collection and processing of garden and food organics. This program has a focus on the provision of controlled environment (enclosed) processing facilities, which are needed to recover food organics in Victoria. A rebate is provided on the tonnages of material processed over the first few years of operation of the project. South Australia has a similar infrastructure investment grants program to councils to develop infrastructure for recovering garden and food organics.

Relatively few programs have been developed to help businesses to separate and direct material for off-site treatment and recovery. Programs have been funded in Sydney and Melbourne to look at the availability of commercial food by business type, processing options and feasibility studies. Few of the recommendations from the programs have been successfully implemented to assist in the recovery of commercial food organics, due to issues highlighted in Section 4.3.

Successful food organics recovery programs are common in Europe where they are underpinned by law. In the Netherlands, specific programs have been made available to businesses to help introduce source separate collection systems. This initiative was launched in 1997 to support the objectives of the *Environment Management Act* 1994 requiring certain businesses to introduce source separate collection and recycling schemes.

5.3.3 Treatment

Construction of reprocessing facilities for treating garden and food organics often involves an investment of millions of dollars. Procurement of processing infrastructure within the financial constraints of local government can have a lasting economic, social and environmental impact on the community.

To help in assessing tenders for treatment technologies for regional processing projects managed by local government, some governments have developed tools that can help evaluate the triple bottom line impacts of a potential project in economic, social and environment terms. In NSW, an alternative waste technology handbook and software package and training program has been developed with a life-cycle assessment basis to help councils evaluate the merits of different proposals on economic, social and environmental grounds.

A number of other jurisdictions deliver programs to local government and the private sector which involve the provision of technical support. For example, New Jersey and Indiana in the United States provide technical information and support services to public and private developers considering the development of new processing facilities. In Australia, a technical unit called the Recycled Organics Unit, based at The University of New South Wales was established in 1998 to provide technical support to processing facilities, and improve the capacity of the industry to produce quality recycled organics that meet the needs of markets.

The Recycled Organics Unit is a joint partnership between the Department of Environment and Conservation (NSW) and The University of New South Wales. Much of the technical support provided is in the form of freely available industry guidance manuals available from http://www.recycledorganics.com

Financial incentives to encourage the private sector and local government to invest in the development of processing infrastructure to treat garden and food organics from municipal and commercial & industrial sectors is common. Some of these programs, which are tied to the provision of upgraded collection services, are discussed in Section 5.3.2.

There are many types of infrastructure support programs in operation worldwide. Some of these programs are strategic, and are tied to quantitative estimates of the level of processing capacity required to meet waste reduction targets. For example, Sweden provides investment grants to developers of new biological treatment plants. In the UK, through WRAP, a capital support program is in place to increase the processing capacity of infrastructure in UK. In the province of Alberta, Canada, a waste management assistance program and resource recovery grant program is in place to encourage municipalities to develop infrastructure and provide recycling services. In California, a recycling investment tax credit program is in operation, providing reprocessing facilities a refund on tax paid on accredited recycling equipment purchased.

5.3.4 Final disposal and beneficial use

The majority of programs implemented world-wide to help reduce the landfill disposal of garden and food organics has involved market research, research and development and promotional campaigns to develop markets for recycled organics, such as compost. Programs have traditionally focused on this area, as markets are required to absorb organic materials that are diverted from landfill. If markets are not adequately developed, organic materials separated from the waste stream can accumulate at facilities and cause environmental impacts. In some cases, the materials may need to be disposed in landfill.

Due to increasing quantities of garden organics being recovered and processed in NSW in the mid to late 1990's, a large marketing and research and development program to increase markets for recycled organics was put in place since 1997. This program, now managed by the Department of Environment and Conservation (NSW) focuses on conducting market development work in partnership with the public and private sector to overcome key market barriers. Programs in place have been informed by market research studies highlighting potential opportunities for using recycled organics, based on user needs, potential costs/benefits, user capacity to pay and potential demand that could be displayed by the market.

Research and development priorities generally focus on proving the cost/benefits of recycled organics compared to conventional materials, developing performance specifications and encouraging market uptake by engaging in demonstration trials and agreements. Specific projects were identified through an expert reference group convened by the NSW EPA in 2000, consisting of key representatives from the public and private sector.

Programs in place in NSW generally focus on developing markets outside the traditional urban and amenity markets. Examples include:

- Using compost in erosion control and catchment management. A three year research and development project conducted in partnership with the NSW Department of Primary Industries to evaluate the benefits of using compost in erosion control and improving water quality in drinking water catchments. As the research phase is nearing completion, development of this market is being supported by partnership agreements with catchment management authorities responsible for improving water quality in catchment areas.

- Using compost in roadside landscaping. Mulching of roadsides represents a large potential market for compost in urban and regional areas. Research is being conducted in partnership with the Roads & Traffic Authority to evaluate the cost / benefits of using compost relative to woodchip in roadside landscaping.

- Using compost in grape growing (viticulture). This project is conducting market and technical research to develop product specifications and cost/benefit data for using composted mulch as a water saving strategy in viticulture across the state.

- Using compost in intensive agriculture. This project is a joint partnership with the NSW Department of Primary Industries to assess the cost/benefits of using compost as a soil amendment for reducing irrigation and fertiliser requirements in commercial vegetable production.

- Using compost in golf courses. A research and demonstration project to evaluate the suitability of compost as an alternative to peat in topdressings, divot repair and as a base for turf construction.

- Compost in mine site rehabilitation. Compost is being compared to conventional practices for revegetating open cut coal mine sites in the Hunter Valley.

Whilst programs focused on market development are well advanced in NSW, similar programs are being implemented in Victoria, South Australia, Western Australia and Queensland. Region specific research and development programs to develop markets for compost are common in the United States and Europe.

5.4 Policies and programs for possible consideration in Western Australia

The review in Section 5 has provided a brief analysis of the major types of policies and program initiatives put in place by a range of jurisdictions to motivate change at different points in the organic material supply chain.

The policies and programs are not specific recommendations for application to Western Australia. They are a collection of instruments that have been successfully used to reduce the generation of organics, and to improve organics recovery in Australia and overseas.

Should any of these instruments be considered for potential application in Western Australia, it is recommended that detailed assessments be performed to ensure that the differing needs and constraints of communities and businesses located in metropolitan and rural / regional areas of the state are met.

Generally, countries that have achieved significant success in reducing the generation and increasing the recovery of organic materials have put in place one or more of the following policies. These policies tend to be more successful if they are enforced through legislation, with financial penalties for non-compliance:

- Requirements on householders and businesses to separate organic materials at source for collection;

- Introduction of user pays systems for waste collection, processing and disposal;

- Municipalities to collect source separated organic materials for centralised processing in areas that it is viable to do so;

- Businesses to separate organic materials for collection and centralised processing depending on business type, number of employees or quantities of organic materials generated;

- Requirement on municipalities and businesses to have waste management and resource recovery plans in place, in line with overall waste reduction and resource recovery objectives set by state or federal governments. Agreed targets may be negotiated via voluntary agreements or covenants;

- Programmed increases in waste disposal taxes or levies to fund research and development, incentives for introducing collection systems and the building of critical infrastructure to enable the processing of organic materials into quality products. In regional areas, such incentives may be tied to the regionalisation of landfills to make resource recovery more economically viable;

- Requirements for the pre-treatment of residual waste before disposal in landfill;

- Clear and enforceable standards on the quality of recycled organics that can be applied to land for beneficial purposes; and

- The establishment of bans for selected types of organic materials (e.g. specific garden organic materials, such as source separate loads of branches, trees, stumps, leaves, trimmings etc) with a medium term time horizon prior to implementation of the ban (e.g. 5-6 years). Lead time provided helps municipalities and the private sector to plan and develop strategic infrastructure required to process separated materials.

To inform the development of these policy instruments, the following studies tend to be undertaken to assess their economic, social and environmental impact on communities, businesses, local government and resource recovery:

- Strategic assessment of current processing infrastructure, including a review of current processing capacity, range and quantities of individual materials that can be accepted;

- Level of investment required and time frames for planning and development of infrastructure for processing forecasted levels of organic material separated for processing;

- Review of contractual arrangements in municipalities for collection, recycling and disposal of waste and timelines for expiry of contracts; and

- Assessment of markets for recycled organics, including their ability to absorb forecasted quantities of recycled organics manufactured from centralised organics processing facilities.

Depending on how the above policy instruments are designed to influence different parts of the organic material supply chain, voluntary supporting instruments or programs may be required to support required policy outcomes. Program initiatives that could be considered to support the above policies are as follows:

- Provide training tools and resources for community groups and local councils to assist householders to home compost. This could involve the development or revision to an existing Earthworks style training course that could be delivered in partnership with a non-governmental organisation or local councils;

- Waste Wise business program or similar initiative. Voluntary partnerships with businesses to reduce waste and improve resource recovery;

- Greening of government program. Encourage government departments to lead by example and develop waste reduction plans and purchasing policies that encourage purchasing of recycled organic products;

- Develop tools and training to assist local councils to evaluate tenders for regional organics processing facilities using best practice triple bottom line assessment methodologies;

- Develop best practice guidelines for kerbside collection of organic materials and residual wastes, and offer training in preferred service standards to local government;

- Work with groups of rural councils to develop regional waste management plans, with a medium to long term strategy to establish better controlled regional landfills. Link performance with funding incentives;

- Encourage investment in collection systems and infrastructure by offering financial incentives from waste disposal levies to local government to establish well controlled regional processing facilities for organic materials;

- Conduct market research and assist in the development of markets for recycled organics in partnership with other government departments and industry;

- Fund a technical service in partnership with a university or educational institution to provide support for the development of the recycled organics industry.

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7 Appendix

Table A1. Summary of Australian and overseas policy and program initiatives (where they exist) to better manage organic materials[9].

Country or Union	State or Country	Statutory Instruments	Supporting Instruments (Programs, Plans, Covenants etc.)				
		Legislation / regulation (includes targets & action plans)	**Information, persuasion and awareness**	**Technological and institutional change**	**Arrangements between gov & organisations**	**Economic instruments**	**Private law instruments**
Australia	Federal	+ The Commonwealth's initiatives are undertaken through the Environment and Heritage Ministerial Council and Environment Australia's administration of the National Heritage Trust. A national per capita waste reduction target of 50% by the year 2000 was adopted in 1992. The Commonwealth currently plays a policy role in a number of waste issues, working in partnership with other government and industry bodies. + No specific policy initiatives focused on improving organics management. Organics management policy undertaken by states and territories individually.	+ National market development strategy for recycled organics developed in 1999 through Environment Australia.	+ Environment Industry Action Agenda (EIAA). A strategic 10-year plan to strengthen Australia's environment industry capabilities that, in turn, will improve overall business sustainability in Australia. + Funding of Barton group and specific initiates considered for funding through Aus Industry via the Resource Recovery sub-group.		+ Funding programs for specific organics industry development initiates funded through Environment Australia in 2000.	
	NSW	+ Protection of the Environment Operations Act 1997. Levy on waste disposal in Greater Sydney Region only. + Waste Avoidance and Resource Recovery Act 2001. + Non-statutory targets set for municipal (recovery to inc from 26 –66%), C&I (recovery to inc from 28 – 63%) and C&D (recovery to inc from 65– 76%) sectors by 2014. + Source separation and treatment of residual waste prior to landfill preferred. + Non-standard fuels (e.g. fuels derived from garden organics and wood/timber) subject to	+ Life cycle studies proving benefits of organics recycling + Fact sheets of benefits of using recycled organics + Local government cost study for recycling of organics + R&D projects to develop specifications and increase markets + Regional organic waste inventories to help	+ Technology research and development to improve industry capacity to produce higher quality products + Development of industry specifications to drive change in manufacturing processes in industry + Funding of regional waste plans produced by regional groups of councils in rural / regional NSW.	+ Formal partnership agreements with government agencies to develop markets for recycled organics (e.g. NSW Department of Primary Industries; Roads & Traffic Authority; Catchment Management Authorities; State Forests) + Waste Reduction & Purchasing Policy across all government agencies to reduce	+ Landfill levy is the main instrument to encourage the separation of organics for recycling. + s88 levy rebate for materials genuinely recycled.	+ Model collection contracts and minimum service standards developed for adoption by councils to support resource recovery and specification of maximum contaminants levels in collected organics.

[9] The review is based on publicly available information. In some cases, a range of additional programs may be underway, though specific details may not currently be in the pubic domain.

Country or Union	State or Country	Statutory Instruments	Supporting Instruments (Programs, Plans, Covenants etc.)				
		Legislation / regulation (includes targets & action plans)	**Information, persuasion and awareness**	**Technological and institutional change**	**Arrangements between gov & organisations**	**Economic instruments**	**Private law instruments**
		DEC approval.	in organics planning in regional areas + Market studies to highlight changes in markets for recycled organics + Funding of a technical agency (Recycled Organics Unit) at University of New South Wales to aid in technical development of industry. + Earthworks training courses delivered to help homeowners compost and worm farm. + Guidelines on home composting and worm farming. + Best practice resource recovery guidelines for local councils.	+ Research and development grants program to help in developing technology for recycling organics (and other materials).	waste and 'buy recycled' + Local Government Action Plan – commitment between local government and state government to sub-strategy targets for resource recovery. + Business Partnerships program focuses on assisting businesses implement cleaner production plans.		
	VIC	+ Environment Protection Act 1970. Levy on waste disposal in metropolitan and regional Victoria. + Draft Towards Zero Waste Strategy provides non-statutory targets for next 10 years (to 2013). Target of increasing total solid waste recovery from current 45% to 75% by 2013.	+ Life cycle studies proving benefits of organics recycling. + Fact sheets on benefits of using recycled organics. eg vegetable production. + Best practices guidelines to processing garden organics. + Market studies and marketing plans to help create awareness and build markets for recycled organics. + Guidelines on home composting and worm farming. + Best practice resource recovery guidelines for	+ Infrastructure investment program to support groups of councils implement systems for municipal garden and food collections and processing, and commercial & industrial food organics recovery of processing. + Support for implementation of Best Practice Kerbside Recycling Scheme to local government for household food and garden organics (as well as other fractions).	+ Waste Wise business and community programs focused on partnerships for achieving agreed waste reduction goals in businesses, universities, schools etc. + Partnerships with government agencies to achieve waste reduction through sustainability packages.	+ Landfill levy is the main instrument to encourage the separation of organics for recycling.	

Country or Union	State or Country	Statutory Instruments	Supporting Instruments (Programs, Plans, Covenants etc.)				
		Legislation / regulation (includes targets & action plans)	**Information, persuasion and awareness**	**Technological and institutional change**	**Arrangements between gov & organisations**	**Economic instruments**	**Private law instruments**
			local councils.				
	SA	+ Zero Waste SA Act 2004. + Non-statutory targets of recycling of at least 50% of all municipal solid waste presented at the kerbside by 2007 with the potential to recycle 75% by 2010 if systems for recycling food waste are successfully developed and implemented. A 30% increase in the recovery and utilisation of commercial & industrial waste by 2010. + Proposal for SA EPA to release a draft Environment Protection (Waste) Policy that provides a minimum standard for kerbside collection services.	+ Objective of developing markets for municipal organics (garden organics/food waste) through market development grants, innovation grants, research and related initiatives. + Objective of developing best practice guides to MRFs, transfer facilities and drop-off facilities.	+ Kerbside Performance Incentives program with funding to local councils to introduce and upgrade kerbside system performance. + Regional infrastructure grants to fund activities in regional council waste management plans + Recycling infrastructure grants for improved organics recovery. + Research and market development incentives grant program. Funding to assist in growth of markets for recycled organics (and other materials)	+ Greening of Government Operations (GoGO) Framework. Objective of helping government agencies reduce waste.	+ Landfill levy is the main instrument encourage the separation of organics for recycling.	
	QLD	Waste Management Strategy for Queensland (1996).	+ Operational guidelines and standards for centralised composting facilities. + Guides for home composting.	+ Recycling Grants Scheme to encourage development of centralised composting facilities.	+ State Government purchasing policy to encourage increased purchasing of recycled products. + Waste auditing of government departments to achieve waste reduction. +Waste Wise business program to encourage waste reduction in commercial sector.		
	ACT	No Waste Strategy by 2010 adopted by ACT Government in 1996. Under the Building (Amendment) Act 1999, formal requirement for waste management plans for construction projects to support No Waste by 2010 Strategy	+ Guide to Who Recycles What in the ACT to help householders and businesses recycle unwanted material. + Best Practice Waste			+ True cost of landfill pricing strategy. Landfill disposal costs adjusted to take into account environmental and social costs of waste	

Country or Union	State or Country	Statutory Instruments	Supporting Instruments (Programs, Plans, Covenants etc.)				
		Legislation / regulation (includes targets & action plans)	**Information, persuasion and awareness**	**Technological and institutional change**	**Arrangements between gov & organisations**	**Economic instruments**	**Private law instruments**
			Management within ACT Government Buildings. Guide for recycling in buildings. + Ecobusiness Workshops to help businesses reduce and recycle waste			disposal.	
European Union	EU Wide Policy	EU Council Directive 1999/31/EC on the landfill of waste (the landfill directive) places targets on Member States to reduce the quantities of biodegradable municipal waste (BMW) going to landfill. To meet these targets, Member States are obliged to set up national strategies for the implementation of the reduction of biodegradable waste going to landfill. The targets set by the landfill directive are set out in Article 5 of the directive and require the following: not later than 16 July 2006, biodegradable municipal waste going to landfill must be reduced to 75 % of the total amount by weight of biodegradable municipal waste produced in 1995 or the latest year before 1995 for which standardised Eurostat data is available; not later than 16 July 2009, biodegradable municipal waste going to landfill must be reduced to 50 % of the total amount by weight of biodegradable municipal waste produced in 1995 or the latest year before 1995 for which standardised Eurostat data is available; not later than 16 July 2016, biodegradable municipal waste going to landfill must be reduced to 35 % of the total amount by weight of biodegradable municipal waste produced in 1995 or the latest year before 1995 for which standardised Eurostat data is available.					
European Union	Austria	+ Australian Sustainable Waste Management Law 2001 + Legal requirement for all companies with more than 20 employees to have a waste management plan. + Legal requirement on municipalities to separately collect and treat organics from households since 1995. + Compost regulation sets out quality requirements and permitted used for compost for each application.				+ Tax on waste disposal in place. + Cost of collection of waste from households dependent on quantity generated.	
European Union	Belgium (Flanders)	+ Ban on landfilling of separately collected food and garden organics and municipal waste. + Ban on landfilling of unsorted commercial & industrial waste. + Threat of federal Ecotax legislation with financial penalties to commercial & industrial sector in 1992 if waste reduction targets not met. Targets met and legislation not introduced.			+ 'Environmental 'covenants' with municipalities in place since 1992 to establish source separation collection and processing infrastructure in exchange for subsidies. + Third generation of covenant currently being developed with new environmental targets.	+ Tax on waste disposal in place. Currently €58/tonne. + Tax on incineration, currently €8/tonne.	
European Union	Denmark	+ Councils legally required to collect food organics from canteens and restaurants that generated more than 100 kg per week.				+ Tax on waste disposal in place. + Waste collection	

Country or Union	State or Country	Statutory Instruments	Supporting Instruments (Programs, Plans, Covenants etc.)				
		Legislation / regulation (includes targets & action plans)	**Information, persuasion and awareness**	**Technological and institutional change**	**Arrangements between gov & organisations**	**Economic instruments**	**Private law instruments**
		+ Ban on landfilling of municipal waste.				charges to householders reduced if home composting is performed.	
European Union	France	+ Ban on landfilling of municipal waste.				+ Tax on waste disposal in place.	
European Union	Germany	+ Ordinance on the Environmentally Sound Disposal of Municipal Solid Waste requires pre-treatment of waste before landfill by 2005. + Biowaste Ordinance 1998 sets strict chemical requirements for organic materials applied to land. + Commercial Waste Ordinance 2003 stipulates that a minimum of 85% recovery of commercial waste is required, and source separation and pre-treatment of residuals is mandatory. + Landfill Ordinance 2002 requires that all waste disposed of in landfill must meet a number of stabilisation requirements, including a total organic carbon level of <5% w/w.					
European Union	Italy	+ National Waste Management Law (Decree 22/97). + Ban on landfilling of untreated waste from 2001. + Recycling targets established: 25 per cent by March 2001; 35 per cent by March 2003. + Financial penalties on provinces where targets have not been met.				+ Tax on waste disposal in place.	
European Union	Netherlands	+ Environmental Management Act 1994. + All municipalities are legally required to collect kitchen food and garden waste separately since 1994. + In 2001 Section 8.40 of the Environmental Management Act was established to legally require certain businesses to separate food organics at source (i.e. hotels & catering; sport and recreation; retail sector and other trades; residential & amenity buildings; textile	+ Program launched in 1997 to help businesses source separate commercial waste, including organics. + Program to ensure the chemical and physical properties of compost are meeting the Other Organic Fertilisers	+ National target set in the 1990s to build 1.6 million tonnes of food and garden organics processing capacity per year. + Contribute to CO_2 reduction through a policy on construction of anaerobic digestion		+ Waste tax introduced in 1995 on all waste disposed of in landfill or via incineration. + Waste tax is currently €83/tonne of waste landfilled for waste of a bulk density less than	

Country or Union	State or Country	Statutory Instruments	Supporting Instruments (Programs, Plans, Covenants etc.)				
		Legislation / regulation (includes targets & action plans)	**Information, persuasion and awareness**	**Technological and institutional change**	**Arrangements between gov & organisations**	**Economic instruments**	**Private law instruments**
		cleaning; motor vehicle establishments; storage depots). + Specific targets set for separate collection of commercial & industrial waste. + Ban on landfilling of unsorted and untreated municipal waste.	(Quality Use) Decree.	plants for processing food and garden organics.		1100 kg/m^3. + Revenue from tax directed to general budget and for environmental policy initiatives.	
European Union	Spain	+ Municipalities with more than 5000 residents are legally required to offer separate collection services for organics.					
European Union	Sweden	+ Ban on landfilling of municipal waste. + Compulsory source separation of waste. + Target of 70% reduction of municipal waste by 2005 (compared to 1994 levels). + Target of 10% reduction of commercial & industrial waste by 2010 (compared to 1993 levels).		+ Investment grants provided to developers of new biological treatment plants.		+ Tax on waste disposal in place. Set at €26/tonne. + Waste collection charges to householders reduced if home composting is performed or if homes participate in communal composting schemes.	
European Union	United Kingdom	+ Landfill trading allowance scheme introduced to cap landfilling of waste. + Waste Strategy 2000 for England and Wales sets out household waste recycling and composting targets, the first of which is to achieve a recycling and composting level of 17% by 2003 in England.	+ R&D on effects of composts on pathogens. + R&D on compost variation across UK to address market issues. + R&D on storage trials with potting media to evaluate product stability and suitability for pot plants. + Commercial benefits of using compost – case studies in agriculture, horticulture and landscaping sectors. + Producing quality compost training – skills based training to increase competency of industry. + Marketing and	+ Development of a British quality standard for compost (BSI PAS 100) and certification systems for composting facilities + Capital support program – increase processing capacity of infrastructure in UK. + Local authority grant scheme and best practice guidelines for organics collection at civic amenity sites.	+ The Composting Association operates the Standards Scheme for certification of facilities to BSI PAS 100 which was developed through support by WRAP.	+ Infrastructure support program. + Grants for local authority managed civic amenity sites.	

Country or Union	State or Country	Statutory Instruments	Supporting Instruments (Programs, Plans, Covenants etc.)				
		Legislation / regulation (includes targets & action plans)	**Information, persuasion and awareness**	**Technological and institutional change**	**Arrangements between gov & organisations**	**Economic instruments**	**Private law instruments**
			awareness campaign-promotion of compost at major trade shows.				
Canada	Alberta	+ Environmental Protection and Enhancement Act 1996 + Target of reducing municipal waste to 500 kg per person by 2010. + Compost Legislation Advisory Committee established to review and propose improvements to the Government of Alberta's compost legislation.		+ Waste Management Assistance Program and Resource Recovery Grant Program to municipalities to develop infrastructure and provide recycling services.			
United States	National	+ US EPA plays a leading role in improving organics recovery from landfill. + US EPA goal of recycling 35 percent of municipal waste generated. + US EPA developed a report titled 'Organic Materials Management Strategies' as a guide for US States when developing organic resource recovery policy and strategy. + 21 US States have introduced bans on the disposal of garden organics in landfill.			+ Greenscapes industry partnership program to improve the environmental sustainability of landscaping sector. Strong focus on using recycled organics as a part of the program. +Waste Wise business program to encourage waste reduction in commercial sector.		
	California	+ Zero Waste California strategy adopted and managed by the California EPA Integrated Waste Management Board. + Integrated Waste Management Act 1989 required a mandatory reduction of 50% of waste to landfill by 2000. Fines of $10,000 per day applies to municipalities for non-compliance. First state in USA to tie targets to penalties. + Waste Management Regulation Title 14 sets out a number of regulations managed by the California EPA Integrated Waste Management Board.	+ Food scrap management guidelines indicating preferred recovery options-prevent food waste, feed people, convert to animal feed and/or rendering, and compost. + Demonstration site programs to develop markets for compost. + Guidelines for promotion of grass cycling. + On-farm composting guides to help in resource recovery in rural areas.	+ Recycling investment tax credit program. Refund on tax paid on accredited recycling equipment purchased by reprocessing facilities. + Recycling Market Development Zone Low-Interest Revolving Loan Fund. Loans provided to industries for development markets for recycled organics (and other materials).		+ Recycling investment tax credit program. + Recycling Market Development Zone Low-Interest Revolving Loan Fund.	

Country or Union	State or Country	Statutory Instruments	Supporting Instruments (Programs, Plans, Covenants etc.)				
		Legislation / regulation (includes targets & action plans)	**Information, persuasion and awareness**	**Technological and institutional change**	**Arrangements between gov & organisations**	**Economic instruments**	**Private law instruments**
	Indiana	+ Indiana Code, IC 13-20-9 + Ban on the disposal of garden organics such as leaf, brush, and woody wastes introduced in 1994.	+ Provision of technical assistance to municipal authorities and developers of organics processing facilities. + Internet information service to support various organics recycling activities.	+ Grant scheme to expand source reduction, recycling, composting, and household hazardous waste programs in Indiana.	+ Waste Wise business partnership and endorsement program to help businesses reduce waste and recycling.	+ Tax on waste disposal in place.	
	New Jersey	+ Mandatory Source Separation and Recycling Act 1987. + Solid Waste Management Act + Compulsory minimum recovery of 25% of municipal solid waste through source separation and processing. + State Solid Waste Management Plan in place since 1993 with latest revision in 1995; target of 50% recovery of municipal waste required. + Ban on landfilling of garden organics.	+ Internet information service to support various organics recycling activities.	+ Clean Communities and Recycling Grant Act 2002 provides a mechanism for municipal and county recycling programs.	+ New Jersey Waste Wise Business Network providing technical assistance for waste reduction and recycling.	+ Tax on waste disposal in place.	
Japan		+ Food Recycling Law 2001. + Requires a cut in food organics disposed by food manufacturers and restaurants by over 20% by 2006.					
Taiwan		+ Waste Disposal Act + Compulsory recycling of food organics from restaurants and households by 2006					