



FOOD AND GARDEN ORGANICS Best Practice Collection Manual

Prepared for the Department of Sustainability,
Environment, Water, Population and Communities



© Commonwealth of Australia 2012

This work is copyright. Apart from any use as permitted under the Copyright Act 1968, no part may be reproduced by any process without prior written permission from the Commonwealth. Requests and enquiries concerning reproduction and rights should be addressed to Department of Sustainability, Environment, Water, Population and Communities, Public Affairs, GPO Box 787 Canberra ACT 2601 or email public.affairs@environment.gov.au

The views and opinions expressed in this publication do not necessarily reflect those of the Australian Government or the Parliamentary Secretary for Sustainability and Urban Water.

While reasonable efforts have been made to ensure that the contents of this publication are factually correct, the Commonwealth does not accept responsibility for the accuracy or completeness of the contents, and shall not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance on, the contents of this publication.

CONTENTS

ACKNOWLEDGEMENTS	1
PART ONE: USER GUIDE	2
Introduction	3
The Need for a Manual	4
A Guide to the Manual	5
Planning and Implementation Timeline	6
PART TWO: GLOSSARY	7
PART THREE: FACTSHEETS AND CASE STUDIES	13
PART FOUR: ELECTRONIC PRESENTATIONS	105
PART FIVE: FREQUENTLY ASKED QUESTIONS	124
APPENDIX: TECHNICAL INFORMATION & BIBLIOGRAPHY	127

ACKNOWLEDGEMENTS

The authors would like to acknowledge the support and contribution to the development of this manual from staff at the Department of Sustainability, Environment, Water, Population and Communities; members of the Working Group including the New South Wales Environment Protection Authority; SULO MGB Australia; SITA Organics Australia; Local Government Association of the Northern Territory; Department of Environment and Conservation Western Australia; Environment and Sustainable Development Directorate, ACT Government; Local Government Association of Queensland; Local Government and Shires Associations of NSW; Zero Waste South Australia; Western Australian Local Government Association; Launceston City Council; and the Department of Environment and Resource Management, and case study contributors including:

Ballina Shire Council, NSW

Bankstown City Council, NSW

Canterbury City Council, NSW

City of Port Adelaide Enfield Council, South Australia

Dulverton Waste Management, Tasmania

Gippsland Regional Waste Management Group, Victoria

Groundswell Project, NSW

Hills Shire Council, NSW

Kempsey Shire Council, NSW

Leichhardt Municipal Council, NSW

Lismore City Council, NSW

Moira Shire Council, Victoria

Nillumbik Shire Council, Victoria

Penrith City Council, NSW

Randwick City Council, NSW

Resource GV, Victoria

Riverina Eastern Region of Councils (REROC), NSW

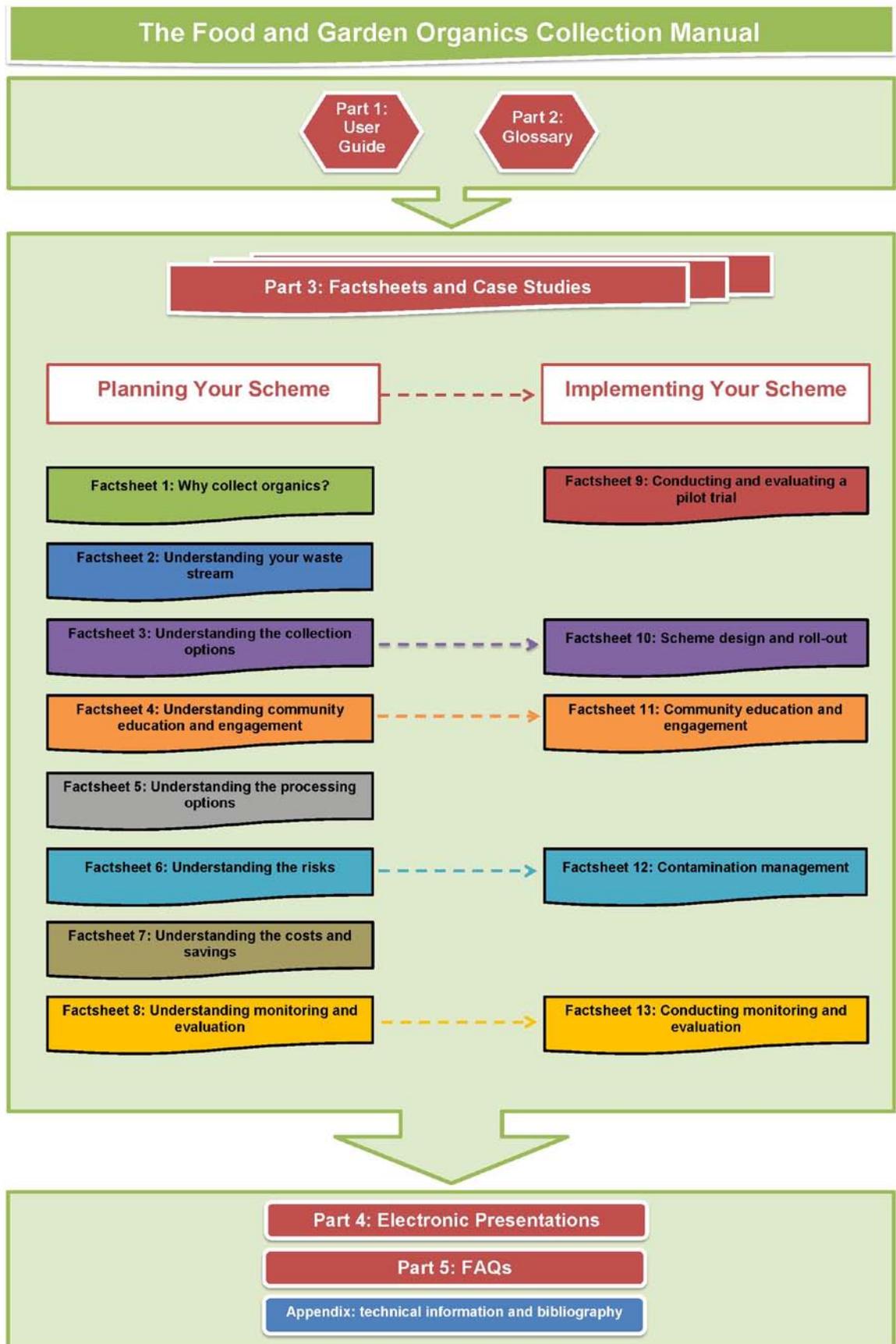
Shoalhaven City Council, NSW

Waverley City Council, NSW

Woollahra Municipal Council, NSW

Zero Waste SA, South Australia.

PART ONE: USER GUIDE



Introduction

Collection of garden organics has become well established in some areas of Australia. In New South Wales (NSW), for example, 42% of councils (64 in total) offer a kerbside organics (green waste) collection service to residents¹. By comparison, collections of food organics are relatively new; the available data suggests only 10% of Australian councils currently offer residents a three-bin system collecting refuse, recycling, and combined food and garden organics².

The *National Waste Policy: Less Waste, More Resources* was agreed to by all Australian environment ministers in November 2009, and endorsed by the Council of Australian Governments. It aims, among other things, to reduce the amount of waste for disposal, and improve the use of waste as a resource in order to achieve broad environmental, social and economic benefits.

The disposal of food waste to landfill can cause environmental harm, including through the generation of greenhouse gases. There are also social and economic impacts associated with food waste disposal; for example, Do Something! estimates Australians are “wasting” \$5.2 billion worth of food each year. For these reasons it is desirable to reduce the amount of food waste generated, and ensure there are appropriate treatment pathways to enable resource recovery from this waste. Food has accordingly been highlighted as a priority material to target for removal from the residual waste stream.

The main purpose of this manual is to provide relevant information to act as a guide for councils wishing to implement a food and garden organics collection scheme. The manual has been designed to:

- ✓ Provide councils with a ‘how to’ guide for planning and implementing a pilot collection scheme, and ultimately rolling out a food and garden organics collection service
- ✓ Assist councils in identifying barriers, opportunities, risks and mitigation measures when rolling out a new collection service.

¹ *NSW Local Government Waste and Resource Recovery Data Report 2009-2010*

² *Inside Waste Industry Report 2011-12*

The Need for a Manual

The Department of Sustainability, Environment, Water, Population and Communities (the Department) identified the need to help inform councils and drive the diversion of organics from landfill. Hyder Consulting was commissioned in February 2012 to produce this guidance.

There are a range of potential advantages to collecting food and garden organics, and diverting organic material from landfill. These include:

- ✓ Achieving superior environmental outcomes
- ✓ Supplying substitutes for dwindling virgin materials
- ✓ Manufacturing high quality products
- ✓ Conserving essential plant nutrients
- ✓ Achieving landfill diversion and recovery targets
- ✓ Reducing climate change impacts
- ✓ Attaining renewable energy certificates
- ✓ Reducing carbon price impacts for liable facilities
- ✓ Reducing exposure to landfill levies
- ✓ Reducing landfill disposal costs
- ✓ Realising parks and gardens costs savings
- ✓ Enhancing local investment and employment
- ✓ Meeting community and voter expectations
- ✓ Achieving long term behaviour change
- ✓ Enhancing social capital
- ✓ Saving valuable landfill space and making best use of existing assets.

This Best Practice Collection Manual addresses each step in the consideration, planning and implementation of an organics collection scheme, from investigating the right type of systems to adopt, through to scheme roll out (including public communication and education) and ongoing monitoring and evaluation of scheme performance.

The manual was developed in consultation with key stakeholders and a working group, with members from state governments, local government associations, waste contractors and local councils.

The manual highlights the importance of effective communication and public engagement, plus monitoring and evaluation of a scheme, in order to achieve the best result. The scheme will fail to meet its desired potential unless the community is engaged.

This manual has been primarily developed to assist Local Government Waste Managers, but the information provided should enable any collection contractor or organisation to conduct an effective organics collection roll-out.

A Guide to the Manual

There is no 'one size fits all' solution to individual council waste and recycling collections. There is no substitute for local knowledge when it comes to developing the most effective system for a particular application. But there is strong potential for those starting out on the path of organics recycling to learn lessons from those who have already rolled out organics programs. Neighbouring councils may also be able to achieve efficiencies through a degree of service standardisation, especially in terms of contractual arrangements in the collection and processing of kerbside collected organics.

This manual has been developed to act as a reference tool for councils in order to support informed decision making during the design of a new collection scheme. Users may pick and choose relevant parts of the guide and adapt the information contained to suit their local situation. The manual is in six parts, including this User Guide. The other parts are:

Part Two: Glossary

The Glossary provides an explanation of the acronyms and terminology used within this manual.

Part Three: Factsheets and Case Studies

The factsheets provide two key focus areas:

- ✓ Planning your collection scheme
- ✓ Implementing your collection scheme.

Planning Your Collection Scheme

These factsheets provide the background, context and theory behind gathering all the required information to inform the design of a successful organics collection system. These factsheets answer **Why?** and **What?** to consider.

Implementing Your Collection Scheme

These factsheets provide practical guidance on implementing your collection scheme and answer **How?** and **When?** each step should be undertaken.

Part Four: Electronic Presentations

Each factsheet has been developed into a simple PowerPoint presentation in order to allow officers to easily adapt the materials and messages for use in council meetings, staff briefings and other stakeholder consultation steps.

Part Five: Frequently Asked Questions

The Frequently Asked Questions (FAQs) section is designed as a 'quick-fix', or simple reference point. Some of the key questions that are commonly asked by council officers when considering an organics collection scheme have been outlined and short, simple answers provided, with a reference to which factsheet contains more detailed information.

Technical Appendix and Bibliography

The Appendix includes a bibliography of all references used in the production of this manual for further reading, plus a detailed description of the processing options for organic materials.

Planning and Implementation Timeline

The following table summarises the suggested timelines required for the planning, preparation and implementation of an organics collection scheme.



PREPARATION AND PLANNING	
12 to 18 months prior to scheme roll out	<p>Get council endorsement for introducing a scheme.</p> <p>Gather audit data and information (what is in your bin?), identify costs, investigate collection and processing options and contractors if necessary, put contracts in place.</p>
4 to 6 months prior to scheme roll out	<p>Order bins / caddies / liners.</p> <p>Develop communications plan and targeted advertising strategy (newspaper, radio, letter drop etc.); design scheme branding, leaflet and posters; conduct pre-scheme attitudinal surveys.</p>
6 to 8 weeks prior to scheme roll out	<p>Communicate with the public and raise awareness, set the context for the scheme, explain the need for the service via leaflets, road shows, advertisements etc.</p> <p>Train call centre staff – provide a list of FAQs and answers; train crew so that operational staff can relay key messages to the public on the ground.</p>
1 to 2 weeks prior to scheme roll out	<p>Relay specific scheme information – what is happening, when, how, who is running it, instructions for participation.</p>
IMPLEMENTATION	
Week of scheme launch	<p>Container drop-off crew deliver containers and instruction leaflets and conduct door to door communications.</p> <p>Raise high level awareness by holding and publicising an event to promote the scheme, endorsed by senior council members, celebrities etc.</p>
MONITORING AND EVALUATION	
5 to 6 weeks post scheme roll out	<p>Continue to communicate with and support the public; report good news and provide updates of scheme's success (e.g. tonnes diverted).</p>
3 months post scheme roll out	<p>Monitor and evaluate participation and contamination rates.</p> <p>Conduct post scheme attitudinal surveys/focus groups.</p>

PART TWO: GLOSSARY

Abbreviation	Definition
AD	Anaerobic Digestion
ANU	Australian National University
AWT	Alternative Waste Treatment
BTU	British Thermal Unit
CBA	Cost-Benefit Analysis
CH ₄	Methane
CO ₂	Carbon Dioxide
CO ₂ -e	Carbon Dioxide Equivalent
ERA	Extended Regulated Area (NSW)
FOGO	Combined Food and Garden Organics
GHG	Greenhouse Gas
GWP	Global Warming Potential
hhld	Household
IVC	In-vessel composting
kg/hh/wk	kilograms per household per week
KPI	Key Performance Indicator
LCA	Life Cycle Analysis
LGA	Local Government Area
LGSA	Local Government and Shires Association of NSW
MACROC	Macarthur Regional Organisation of Councils
MBT	Mechanical-biological Treatment
MGB	Mobile Garbage Bin
MRF	Materials Recovery Facility
MSW	Municipal Solid Waste
MUD	Multi-unit dwelling

Abbreviation	Definition
NO ₃	Nitrate
NGER	National Greenhouse and Energy Reporting
O ₂	Oxygen
ORRF	Organic Resource Recovery Facility
PR	Public Relations
RECs	Renewable Energy Certificates
RWMG	Regional Waste Management Group
SMA	Sydney Metropolitan Area
SUD	Single-unit Dwelling
Syngas	Synthetic Gas
TBL	Triple Bottom Line
tpa	tonnes per annum
VCU	Vertical composting unit
WaSIP	Waste and Sustainability Improvement Payment (NSW)
WRAP UK	Waste & Resources Action Programme United Kingdom
ZWSA	Zero Waste South Australia

Terminology	Definition
Alternative Waste Treatment (AWT)	A generic term used for waste and resource recovery technology systems. May be considered “alternative” to landfill disposal of waste. AWTs are able to process both mixed wastes and source separated wastes.
Anaerobic digestion (AD)	Processing technology for organic residues. Anaerobic digestion reduces and breaks down organic compounds under oxygen-depleted conditions. Energy can be recovered in the form of methane-rich biogas.
Biochar	Biochar is a stable form of charcoal produced from heating natural organic materials in a high-temperature, low oxygen process known as pyrolysis. Sources of material for biochar manufacturing include forestry and agricultural waste products, municipal green waste, biosolids, animal manures and some industrial wastes such as paper mill wastes. Biochar is chemically and biologically more stable than the original carbon, making it more difficult to breakdown.
Biosolids (sludge)	The residual, semi-solid material left from industrial wastewater or sewage treatment processes.
Carbon dioxide equivalent (CO ₂ -e)	A unit of measurement that allows the emissions of different greenhouse gases to be compared using carbon dioxide as a standard unit for reference. The amount of CO ₂ -e depends on the global warming potential of a given chemical when measured over a specified timescale (generally 100 years). For example, methane has 21 times more global warming potential over 100 years than carbon dioxide. This means that one tonne of methane emissions is equivalent to emissions of 21 tonnes of carbon dioxide.
Carbon footprint	A measure of the total amount of greenhouse gas emissions of a defined population, system or activity, considering all relevant sources, sinks and storage within the spatial and temporal boundary of the population, system or activity of interest. Usually calculated in terms of carbon dioxide equivalent.
Carbon pricing mechanism	Landfill facilities that emit 25,000 tonnes or more of carbon dioxide equivalent (CO ₂ -e) greenhouse gas emissions each year are liable under the carbon pricing mechanism. The carbon price will not apply to emissions from waste deposited prior to 1 July 2012 (known as legacy waste emissions), but legacy waste emissions do count towards determining whether a facility meets the participation threshold. A fixed carbon price will apply for the first three years of the scheme (2012-15), starting at \$23 per tonne of CO ₂ -e. After 2015 the carbon price will be determined by market forces. The carbon price provides an incentive for all businesses to cut their pollution by investing in clean technology or finding more efficient ways of operating. In the context of waste, this may occur through the diversion of organic biodegradable material from landfill, the capture and destruction of landfill gas by flaring, or its use as an energy source.

Terminology	Definition
Climate change	Significant and lasting change in the statistical distribution of weather patterns over periods ranging from decades to millions of years. It may be a change in average weather conditions, or in the distribution of weather around the average conditions (i.e. more or fewer extreme weather events). Climate change is caused by factors that include oceanic processes, variations in solar radiation, volcanic eruptions etc. and human impact on the environment (anthropogenic impact). The term "climate change" is often used to describe human-specific global warming impacts.
Contaminants	Undesirable substances or objects in contact or mixed with a material.
Cost-benefit analysis (CBA)	Systematic process for calculating and comparing benefits and costs, expressed in monetary terms, of a project or policy. It is an analysis of the expected balance of benefits and costs, including alternatives and the status quo, helping predict whether benefits outweigh costs, and by how much.
Food organics	Unwanted or leftover household food scraps. Food organics can be classified as 'unavoidable' (non-edible peelings) or 'avoidable' (leftover food).
Garbage	Residual waste, non-recyclable / non-recoverable waste materials
Garden organics	Typically garden organic 'wastes' that arise from gardening and maintenance activities, such as lawn clippings and branches.
Global warming potential (GWP)	A measure of how much a given mass of greenhouse gas is estimated to contribute to global warming. It is a relative scale which compares the gas in question to the same mass of carbon dioxide (whose GWP is by definition 1). A GWP depends on the time before the gas is removed from the atmosphere and thus is calculated over a specific time interval. In this report a 100 years' time interval is assumed, consistent with Intergovernmental Panel on Climate Change standards.
Greenhouse gas (GHG)	Gases present in the earth's atmosphere which reduce the loss of heat and therefore contribute to global temperature rise through a process often dubbed the "greenhouse effect".
Kitchen caddy	Kitchen bench top container for collection of household food scraps.
Landfill levy	Levies applied to wastes disposed to landfill. Landfill levies have been widely adopted in many countries, including Australia, and generally aim to encourage resource recovery in preference to landfill disposal by attempting to account for the cost of environmental externalities associated with waste disposal.
Life cycle analysis (LCA)	The investigation and valuation of the environmental impacts of a product or service caused by its use and existence, spanning the full life cycle of that item from creation to final disposal or destruction.
Liner	Compostable bag used to line / cover the kitchen caddy

Terminology	Definition
<i>National Greenhouse and Energy Reporting (NGER) Act</i>	<p>The <i>National Greenhouse and Energy Reporting Act 2007</i> introduced a single national framework for the reporting and dissemination of information about the greenhouse gas emissions, greenhouse gas projects, and energy use and production of corporations. The objectives of the NGER Act are to:</p> <ul style="list-style-type: none"> ✓ Underpin the introduction of an emissions trading scheme ✓ Inform government policy formulation and the Australian public ✓ Help meet Australia's international reporting obligations ✓ Assist Australian, state and territory government programs and activities ✓ Avoid the duplication of similar reporting requirements in the states and territories.
Organics	Material that is organic in nature and is suitable for biological process treatment, such as composting. In this manual, the term 'organics' is used to refer to garden and food organics.
Renewable energy certificates (RECs)	The Australian Government has adopted a Renewable Energy Target (RET) and designed a scheme to create a financial incentive for investment in renewable energy sources through the sale of Renewable Energy Certificates (RECs). There may be potential to gain financial benefits via RECs if organic materials are used for generating 'green' energy. For instance, woody garden organics and other wood residues can be used for co-firing industrial boilers, while anaerobic digestion can be used for energy recovery from moist organic residues. In both cases, the generated energy can be used to power the facility, and surplus energy can be exported to the grid. The associated RECs can be an additional source of income for the facility.
Social capital	Social capital is a sociological concept which refers to the value of social relations and social networks and the role that cooperation and confidence plays in getting collective or economic benefits.
Triple bottom line (TBL)	An assessment process that captures an expanded spectrum of values and criteria for measuring organisational and societal success covering economic, environmental and social factors.
Waste hierarchy	The waste management hierarchy is a nationally and internationally accepted guide for prioritising waste management practices with the objective of achieving optimal environmental outcomes. It sets out the preferred order of waste management practices, from most to least preferred. It generally has seven steps: avoid, reduce, reuse, recycle, recover, treat and dispose.
Waste audit	Determination of quantities (weight or volume) in order to provide a classification of the waste stream and/or categorisation of waste materials.
Waste & Resources Action Programme United Kingdom (WRAP UK)	An organisation funded by the four national governments across the UK in order to help businesses and individuals reduce waste, develop sustainable products and use resources in an efficient way.

PART THREE: FACTSHEETS AND CASE STUDIES

Why collect organics?

This factsheet will help councils to gain an understanding of the reasons for why to collect source separated food and garden organics. The factsheets describes how diverting organics from landfill can achieve great environmental outcomes, alleviate costs of landfill disposal, and help avoid carbon price impacts. It provides examples of how diverting organics can help conserve valuable resources; and explores the social benefits of a food and garden organics collection service.

Diverting food and garden organics from landfill through the use of a kerbside collection service followed by an appropriate treatment process may assist in:

✓	Achieving superior environmental outcomes
✓	Supplying substitutes for dwindling virgin materials
✓	Manufacturing high quality products
✓	Conserving essential plant nutrients
✓	Achieving landfill diversion and recovery targets
✓	Reducing climate change impacts
✓	Attaining renewable energy certificates
✓	Reducing carbon price impacts for liable facilities
✓	Reducing exposure to landfill levies
✓	Reducing landfill disposal costs
✓	Realising parks and gardens costs savings
✓	Enhancing local investment and employment
✓	Meeting community and voter expectations
✓	Achieving long term behaviour change
✓	Enhancing social capital
✓	Conserving existing landfill airspace

There is a new direction in the way in which Australian councils are managing their wastes. The historic ‘mass dump’ mentality is making way for more innovative waste and resource management solutions, supported in part by the introduction of a carbon pricing mechanism in 2012, as well as landfill levies, waste minimisation and recycling targets, and the ability to generate renewable energy certificates.

Food and garden organics are a key target for increased resource recovery. The fact that organics represent the single largest fraction in a household garbage bin, plus the detrimental environmental impacts organics can have in a landfill environment, have led to the development of segregated collection schemes for organics, combined with development of appropriate processing facilities, products and markets.

Up to 60% of the household waste we throw away each week is food and garden organics.

However, the contents of everyone’s bin differ slightly depending on the food we eat, the items we buy, whether we have a garden or not, and whether we compost at home.

In the past few years governments around the world have increased their **focus on reducing food organics going to landfill**. The United Kingdom is active in engaging householders to address this issue, with more than 137 local authorities providing food organics collections. The European leaders in reducing household residual waste include Belgium, Netherlands, Austria, Germany and Switzerland. The German Government recently mandated all local governments establish combined garden and food organics collection schemes.

In Australia, many councils recover garden organics and an increasing number of councils are considering, trialling or implementing food organics recycling.



Benefits and drivers

The waste hierarchy is an internationally recognised classification system that prioritises waste management strategies in order of preference. Its aim is to extract the most benefit through resource recovery and generate the least amount of waste. In Australia, all governments have adopted the waste hierarchy as a guiding principle for waste management in their policies and legislation. Landfill disposal is the least preferred option in the waste hierarchy.



There are many reasons to avoid sending food and garden organics to landfill. These include cost savings from avoided landfill levies and other economic benefits, as well as the environmental and social benefits. The introduction of organics collection schemes usually requires an economic driver or a political imperative. Non-economic arguments often get lost in the debate. But economic principles should prompt the introduction of organics collection schemes wherever cost savings can be demonstrated.

The detrimental economic, environmental and social issues associated with landfilling organic residues have seen them targeted as a priority for increased resource recovery at all levels of government. The introduction of market-based instruments (such as landfill levies) has helped make the economic rationale for action clearer in many Australian regions.

There are still, however, many areas of Australia where direct economic figures may not quite stack up in favour of organics recycling, such as where landfill disposal is relatively cheap or where low quantities of organics are produced. As the beneficiaries of organics recycling schemes often extend well beyond the immediate sphere of the waste management department in council, a holistic assessment of the costs and benefits of an organics collection scheme, for example through a life cycle assessment, may allow for a more balanced assessment and outcome.

Economics

The carbon pricing mechanism

Under the Federal Government's Carbon Pricing Mechanism, landfill operators, including councils, will be financially liable for carbon pollution associated with landfill greenhouse gas emissions, where those emissions exceed the facility threshold of 25,000 tonnes CO₂-e (carbon dioxide equivalent) per annum. The carbon price will not apply to emissions from waste deposited prior to 1 July 2012 (known as legacy waste emissions), but legacy waste emissions do count towards determining whether a facility meets the participation threshold.

Councils that do not operate their own landfill may still be exposed to carbon price mechanism if they send waste to a commercially run landfill that exceeds the 25,000 tonnes CO₂-e emissions threshold.

The starting price for carbon pollution will be \$23 per tonne CO₂-e in 2012, rising to \$24.15 in 2013 and \$25.40 in 2014. From 1 July 2015, an emission trading scheme will commence, under which the carbon price will be determined by the market. A price collar will be in place for the first three years, with the "ceiling" \$20 above the expected international price for 2015, rising by 5% in real terms per year.

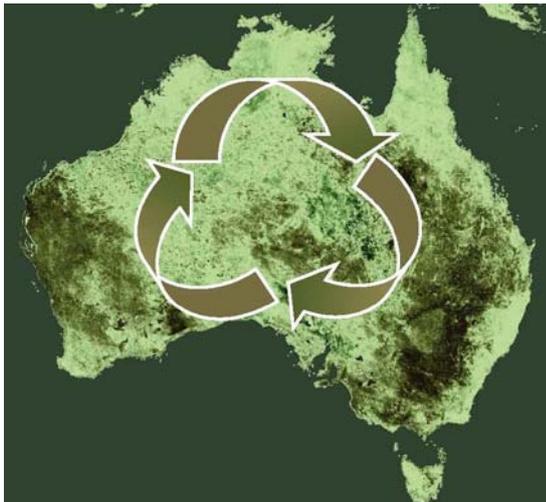
In terms of the waste sector, the carbon price mechanism will incentivise a reduction in emissions through the diversion of biodegradable material (including garden and food organics) from landfill and the capture of landfill gas and its destruction (flaring) or use as an energy source, on sites where the gas volumes are sufficient to make this feasible. More information is available at:

<http://www.cleanenergyfuture.gov.au/opportunities-and-obligations-landfill-managers>.

Landfill costs and levies

One of the objectives of landfill levies is to provide an incentive to minimise the disposal of waste to landfill, and support efforts to develop recycling and resource use. Source separation of organics will reduce landfill disposal costs, including the cost of landfill levies.

Food and garden organics collections trials and services in Australia are reported to have, on average, achieved a capture rate of 8 kg per household per week, or more than 400 kg / household/ year. Diversion of such quantities reduces disposal costs. Potential savings for various hypothetical councils are demonstrated in the table below by calculating reductions in landfill gate fees, landfill levies and carbon price liabilities following the introduction of an organics collection scheme. The modelling assumes organics collections are offered to 50% of all households in the council area, of which 80% actually participate in the scheme).



Renewable Energy Certificates

There may be potential for councils or organics processors to gain financial benefits via **Renewable Energy Certificates** (RECs) if these materials are used for generating 'green' energy. For instance, woody garden organics and other wood residues (shredded and particle size graded) can be used for co-firing industrial boilers, while anaerobic digestion can be used for energy recovery from moist organic residues. In both cases, the generated energy may be used to power the facility, with surplus energy exported to the grid. The associated RECs can be an additional source of income for the facility.

Enhanced investment and employment

Kerbside collection and processing of garden and food organics requires investment, creates employment, and enhances economic activity compared with the mass-dump model. Necessary investments include the purchasing of bins, kitchen caddies and collection vehicles, as well as the construction of a processing facility. On-going direct employment will be created for drivers of collection vehicles and for staff at the processing facility. Indirect employment will also be created.

In 2011, the Organics Recycling Industry estimated the 120 businesses (approximately) that are involved in organics recycling and composting in Australia overall have combined capital investment of more than half a billion dollars (\$580,867,000) and employ the equivalent of 1,900 full-time people, in addition to creating jobs in transport, distribution and application of products across Australia.

The enhanced commercial activities resulting from organics recycling, and the wider societal benefits that flow from it, should ensure organics recycling is the preferred option even if costs are on par with landfilling (or even slightly higher).

Recovery targets

Most states and territories in Australia specify waste diversions and/or resource recovery targets in their waste management strategies. Significant reductions in food and garden organics disposed to landfill will be vital to achieving the waste diversion and recovery targets for municipal solid waste (MSW), as outlined below:

State	Target
NSW	66% recovery of MSW by 2014
SA	60% recovery of MSW by 2012 and 70% recovery by 2015
VIC	65% recovery of MSW by 2014
WA	50% recovery of MSW in Perth Metropolitan Region by 2015 and 65% by 2020
QLD	50% recovery of MSW by 2014 and 65% by 2020 (aspirational only, not mandated)
NT	Reduction of waste to landfill by 50% by 2020 (aspirational only, not mandated)
ACT	Increase in resource recovery rates by over 80% by 2015, over 85% by 2020 and over 90% by 2025

Environmental benefits

Reducing greenhouse emissions

Segregating and recovering food and garden organics from the waste stream, or minimising or avoiding it in the first place, will reduce greenhouse gas (GHG) emissions. Organic material that decomposes in the anaerobic environment of a landfill produces methane, a potent GHG with a global warming potential significantly greater than carbon dioxide.

When landfill gas is captured and either flared or used to generate power, GHG impacts are reduced. However, not all landfill gas can be captured due to inherent inefficiencies of the collection systems—while estimates can vary widely, in general 40–75% is considered by the industry to be the average range of lifetime capture efficiencies. Capture efficiency will depend on a number of factors in addition to system design details, such as whether the gas capture system was retrofitted, or installed as part of the original landfill development. Another important factor is the instability of the landfill mass, caused by the decay of buried material. This can lead to fissures developing through which gas may escape. It should be noted that not all landfills in Australia have a gas capture system installed because in many cases it is not considered to be economical unless the landfill accepts a large volume of waste.

Using a life cycle assessment approach, the *Environmental Benefits of Recycling Study* has demonstrated kerbside collection and composting of each tonne of garden and food organics or garden organics alone saves 250 and 320kg of CO₂e, respectively. In 2006–07, the Australian Organics Recycling Industry diverted at least 3.7 million tonnes of organic material from landfill, comprising materials such as garden and food organics, wood and timber, biosolids and sludges.

Conservation of valuable resources

Garden and food organics are essentially plant matter, containing carbon (energy), nutrients, minerals and water, all of which are cycled endlessly in natural ecosystems. Disposing food to landfill therefore wastes the energy and nutrients contained in the produce, and it also wastes the energy, water and resources used to produce, process, store and transport the food.

Organic residues have the potential to be beneficially reused, either for land management purposes or for energy generation, or both. Organic residues were traditionally processed through particle size reduction and/or composting, and used in landscaping as well as in agriculture and horticulture, providing benefits primarily through the supply of organic matter (carbon) and nutrients to maintain productivity and improve soil health.

By processing more than 5.8 million tonnes of organic material (including municipal and commercial organics, biosolids and manures), organics recycling in Australia recovers nutrients equivalent to more than 29,000 tonnes of urea, 2,900 tonnes of super phosphate and 14,500 tonnes of potassium sulphate that would otherwise be lost to landfill each year. Recovery and re-use of phosphorous is extremely important in the long-term, as rock phosphate deposits are finite (100–130 years) and crop production will cease without it.

In more recent times, woody organic residues have seen a renaissance in their use as fuel for steam or energy generation. The remaining ash (for example boiler ash from sugar mills) contains minerals that have agricultural value, and can be used to improve soil health and productivity so long as contaminant levels are not excessive.

Anaerobic digestion can in some situations offer the best of both worlds, allowing for the generation of energy while also providing organic matter and plant nutrients for land management and crop production.

Soil carbon sequestration can potentially help mitigate climate change. The use of organic soil amendments such as mulch, compost or biochar as a means of increasing stable soil carbon pools has therefore become increasingly popular. It is estimated that approximately 10% of carbon applied with a mature garden organics compost will still be in the soil after 100 years, while most carbon contained in biochar will remain in the soil for much longer. However, supply of degradable carbon to the soil is equally important, as it provides energy to drive biological and biochemical processes, and improves soil health.

The declining supply of virgin materials such as top soil, peat moss and forestry residues (sawdust, bark), due to increasing demand and decreasing supplies in urban centres over the last 15 to 20 years, is being partly compensated through the use of recycled organic products.

The raw materials used in composting largely determine the quality of the finished product. Recycled organic products manufactured from source separated organics have shown low levels of physical and chemical contamination. These products therefore have wide potential application and the chance of being accepted in a wide variety of markets. The use of recycled organic products with low contaminant levels is central to developing agricultural and horticultural markets, and also for minimising soil contamination.

As a minimum, mulch and compost products should comply with specifications stipulated in the *Australian Standard for Composts, Soil Conditioners and Mulches* (AS 4454-2012). This standard specifies the minimum product quality requirements, but does not ensure efficacy for various applications. It is desirable that product quality, and in fact management of the entire processing operation, is third party audited.

While it is advantageous to generate products that comply with industry standards, the ultimate test is customer satisfaction, something that is largely based on product efficacy and value for money. The first priority is to develop and manufacture products that meet customer demand and expectations. This is no different with a council's own Parks and Gardens Department, except that, when the products work well, associated cost savings and benefits will stay with council.

Being able to supply residents with a high quality compost product that is made from their organic residues can be used very effectively for on-going education and motivation of the community, something that also aids market development.



Social benefits

Potential for behaviour change

The Australian Institute estimates *“the average household in Australia throws out about \$616 worth of food a year, or \$239 per person”*.

It has been demonstrated that the introduction of a third bin for collection of food and garden organics inherently encourages people to source separate other materials from the residual waste stream, and can reduce overall waste produced.

Social capital

Social capital is a sociological concept which refers to the value of social relations and the role of cooperation and confidence to get collective results. In general terms, ‘social capital’ is the core of social relations, and covers benefits derived from cooperation between individuals and groups.

Social capital develops when individuals and groups within a social system interact for mutual benefit in a variety of ways over a period of time. They may build long-term trust through consistent behaviour and high levels of involvement in a council’s work.

Community strengthening and positive opinion of council – an organics collection scheme may help to strengthen the local community and stimulate interest and involvement in a council’s environmental and sustainability initiatives.

Conserving landfill space

Developing a new landfill is a major undertaking for any council or company. Planning, getting approvals, building community support and finally constructing the cells, requires significant human and financial resources. Consequently, an existing landfill represents a very valuable asset, the replacement costs of which are difficult to predict.

As it is often very difficult to find suitable locations for new landfills (not to mention hard to convince the surrounding community of the benefits of having a new landfill constructed nearby), councils and private landfill owners aim to utilise existing landfill sites for as long as possible. A good way of achieving this is the reduction of waste going to landfill through waste minimisation and recycling.

The reduction of organic material going into landfill may also alter the quantity and quality of leachate and landfill gases generated, which may offer savings in management and treatment costs.

Understanding your waste stream

Before committing to investing in an organics collection scheme, it is obviously important to assess how much waste might be diverted from landfill as a result. This information can then be used to calculate potential benefits and cost-effectiveness, and help shape the scope and design of the scheme.

How much food and garden organics are available?

A 'typical' Australian household garbage bin is made up of the following materials by weight:



Garbage mix type (NGER technical guidelines, 2011)

The percentages listed above are for an 'average' household garbage bin and indicate that over 50% is food and garden organics, with food being the single largest component, approximately 35% by weight. In 2006–07 an estimated 2.7 million tonnes of household food organics were disposed to landfill across Australia.

The amount of garden organics in the garbage bin depends on a range of factors, especially whether a garden organics collection service is available. On average, household garbage comprises around 17% garden organics which in 2006–07 equated to an estimated 1.3 million tonnes of garden organics disposed to landfill across Australia.



Garden organics (Hyder)

Australian waste data

Waste audits are the most common way of finding out how much food and garden organics are contained in household garbage. The [National Food Waste Assessment Report](#) (2011) provides substantial information about existing waste audit resources held by auditing consultants and councils, or regional waste management organisations. While significant numbers of residential waste audits were identified by this assessment, the report does not provide a comprehensive collation of this audit data across Australia.



Food organics (Hyder)

Increasing numbers of household-level audits are being undertaken in Queensland and Western Australia, although the largest number of audits to date has been undertaken in NSW, South Australia and Victoria. The most reliable data on household level waste auditing may be found in South Australia and NSW, where consistent methodologies for undertaking such audits have been in place for longer periods.

National Waste Report

[The National Waste Report](#) (2010) documents the current status of, and emerging trends in, resource recovery and waste management in Australia for each jurisdiction. The report covers

- ✓ Municipal solid waste (MSW)
- ✓ Commercial and industrial waste
- ✓ Construction and demolition waste
- ✓ Hazardous waste.

The report contains national municipal organic waste data from 2006–07, the most up-to-date national dataset available when the report was prepared, but it does not contain state-specific data. The report provides an approximate food organics generation rate per household across Australia.



Waste audit (Hyder)

Household waste audits in New South Wales

NSW councils in the Sydney Metropolitan Area (SMA) and Extended Regulated Area (ERA) carried out household residual waste audits as part of the Waste and Sustainability Improvement Payment (WaSIP) program in 2007–08. The audits were conducted using a consistent NSW Audit Methodology, and included audits of household residual waste bins as well as recycling and garden organics, where appropriate.

The results of statistical analysis of the waste audit data are available in the [Report on the Results of Waste Audits of Household Kerbside Collection Systems 2007–08](#). The report shows the average residual bin in the SMA/ERA contains 40% food organics and 11% garden organics, although it also shows variation between each council area, and between single-unit dwellings (SUDs) and multi-unit dwellings (MUDs).

Household waste audits in Victoria

Sustainability Victoria conducted a one-off audit of the composition of MSW across four metropolitan Melbourne councils in 2008, with results presented in the [Kerbside Garbage Composition: Recent Findings](#) report. Sustainability Victoria also reviewed bin audits conducted by metropolitan Melbourne local governments from 2005 to 2007 in order to supplement these findings.

The audits found almost 50% of the garbage bin content was made up of organics, with more than 40% of this being food organics. The local governments with a two bin system had approximately 15% garden organics in their garbage bins, whereas for local governments with a three bin system 5% of the garbage bin comprised garden organics.

Usability of default data

It is not advisable to rely on national or state and territory data when planning an organics collection scheme because different amounts of organics are generated by different sectors of the community. Area specific compositional analysis will provide a more accurate picture of the available organics, and enable the quantity per household produced to be more accurately estimated for a specific council area.

The waste audit process

Conducting a waste audit is the first necessary step in any serious attempt to quantify and reduce waste – **“you can’t manage what you don’t measure”**.

Waste audits can be used to gather critical information to help achieve the best outcome from an organics collection system. A garbage bin audit, including a waste composition analysis, can provide a breakdown of the amounts and types of organics wasted and help you to understand the composition of waste going to landfill, and what could be recovered for recycling or composting.

Agreeing to follow a standard audit methodology is a good way to encourage trust between various stakeholders who may rely on the audit results for making decisions. For example, many councils have maximum contamination rates specified in their contracts with private sector processors of organics. If all relevant parties have access to an agreed, reliable data set, it will be easier to negotiate issues related to system performance in an open and transparent way, which will ultimately help deliver the best overall result from the system in place.

Until very recently, there have not been clear guidelines for undertaking residential kerbside auditing in most states and territories, with South Australia and NSW notable exceptions. Despite variability in audit methodologies, the increasing number of physical audits that have been undertaken in the past three to five years are likely to provide a valuable base of information about the character of Australian domestic waste, as well as the quantity of food and other organics present in this waste stream.



Waste audit (Hyder)

The [Guidelines for Conducting Household Kerbside Residual Waste, Recycling and Garden Organics Audits in NSW Local Government Areas](#) outlines key issues and methods for auditing household waste streams. The guidelines promote a consistent waste audit methodology and reporting framework for measuring the quantity and composition of average household residual waste and/or recycling and/or garden organics bins at the kerbside, and provide councils with the basis for reporting and evaluating their own overall performance as well as programs, sector and waste stream performance.

Sustainability Victoria's [Guidelines for Auditing Kerbside Waste in Victoria](#) are intended to be used by councils and their contractors in planning and carrying out physical audits of household garbage, recyclables and organics collection services. The guidelines are for weight-based physical audits where materials are manually sorted and weighed according to categories of materials types. The intent of the guidelines is to promote greater standardisation of future audits, allowing councils to compare the performance of their waste and recycling management systems over time, and with other councils. The guidelines were developed in consultation with councils and waste auditing businesses in order to develop an audit methodology that cost-effectively produces accurate and useful data and information.

Zero Waste South Australia (ZWSA) has also developed a standard methodology for conducting kerbside waste and recycling audits, included in the [Guide to Kerbside Performance Reporting](#). ZWSA also offers a comprehensive program of training and support to councils and their consultants, including training courses in the use of the audit methodology. A list of trained and approved consultants that can assist councils with the auditing process is available from ZWSA upon request.

How much can be diverted?

The actual portion of the available food and garden organics that will be captured in a collection service will depend on a number of factors, and to some extent will be determined by the community served (for example, commitment to recycling, cultural influences on cooking habits, home composting rates, and amount of food left in packaging).

Key statistics published for ten successful Australian kerbside organics collection trials and services have been reviewed for this guide and average values are outlined in the following tables to represent indicative recovery rates possible for food and garden organics. A summary of each case is provided in the Appendix.

Key Collection Statistic	Overall average value
Participation rate	66%
Contamination rate	3%
Total organics yield	8.0 kg /hhld/week
Food organics yield	1.8 kg /hhld/week
Garden organics yield	7.7 kg /hhld/week
Food organics capture rate	33%
Garden organics capture rate	96%
Combined organics capture rate	55%

Overall Average Recovery Statistics (of ten Australian collections reviewed)

Food organics

The average food organics yield based on four Australian trials is 1.8 kg per week. The following table provides a more detailed recovery statistics for food organics for several subsamples reviewed³.

Food organics yields (kg/hhld/week)	Average of subsamples
Yield (in a food-only collection service)	2.5
Yield (in a combined food and garden collection service) ⁴	1.73
Yield (SUDs) ⁴	2.2
Yield (MUDs)	1.0
Yield (weekly collection)	1.97
Yield (fortnightly collection) ⁴	1.49

³ Note that there were three 'food-only' subsamples and four subsamples of MUDs included in the review

⁴ Food organics figures from the Groundswell project are excluded due to the inclusion of Goulburn-Mulwaree monthly collection frequency which resulted in low yields of food

WRAP UK commissioned a waste audit in 2007 covering six of 19 food organics collection trial areas. The average food organics yield across the waste audits was 3.3 kg per household per week across the six trials.



Food organics (Hyder)

The following characteristics of food organics collection should be noted when making assumptions about what can be achieved in your council area:

- ✓ Refuse collection frequency is a statistically significant factor in the performance of food organics collections. Areas with fortnightly collections of refuse have higher weekly food organics participation and yields.
- ✓ Participation and yields can decline over time in areas with weekly refuse collections, while in areas with fortnightly refuse collections yield and participation tends to be maintained.
- ✓ Food organics yields may be influenced by the size of the bin provided for refuse.
- ✓ Higher food organics yields will generally be found in more affluent areas.

Garden organics

The proportion of garden organics in household waste is an important factor influencing collection strategies. Key issues to consider when evaluating how much garden organics will be presented for collection include:

- ✓ Proportion of properties with gardens – many urban councils have high proportions of housing stock with either no gardens (such as multi-unit dwellings), or small gardens, where a separate garden waste collection service may deliver small amounts of garden organics.
- ✓ Garden size – properties with larger gardens will be expected to produce more garden materials.
- ✓ Seasonality – garden organics volumes usually increase in spring/summer/autumn and reduce in winter. On the other hand, food organics shows little seasonal variation.



Garden organics (Hyder)

Participation in free garden organics collections can be high. Councils that do not currently collect garden organics should therefore be wary of basing predictions of garden organics tonnages on levels currently in the garbage stream alone.

Many councils have experienced additional garden organics being drawn into the collection system when kerbside organics collections are introduced. This may increase the recycling rate, but it will also lead to higher total waste arisings.

Available figures on average yields from Australian households show that garden organics collections can capture 7kg/hh/week in urban areas and up to 10kg/hh/week in rural areas. The following table provides a more detailed recovery statistics for garden organics for several subsamples reviewed as part of the ten Australian kerbside organics collection trials and services.

Garden organics yields (kg/hhld/week)	Average of subsamples
Yield (in a combined food and garden collection service)	7.7
Yield (SUDs)	9.4
Yield (MUDs)	2.5
Yield (weekly collection)	7.6
Yield (fortnightly collection)	7.8

Case Study – Resource GV waste audits

Resource GV is a regional waste management group in Victoria's Goulburn Valley Region with member councils of Campaspe Shire, City of Greater Shepparton, Mitchell Shire, Moira Shire, Murrindindi Shire and Strathbogie Shire. The organisation engaged a consultant (WasteMin) to conduct comprehensive domestic waste audits in 2010 in order to compare changes from the 2007 audits and identify options for reducing the disposal of organics to landfill.

Councils in the region provide, in general, a weekly 120 litre Mobile Garbage Bin (MGB) service for garbage and fortnightly 240 litre MGB service for recyclables. Nillumbik Council also offers a weekly food and garden collection service in a 120 litre MGB; however the other councils in the region did not offer a regular kerbside organics at the time of the audit.

The audit methodology was based on a random selection of 555 residential dwellings in a representative cross-section of communities in each municipality. Between 55 and 100 bins were sampled in each locality selected. A total of 6,163kg of garbage was audited, with data collected per bin sampled and recorded in grams.

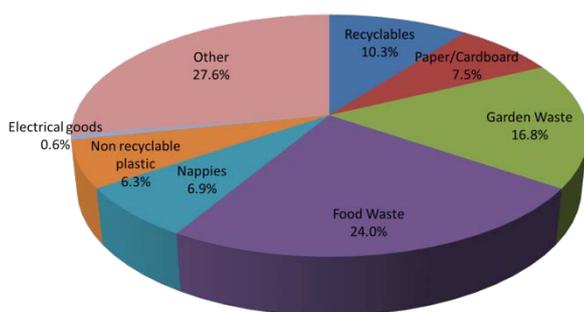
The detailed dataset was analysed to provide information on the best potential areas to target for collection services, education programs and other resource recovery approaches.

Data was presented in several main forms such as:

- 1 An overall profile of the total garbage, recycling and organics bin contents for each area or subgroup (example shown in Figure 1)
- 2 A breakdown of sub-categories by weight and volume within recyclables or food and garden organics (example shown in Figure 2)
- 3 A graphical comparison of composition by weight between the 2007 and 2010 audits, to indicate improvements and other trends for each council area
- 4 A graphical comparison of the garbage stream and subcategories by weight between the region’s six council areas, to indicate materials with lower than average resource recovery rates in each council area.

Lessons Learnt: One of the key findings of the Resource GV audit series was the higher than average disposal of food and garden organics in the areas of Campaspe Shire and Moira Shire (Factsheet 11), which convinced these councils to consider options for new collection services and promotion of composting. Since that time, both councils have conducted pilot food and garden organics collections, and at the time of publication were considering a move towards full implementation of these services. The Moira pilot trial resulted in an additional 23% diversion from the garbage bin.

Figure 1 – Resource GV region garbage composition 2010



Kerbside-collected garbage ready to be audited

Figure 2 – Breakdown of food organics in garbage bin

Sub –category Food organics	Percent of garbage stream by weight	Percent of garbage stream by volume
Unavoidable food waste	9.1%	5.2%
Soiled packaged food	6.1%	3.5%
Whole fruit / vegetables	1.8%	0.5%
Avoidable food waste	4.3%	2.1%
Other food	2.7%	1.2%
Total food organics % of garbage stream	24.0%	12.5%

Understanding the collection options

The design and roll-out of an appropriate source separated organics recycling program will depend on the type of organic materials collected, the expected quantities, and the type of collection containers used (as well as the frequency of collecting them). This Factsheet provides an overview of common organics collection options and appropriate equipment. Detailed information on the design and roll-out of an organics collection service is provided in Factsheet 10, in the *Implementation* section.

Types of organics collection services

A council considering introducing an organics collection service typically has four broad collection options:

- 1 Collect garden organics only
- 2 Collect food organics only
- 3 Collect food and garden organics, but in separate containers
- 4 Collect food and garden organics combined together in a single container.

Many Australian councils have already introduced kerbside collection of garden organics. Where food organics are also collected, many councils have opted to combine the collection of food and garden organics in a single container. This can increase the yield of organic material collected/diverted, without requiring an extra receptacle or collection run.



Garden organics (Hyder)

The argument for a separate food organics collection service is primarily driven by the economics of organics processing. Garden organics may be processed using a relatively inexpensive open-windrow composting system, while the inclusion of food waste will generally require the use of more expensive enclosed processing technology. Where combined collections are offered, all organic material may need to be processed through enclosed systems.

Where separate schemes have been introduced (for example in the UK and Italy) householders receive a small container (10–20L) for food that is collected once or twice per week, while garden organics are collected either infrequently (once per month) or at a street or community level. The separation into garden and food organics streams allows for the low-cost processing of garden organics in open windrows, with a lower volume requiring enclosed processing.

If urban authorities provide a combined organics collection service for multi-unit dwellings, it might be almost a ‘food only’ collection service as residents would usually have small gardens (or no gardens). In these cases, council will need to decide whether to cater to these circumstances by providing different bins (smaller, aerated) and/or more frequent collection, or to provide a consistent service for organics across the wider council area. Providing a range of services complicates communication with the community.

It is possible to use split bins for collecting organic waste in the same receptacle and truck used to collect the residual waste or recycling stream, however this type of system may lead to increased rates of contamination.

Collection frequency

Organics collections are usually introduced as a weekly or fortnightly service. Garden organics alone are commonly collected fortnightly, but the co-collection of food and garden organics usually requires a weekly collection service. Some European councils have opted for a weekly collection in summer and a fortnightly collection in winter, although this requires more elaborate communication with the community.

Increases in overall collection costs can be minimised if it is possible to alternate a fortnightly organics collection with a fortnightly garbage collection. However, the option to move to fortnightly garbage collection needs considerable community consultation and support. It has been found that a fortnightly collection of garbage supports improved diversion, provided that food organics are collected weekly. However, there is always concern that reducing garbage collection frequency, or the size of the garbage bin, will result in increased complaints from residents and contamination of the organics bin, although trials in South Australia have not borne that out (as outlined in the case study on Page 29).

Vehicles and containers

Access to appropriate collection vehicles and container systems is a fundamental consideration for organics collection services.

Vehicles

The configuration of collection vehicles and services may have a significant impact on the overall efficiency and cost effectiveness of organics collection services.

Organics have a different bulk density and are more compactable than residual household waste. It is important to ensure the capacity of the collection vehicle is appropriate to the tonnage collected. Monitoring the quantity of organics loaded into the truck is recommended so as to avoid overloading, particularly when the proportion of grass clippings is high, or in high density housing areas where the proportion of food organics is high.

Split-body trucks may potentially allow for one vehicle to collect (and keep separate) different material streams. In Australia, split-body trucks were used extensively in the past for recycling collections to separate recyclable containers from paper. This system has also been trialled for collecting household refuse and commingled recycling together, although with very limited success. Internationally, there are examples of systems where split-body trucks are used to simultaneously collect household refuse and source-separated food organics.

Collection rounds have to be planned according to anticipated quantities and composition of collected organics (which may fluctuate by season and area). As the segregation of garden and food organics alters quantity and composition of residual waste, existing garbage collection services may also have to be adjusted.

Collection vehicles should be leak proof and have apertures closed when not being loaded.



Collection truck (Leichhardt City Council)

Issues of rising fuel costs and other potential costs for increasing vehicle fleet sizes (such as overheads associated with insurance and maintenance) also need to be considered when planning changes to the vehicle fleet.

Containers and liners

Providing practical and convenient methods that make organics collections easy for householders will help to maximise yields.

The **external** container, in which organics will be presented for collection at the kerbside, should be a rigid plastic bin with a lid that prevents leakage and scavengers (cats, dogs, birds) and vermin from gaining access to food residues.

If food and garden organics are to be collected together, then a 120–240L wheeled bin will typically be needed. The exact size depends on collection frequency and average garden size. It is important to consider if the container capacity is sufficient for the household size. Containers with a capacity too large for the average household are likely to draw in additional garden organics which would not previously have been collected, and may spark visual amenity concerns in some areas. On the other hand, a 240L bin collected fortnightly might be too small for residents with large gardens. Some flexibility and choice for householders will help schemes fit local circumstances better.



Kerbside bin (Crows Nest Shire)

Councils have the option of using aerated organics collection bins to reduce odour risks. Venting systems can often be retrofitted to existing bins or incorporated at the time of manufacture. For example, vented lids are available that can be easily retro-fitted to a bin. There are also bin designs that incorporate an internal frame to increase air flow or have a base plate for easy cleaning and prevention of organics such as wet grass from matting on the base of the bin, and a host of options in relation to the number of body vents that may help to optimise the decomposition process and weight reduction of the contents.

There are also bin odour/moisture control products available on the market. Lids can be fitted with 'gravity latches' that prevent animals accessing the contents even if the bin is tipped over.

Smaller sized wheeled bins (60L and 80L) that are designed specifically for organics are also available. These containers may suit confined spaces, for examples in multi-unit dwellings, and can still be fitted with features such as vents, vented lids and gravity latches, and be collected by kerbside collection vehicles.

Where food organics are collected separately on a weekly basis, a 20–25L container will be sufficient for the majority of households. Container size and type need to be flexible to meet the need of the household.

To help residents segregate food organics from other waste, it is recommended that councils supply them with the appropriate equipment, such as a 'kitchen caddy'. A 'kitchen caddy' is a container used **indoors** for storing food organics until they are transferred to the external bin.



Kitchen caddies and liners (WRAP UK)

Most food organics trials and programs in Australia have included provision of bench top kitchen caddies to encourage participation and increase food organics capture rates. Caddies come in two general forms – solid and ventilated. The vented style provides good aeration and reduces odours, although compostable liners must always be used. Caddies with solid sides do not necessarily need liners.

Caddies should have a wide opening so that plates can be easily scraped clean. The caddies should be large enough to contain at least 2–3 days' worth of discarded food. Caddies should be easy to carry, empty and clean.

Easy to open lids of caddies do not always close tightly, allowing flies (mainly small fruit and vinegar flies) to become a nuisance. Caddies with tightly closing lids can eliminate this problem.

Liners are bags that fit inside the caddy. Liners used for collecting food organics have to be made from compostable organic material, such as corn or potato starch, or paper. Liners are defined as compostable if they comply with standard test methods for compostability (AS 4736-2006 Australian biodegradability standard). Liners require adequate mechanical strength to retain their contents, yet allow some gas exchange. Food does not stick to the inside of the caddy when liners are used, reducing the need for cleaning. They also aid collection as food scraps are more easily emptied from the caddy and food and liquid stays contained in transit, reducing the risk of any leakages or spills. This increases convenience for householders and may therefore lead to increased participation and diversion.

Case Studies

‘Valuing our food waste’ project – Zero Waste SA

Between 2009 and 2010, Zero Waste SA coordinated a 12 month household food organics collection pilot, which was the largest trial of its kind in Australia and involved 10 local councils, trialling two different collection system configurations across 17,000 households.

The main aim of the pilot project was to identify the key factors within a domestic collection system that would maximise the diversion of food waste from landfill. For most of the council areas, food organics were co-collected with garden organics in 240L MGBs as part of an existing garden organics collection.

The pilot compared two main factors:

- 1 The response to weekly or fortnightly collection of garbage and/or organics
- 2 Effectiveness of a lined, ventilated kitchen bench-top caddy collection system (named ‘Bio Basket’ and ‘Biobags’ in the pilot) compared to an unlined, solid container.

Other key elements of the pilot project included development of targeted consistent education materials in collaboration with participating councils (including brochures in different languages) and stickers for kitchen receptacles/bins.

The research, monitoring and evaluation associated with the pilot included a benchmark waste audit of 1,130 households prior to the trial; telephone surveys; door-to-door interviews; odour testing; and follow-up kerbside audit that included visual inspections of bins. Overall rates of diversion from landfill achieved during the trial exceeded 70% for households using a ventilated container and 61% for one council using an enclosed (non-ventilated) container.

The pilot found that the best performing collection system involved using a lined, ventilated kitchen caddy with a fortnightly residual collection, with this configuration recovering an average of 1.86 kg/hh/week of food. This represented a food waste capture rate of up to 74% for this system.

The system combining a solid and unlined kitchen caddy with weekly collection of residual waste had a much lower performance, yielding an average of 0.38 kg/hh/week of food waste and up to 20% capture of total food organics disposed. The food capture rate varied widely between different trial areas, being as low as 5% in one sample subset (Whyalla – using a solid kitchen caddy with weekly residual) and as high as 74% in another sample subset (Kensington – using a ventilated and lined caddy with fortnightly residual collection).

Feedback from participants suggested that about two thirds were not inconvenienced by fortnightly residual waste collections, while the remainder said fortnightly collection was undesirable. Overall household participation rates of 74% were achieved in the pilot collection areas with lined and ventilated containers, and 60% in areas using enclosed caddies. The majority of those who did not participate at all reported they were already composting at home.

Flies and odour were the most common reasons reported for households under-utilising the food organics collection system. Contamination rates were very low in all areas throughout the collection period, and remained well below 1% (by weight) of the total organics bin. An unintended positive outcome was that the targeted education program also improved participant use of the recycling service and understanding of waste issues in general.

Lessons Learnt: This trial found households using a lined (compostable liner) and ventilated caddy achieved a greater food organics diversion rate than households using a solid caddy. It also found that a fortnightly collection of garbage influenced a higher rate of capture of available food organics for collection and processing.



Food organics (Leichhardt City Council)

Collecting food organics in high density urban populations – Leichhardt City Council

The Leichhardt City Council area, in Sydney’s inner west, has a population of over 51,000, residing in about 15,000 single dwellings and 10,000 multi-unit dwellings. In working towards the NSW Government’s 66% landfill diversion target for 2014, the council has looked closely at the domestic waste stream. It initially trialled several food organics collection options, and has since rolled out a full service to multi-unit dwellings.

The council found that food waste accounted for 44% of the contents of an average household garbage bin in 2007. Most of the available garden waste material was already being recovered through the garden organics service offered to single dwellings, and therefore the majority of organics still going to landfill was food. This was the core reason that the council decided to undertake a food-only collection trial in mid-2007 called “Kitchen Organics – Leichhardt Food Recycling Collection Trial” which aimed to assess the community’s views and determine whether source-separation of food waste was a viable resource recovery option. An education program, ‘Less Leftovers in Leichhardt’, had also been run by the Council, which aimed to encourage food waste avoidance within the community, prior to consideration of the food collection trial.



Kerbside bin trialled in Leichhardt City Council

Another factor that influenced the decision to focus the trial on food organics was the availability at the time of the EarthPower anaerobic digester facility at Camellia, which was able to process food material but did not accept garden organics.

The trial was designed to test four different collection systems in four areas, with a total of 600 households participating over a period of 12 weeks.

The variables tested in the trial are shown in the following table.

Dwelling Type	Kitchen System	Collection System
Single dwellings	Enclosed kitchen caddy	Existing 240L garden organics MGB Food and garden combined
Single dwellings	Enclosed kitchen caddy	New 46L MGB Food only
Single dwellings	Ventilated kitchen caddy with biodegradable bags	New 46L MGB Food only
Multi-unit dwellings	Ventilated kitchen caddy with biodegradable bags	New Bio-Insert MGB Food only

The trial was considered extremely successful, with about 61% of those households that had an existing garden waste service participating and diverting – on average – 3.8 kg of food and garden organics per week. In comparison, only 47% of dwellings without a garden waste service participated, and achieved an average yield of 3.0 kg of food per week. Participation rates for individual units within multi-unit dwellings were not measured, but capture rates were on average 1.2 kg of food per unit.

The food organics collection ceased at the end of the 12-week trial, however a new food organics service was commenced in the following year for multi-unit dwellings (MUDs) only. Households in single dwellings continue to be encouraged to reduce food disposal through composting and worm farming.

There were several reasons for the new service focusing on MUDs. Firstly, the council found its existing communication program was less effective for educating MUD residents about the collection service than it was for educating residents with gardens. Furthermore, community feedback on the scheme was found to be particularly positive amongst MUD residents. 89% of MUD residents that responded to a Council survey rates the system at the highest level with respect to ease and convenience, while 98% of MUD residents surveyed indicated they would continue participating, if collection were offered on an on-going basis. Council also determined the most cost-effective way of implementing a new collection service in MUDs was to replace approximately one of every 10 garbage bins in unit blocks with a new 240L shared food organics bin, rather than requiring a new bin for every household. Finally, the council found a suitable, cost-effective facility willing to process separated food organics.

In an attempt to minimise complaints due to odour and pests, MUD residents received an aerated kitchen bin and an annual supply of biodegradable bags. These were used together with an insert bin (within the 240 L shared organics bins) designed to increase air flow in an attempt to minimise complaints from odour and pests. Unfortunately, this combination caused some unexpected problems as the bags sometimes get caught in the bin insert and leave food residues in the bin after collection.

A key issue that has arisen since introducing the service is the closure of the EarthPower facility, leaving the council with limited alternative options for processing. There is currently an informal agreement to send the source-separated food to the SITA SAWT facility at Kemp's Creek, where it is processed with Penrith City Council's food and garden organics.

Leichhardt Council has been negotiating a joint regional contract with nearby councils in inner Sydney for the processing of organics, but this has been an extremely complex and drawn out process lasting a number of years. It is possible that when a new regional contract is finalised, the council will move towards a combined food and garden organics collection service that is made available to all residents.

Lessons Learnt: Leichhardt City Council thoroughly reviewed a range of collection options and designed its current scheme based on tested factors, such as the characteristics of the waste stream, the methods that were successful with its residents, and the processing solutions available at the time of implementation.

Shoalhaven City Council – 'Wet and Dry' Collection Trial

Shoalhaven City Council on the NSW south-coast undertook a 14-week waste collection trial in mid-2009 of an innovative 'wet and dry' bin system. The trial involved about 700 households and several businesses located in a small village near Nowra, which is popular with holiday makers. The two-bin methodology was designed to investigate whether organics recovery could be achieved without investment in new collection infrastructure.

For the duration of the trial, which was coined 'Get to the Point', the residents and businesses of Greenwell Point were asked to put away existing 240L garbage and recycling bins. Instead they were provided two different 240L MGBs: one with a white lid and the other an orange lid.

The white-lidded bin was to be used for 'wet' organic materials including food, garden vegetation, seafood, earth-based materials, animal manure, pet bedding and nappies.

The orange-lidded bin was to be used for all other materials, such as dry recyclables (placed in the bin loose as per the yellow recycling bin) and residual waste (placed in plastic bags to remain separate from recyclables). Residents were also supplied with a bench top kitchen caddy and a supply of biodegradable bags for food scraps.

The orange-lidded dry recycling bin was collected weekly and taken to Shoalhaven Recycling's MRF in Bomaderry for processing. The process was to first manually remove bagged material (residual) then allow the rest of the material to be processed as normal recycle, using standard procedures to separate the contamination and loose recycling.

The white-lidded organics recycling bin was collected fortnightly and delivered to a composting area at the West Nowra Landfill. Contaminants were removed and the material was composted in one of two simple systems in order to compare the processing performance of each technique. These were:

- 1 Effective micro-organism inoculated compost system
- 2 Forced aeration compost.

The first composting process was based on the 'Groundswell' technique, using a microbial inoculant to stabilise the composting process, reduce processing time and improve the compost yield. In the second process, the compost pile was covered and a slotted pipe was placed in the centre to aerate the pile with a thermostatically-controlled fan.

Both systems produced compost products that complied with AS4454 standards. The systems were revised and improved during the trial and both were found to be suitable for a decentralised organics processing approach that would be necessary for the geographically dispersed population of the LGA.

The council expected an overall recovery rate of about 68% but results exceeded expectations with the community diverting 80% of its waste from landfill. An audit of the wet bins found 94% of the collected material was compostable while 6% was residual waste.

A critical issue arose early in the trial related to the collection truck's compaction devices and compaction rates, which caused garbage bags to split and contaminate recyclates. Testing of various compaction rates and minor truck modification found that optimum recovery was achieved when the load was compacted to 200kg/m³ using a pendulum-style compaction device. The trial also indicated that the padding provided by garbage bags amongst recycling reduced overall glass breakage.

The council attributed the positive trial results primarily to the effectiveness of the community engagement strategy. This included a consultative and collaborative approach to empower the community, a range of education materials, transparency of council operations and close cooperation with the MRF operator and collection contractor. Further to this, the flexible approach of the MRF operator and the simplicity of implementing the composting systems were critical factors in the trial's success.

As the trial used such a novel approach, the council consulted extensively with the participating community, also maintaining a visible presence and high level of communication during the trial period. Council collaborated with a key local community group to ensure the roll-out process was successful, provided trial updates at the community group's monthly meetings and published news and educational articles in the local newsletter. In addition, the council set up a local shop-front in the local community hall which initially ran three times per week and later twice per week. Council staff provided this forum to distribute additional supplies of compostable bags, explain the process and address any questions or concerns. Council staff also undertook home visits to assist elderly residents and trouble-shoot difficult problems.

Concerns about pests and odour from the organics bins were addressed on a case-by-case basis and in general were resolved through behavioural changes such as freezing seafood scraps until collection day and layering organics with newspaper and cardboard in the bin. Overall the system was extremely well accepted by both local residents and the businesses involved, including restaurants and other food outlets, with 85% of survey respondents in favour of the trial system and an additional 5% finding there was little difference to the existing system.

Since the completion of the 'wet and dry' collection trial, Shoalhaven City Council has so far not proceeded with full implementation of a kerbside collection service for food and garden organics. This was largely due to the reluctance of private sector MRF operators to commit to operating the council's recycling facilities given the perceived risks associated with the novel collection system for dry waste.

Lessons Learnt: The trial demonstrated the potential for additional resource recovery using existing collection infrastructure. In essence, the trial design completely removed the 'garbage' bin, leaving two types of recycling bin in its place, a system that was intended to simultaneously incorporate low-technology resource recovery solutions and facilitate sustainable behaviour change by both residents and businesses.

Understanding community education and engagement

An effective education and engagement strategy is essential to the successful introduction of a new organics collection services in your community. To ensure residents are given the knowledge and skills to undertake the behavioural changes they are asked to do, it is important that community communications are well researched, planned and adequately resourced.

There are three main approaches to community engagement:

- ✓ Information Giving
- ✓ Information Gathering
- ✓ Consultation.

Information Giving usually involves a unilateral announcement of intent or decision by a group, authority, or organisation, with no attempt made to gather or listen to views. Stakeholders have a lack of 'buy-in' to the decision as they are often excluded from the decision making process. An example could be delivery of a brochure or leaflet in the mail to residents, which outlines the benefits and costs of a food and garden collection scheme.

Information Gathering is an extractive (market) research form of engagement where individuals or groups are engaged in interviews or questionnaire based research. Respondents have no opportunity to influence the process or the eventual use of the information. Surveys canvassing participation rates and residents' attitudes to a scheme, such as around liners, caddies or collection frequencies are an example of information gathering.

Consultation is the seeking of views on a prepared proposal, system or plan. There is an intention to listen to responses and the potential for amendments to the proposal to be made. Those consulted do not share, but may influence, decision making.

The most successful community engagement comes through participatory planning and decision-making, where groups are fully consulted at all stages and on all questions. This may not be easy initially, but it can help ensure decisions are widely accepted in the long-run.



Public consultation through door to door visits (Hyder)

The different stages

When introducing new services, the education and engagement strategy must be staged and maintained over a period of time. There are a number of clear stages including:

- 1 Pre-launch communications
- 2 Information when the service is rolled out
- 3 A monitoring and evaluation program
- 4 On-going education and communications to householders throughout the life of the collection service.



Information brochure (The Hills Shire)

1 Pre-launch communications

Before introducing a food waste collection scheme, it is essential that all householders are provided with information about the new service. Pre-launch communication could include an information leaflet, advert or notice informing residents that a new service is being introduced; what the new service is; when it will be introduced and why; what types of organics householders will be able to recycle; and who to contact with queries (for example the number for a helpline, and a website address).

2 Information when the service is rolled out

To follow up after the pre-launch leaflet, councils should produce communications materials to support the launch of the service. This communication usually takes the form of a 'service leaflet' outlining how householders can participate (in terms of collection dates and what to do with their collection container), what types of organics householders will be able to recycle, who to contact if they have a query, and practical advice on how to make the most of the system and deal with any potential problems.

3 A monitoring and evaluation program

At the inception of the scheme a monitoring and evaluation program should be considered in order to establish a baseline from which outcomes from the scheme can be measured. It is also advisable to monitor and evaluate the effectiveness of the communication methods used. This will help ensure future communication activities benefit from lessons learned regarding ways of targeting different audiences, and the effectiveness of different formats for delivering a message.

4 On-going education and communications

It is also essential to continue education and communications to householders over regular intervals throughout the life of the organics collection service.

More information is provided in Factsheet 11 – *Community Education and Engagement*.

Case Study – Gippsland Regional Waste Management Group

The Gippsland Regional Waste Management Group (GRWMG) in Victoria encompasses the municipalities of Bass Coast, Baw Baw, East Gippsland, Latrobe, South Gippsland and Wellington Shires, covers an area that extends from Phillip Island to Mallacoota, and is home to about 250,000 urban and rural residents.

GRWMG received funding from Sustainability Victoria for a project that tested several strategies to reduce the amount of organics sent to landfill. Conducted in 2011, a key part of the project included a 6-month kerbside food organics collection trial for two different urban areas, testing both the collection and processing systems. A 6-month home composting and food waste avoidance program was also trialled in rural areas, in order to test the suitability of five different composting methods overall.

A range of different systems and approaches were tested because GRWMG recognised a one-size-fits-all approach would not work across its diverse community. The collection trials in the townships of Mallacoota and Churchill were designed because these communities already had access to a garden organics collection. The Home Composting program was conducted in Inverloch and Golden Beach, rural areas where a kerbside service was not economically feasible and avoidance of organics from the waste stream is a high priority.

In planning to conduct the trials, GRWMG acknowledged it was an organisation virtually unknown to the communities it was working with, which would cause issues in engaging residents to participate. To improve community buy-in to the project, the organisation consulted and collaborated with key community groups operating in those townships. During the roll-out, the local Rotary Club, Lions Club and Friends of Mallacoota groups were employed to conduct the door-to-door distribution of kitchen tidy bins and education packages. This was mutually beneficial as it improved interest in the objectives of the project, while supporting these local groups financially.

PLANNING YOUR SCHEME – **FACTSHEET 4** –
UNDERSTANDING COMMUNITY EDUCATION AND ENGAGEMENT

The trials also engaged the communities by working with local processors to test different methods of processing. A local cattle farmer accepted the food and garden waste material collected in the Mallacoota area and processed this in-kind during the trial. The farmer already produced compost using local by-products such as abalone offal and timber mill sawdust. Given the farmer was willing to test the low-tech 'City to Soil' method of composting (developed in the 'Groundswell' Project in southern NSW), the GRWMG provided the specialised inoculant and tarps required for this approach.

GRWMG found that, by working closely with the community in regards to both the collection and processing systems, the trial achieved a high participation rate, low contamination levels, and good results from the use of the end-product compost to improve local beef pastures. The trial was so successful that East Gippsland Shire Council continues to offer the service in Mallacoota and provide support to the processing of material.

Lessons Learnt: Gippsland Regional Waste Management Group demonstrated that cost-effective diversion of organics from landfill can be achieved in regional areas by engaging and collaborating with the local community and using a combined approach of source-separated food organics collection, low-cost local compost processing, and home composting.

Understanding the processing options

There were more than 187 organics processing facilities in Australia in 2009–10, handling over 5.8 million tonnes of organic residues between them. The feedstock to these facilities included 1.58 million tonnes of garden organics and 211,000 tonnes of food organics (not including food residues in MSW).

NSW and Victoria recycled the bulk of source separated food organics, accounting for 100,000 and 84,000 tonnes respectively. While many facilities were originally designed to process garden organics, most have been modified to enable them to handle other putrescible feedstock such as mixed garden and food organics (as well as other putrescible organic residues), without causing environmental nuisance or harm.

There are three general treatment options for organic residues: combustion (including gasification); composting; and anaerobic digestion. The most suitable method of treatment for a given application will depend largely on the chemical and physical properties of the materials being processed (see table below).

Combustion	Composting	Anaerobic Digestion
Wood		
	Tree & Shrub Prunings	
	Land Clearing	
	Vegetation Management	
	Park & Garden Residues (winter - summer)	
	Mixed Garden & Food Organics (rural - urban)	
	Commercial Organics	
	Kitchen Organics	
	Food Scraps	

Different processing options are better suited for different types of organics

As a general rule, organic residues with high carbon density and low moisture content (such as wood) are better suited to combustion whereas putrescible residues with high moisture content (such as food) are better suited for anaerobic digestion. These types of putrescible materials are also suitable for processing in vermiculture

operations, which is not the case for dry and woody material. A wide variety of materials can be composted, although not always on their own. The ability to blend dry and moist, carbon-rich and nutrient-rich materials, makes composting a very versatile processing option.

The choice of processing technology is primarily governed by:

- ✓ What outcomes council and the community expect to achieve
- ✓ Location and size of proposed site and associated environmental constraints
- ✓ Type and quantity of expected feedstock
- ✓ Investment and operating costs
- ✓ Type of products to be manufactured
- ✓ Sustainability issues (such as measured through LCA or carbon footprinting).

A critical aspect of choosing an appropriate processing technology is site location. Even fully enclosed composting facilities can result in odour complaints when poorly operated and located close to residential areas. Negative headlines (for example caused by odour emissions, biosecurity, contamination in output, water contamination, fire or technical problems) can be detrimental to community engagement efforts.

A general rule of thumb is that the more material that is processed at a site and the higher the proportion of putrescible residues (for example food organics, biosolids, food processing residues or liquids), the higher the risk for nuisance and environmental problems to occur.

In some jurisdictions licensing requirements will dictate the design of an organics processing system and may, for example, preclude the use of open, uncovered windrow composting for the co-composting of food organics.

Technologies for processing organics

Simple pile composting has been modified and developed over the last sixty years into various mechanised and sophisticated composting technologies. Over the years, many different composting systems were developed and offered in the market place, some of which have endured, while many others vanished. Nevertheless, the basic principles of composting remain unchanged, as the process is governed by the fundamentals of biological and biochemical processes.

In the *Practical Handbook of Compost Engineering*, composting is defined as the biological decomposition and stabilisation of organic substrates under aerobic and thermophilic (>45°C) conditions to produce a product that is stable, free of pathogens and plant seeds, and can be beneficially applied to land. There are seven general types of processing technologies for organics, as outlined below and further explained on the following pages.

- 1 Vermicomposting
- 2 Open windrow composting
- 3 Aerated static pile composting (with or without covers)
- 4 In-vessel composting (tunnel, box, vertical silo, drum)
- 5 Fully enclosed composting (agitated bed, agitated pile)
- 6 Anaerobic digestion (wet, dry)
- 7 Combustion (including pyrolysis and gasification).

Most organics processing facilities can be compartmentalised into pre-processing, processing and post-processing operations. In the case of composting facilities, pre-processing includes segregation of physical contaminants, size reduction of bulky materials, blending of different feedstock, and addition of water, microbial inoculants or other additives that are designed to improve the composting process or the finished product.

The composting process can be divided into a first, high-rate phase, and a second, curing phase. Many composting systems are organised along this divide. The first stage is characterised by high oxygen uptake rates, elevated temperatures, high consumption of easily degradable components, and high odour emission potential.

The second stage is characterised by lower temperatures, reduced oxygen demand and lower odour potential. Traditionally, the intensive composting phase has been more engineered and controlled due to the need to reduce odours, supply high aeration rates and maintain process control. The curing phase is usually less engineered and less process control is applied.

Post-processing in a composting facility can include screening and air-sifting, blending, adding performance enhancing components (nutrients, microorganisms), or pelletising.

Comparison of composting technologies

There are a number of factors councils need to consider when choosing a composting technology. A primary consideration will be investment and operating costs, and budgetary constraints. Other factors include the type and quantity of feedstock, site location and size, regulatory requirements, and anticipated product use. These considerations will vary according to the circumstances of a specific project and council. A brief comparison between different composting technologies is provided in the table below.

Technology	Aeration	Air purification	Investment cost	Land area required
Vermi-composting	Passive	No, but possible	Low to medium	Large to medium
Windrowing	Turning, passive aeration	No	Low	Very large
Aerated static pile	Positive/negative forced aeration	No, but possible	Medium	Medium
In-vessel composting	Agitation, mechanical turning, forced aeration	Yes, but exceptions	Large	Medium to small
Fully enclosed composting	Agitation, mechanical turning, forced aeration	Yes	Very large	Medium to small

The following aspects need to be considered when assessing and comparing different processing technologies:

- ✓ Investment costs (\$ / tonne throughput)
- ✓ Operating costs (\$ / tonne throughput)
- ✓ Operational experience
- ✓ Options for process management
- ✓ Options for achieving desired product quality
- ✓ Risk of emitting odour / bio-aerosols and releasing leachate
- ✓ Ability to process different feedstock
- ✓ Options for expanding processing capacity
- ✓ Footprint (tonne annual throughput per square meter)
- ✓ Energy and water use.

Investment and operating costs

Although investment and operating costs are usually among the most important factors in deciding for or against a certain processing technology, this information is rarely available in the public domain. Processing costs and gate-fees for composting are commercially sensitive, and therefore not publicly divulged.

Costs for composting vary greatly, depending on the type of materials processed, annual throughput, the type of technology employed, and the kind of products generated. Data suggest that costs for composting range between \$25 and \$130 per tonne (note that processing cost may be different to gate-fee charged). Composting of garden organics alone incurs significantly lower costs than co-composting of garden organics with food or other putrescible materials.

Type and quality of product

The choice of processing technology determines, at a macro level, the type of products that are being generated. Fundamentally, the various processing technologies generate the following products:

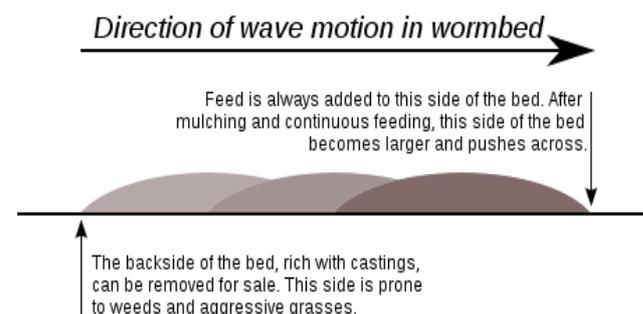
Technology	Product
Vermicomposting	Vermicast, possibly worm liquid
Composting	Compost of different maturity stages and particle size grading
Anaerobic digestion	Digestate (liquid) or digested residues, biogas
Combustion	Ash, heat energy
Gasification	Liquid, solid (char) and gaseous (syngas) products

As in many other manufacturing processes, the raw materials used in organics processing operations largely determine the quality of the finished product. Recycled organic products manufactured from source separated organics have shown low levels of physical and chemical contamination. These products therefore have wide potential application and the chance of being accepted in a wide variety of markets. The use of recycled organic products with low contaminant levels is central to developing agricultural and horticultural markets, and also for minimising soil contamination.

1 Vermicomposting

Large-scale vermicomposting is practised in various countries, and has been explored in Australia. At the turn of the century, there were four or five large vermicomposting operations processing municipal organics (biosolids, garden and food organics) and animal manures. However, today we understand there is only one such operation left in Australia, in Broken Hill. Fundamentally, vermicomposting requires a higher level of management and is less forgiving than windrow composting.

There are two main methods of large-scale vermicomposting: In the extending windrow system, small piles of organic material are provided for worms. More organic material is added to the pile continuously (see diagram).



The second type of large-scale vermicomposting, which is considered 'state-of-the-art', is the raised bed or flow-through system. Here the worms are fed by regularly adding a thin layer of fresh material across the top of the bed, which is subsequently harvested from the base of the suspended bed.

The vermicomposting facility in Broken Hill employs less sophisticated technology and incorporates windrow composting into the operation as a means of ensuring the finished product is pasteurised.

2 Open Windrow Composting

Open windrow composting is employed by the vast majority of organics processing facilities in Australia, and indeed the world. Open windrow composting is very widely used because it is relatively cheap, flexible and reliable as a means of processing and stabilising organic residues.

The downside of windrow composting is that it offers limited process control, which increases environmental risks, particularly odour and leachate emissions. Open windrow composting is obviously difficult in high rainfall areas. This problem can be alleviated by either using windrow covers, or by (partially) covering the operation with a roof.

In windrow composting, raw materials are set up in long rows that are then turned regularly, either with front end loaders or dedicated windrow turners. The type of turning equipment used determines the size of rows, and hence the area required for processing a given quantity of input material. Compared to other processing options, windrow composting has a relatively low throughput per unit surface area, which means demand for land is relatively high. On the other hand, investment and operating costs are relatively low, making windrow composting often the only organics processing technology able to compete with low landfill costs.

3 Aerated Static Pile Composting

Aerated static pile composting was originally developed for composting biosolids in North America. In aerated static pile composting, organic residues are mixed together in one large pile, instead of rows. To aerate the material, the piles are placed over a network of pipes that deliver air into (or draw air out of) the pile. Aeration can be via permanent sub-surface channels, or via mobile pipes that are located above ground. Air blowers might be activated by a timer or temperature/oxygen sensors.

Aerated static pile composting is suitable for a relatively homogenous mix of organic residues with acceptable moisture, bulk density and porosity characteristics. According to the US EPA, this technology should work well for composting garden and food organics, but not so well for processing animal by-products or grease from food processing industries.

Temperatures in the outside layer of the piles do not reach levels that ensure elimination of pathogens and weed seeds. This can be overcome by (i) physical turning of the pile, (ii) windrowing before or after static pile composting, (iii) covering the pile with finished compost or compost covers.

Aerated static pile composting typically requires equipment such as blowers, pipes, sensors, and access to electricity, which can be generated on site, or off the grid. The controlled supply of air enables construction of large piles (governed by material characteristics), which results in increased processing capacity per unit of land.

An example of a larger scale system utilising an aerated, static pile is the SITA Australia BioWise organics processing facility in Kwinana (WA), which has the capacity to process up to 50,000 tonnes per year of organic material.

Over the last five or so years, several composting operations in Australia have integrated static aerated pile composting into their operations. Custom Composts (WA), Peats Soil and Garden Supplies (SA) and Pinegro Products (VIC), for example, employ an above ground mobile forced aeration system, while Jeffries (SA) opted for a non-mobile static aeration system. These companies use static aerated piles to compost kerbside collected organics, bark, manures and biosolids.

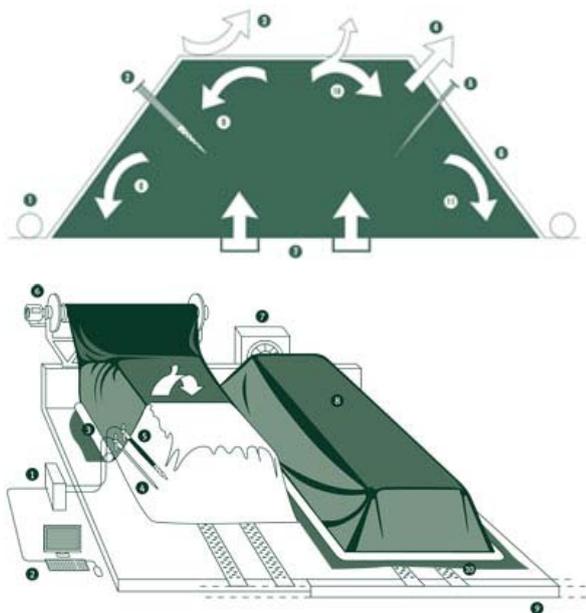


Establishing a mobile aerated floor (MAF) composting pile

3.1 Covered Aerated Pile Composting

The use of semi-permeable compost covers alleviates some of the potential problems associated with static aerated piles, such as drying out, rain water penetration, odour and bio-aerosol emission, and non-pasteurisation of the outer layer of the pile.

Examples of technologies that are utilised in covered static pile aerated composting include GORE-TEX Covers and the MOR Compost Cover Technology. In both cases the covers are provided as part of a complete composting system, including covers, cover handling equipment, an aeration system, monitoring equipment, and software for managing the system. These covers protect the composting material from the penetration of rainwater, while allowing CO₂ to escape. Condensation on the inside of the covers helps manage odours and other gaseous substances, while also reducing pathogenic microbes through better temperature control.



Principle of a GORE-TEX Cover in an aerated static pile (top) and schematic view of operational GORE-TEX composting system (bottom)

Timaru District Council in New Zealand established the first (and so far only) GORE-TEX Cover composting facility in the Southern Hemisphere in 2006, processing source segregated garden and kitchen organics.

4 In-vessel Composting

When in-vessel composting (IVC) systems are used, organic materials are fed into a drum, silo, tunnel, box or similar container where the initial, intensive composting process takes place in controlled environmental conditions (temperature, moisture, and aeration).

These IVC systems usually employ forced aeration or a mechanism to turn or agitate the material (or both) to facilitate proper aeration and process conditions. Materials are generally premixed before being loaded in the vessel. This must be done very thoroughly where no agitation occurs during the in-vessel composting phase.

Materials are typically processed 'in-vessel' for periods between one and three weeks before they are further composted and cured in (aerated) windrows or static piles. Most facilities with in-vessel containers only use them for the first phase of the composting process, where process control is critical. Using containers for the entire composting process would be costly. IVC equipment can be located in the open, or it can be housed fully or partly in a building to contain odours being generated during unloading and pre-processing of organic residues.

A wide range of IVC systems are available in the market place. They mainly vary in the type of vessel employed, size, aeration/agitation method, and details such as the control devices, loading equipment and leachate management approach used.

4.1 Tunnel Composting Systems

Tunnel composting systems are essentially long aerated concrete containers that can be closed, have forced aeration through a floor plenum, and allow for internal air circulation. They are loaded and unloaded from one end and operate in batch mode after the tunnel is fully loaded. Materials are loaded and unloaded either with front-end loaders or fully automated conveyer systems.

A number of tunnel composting facilities operate in Australia. Since 2000, Natural Recovery Systems has operated a tunnel composting facility in Dandenong, Victoria. The facility has five units and recycles a range of garden and food organics. The SITA SAWT facility at Kemps Creek, NSW, operates 8 to 10 tunnels (depending on incoming quantities) that are dedicated to processing source separated food and garden organics from Penrith City Council. The SAWT facility processes around 35,000 tpa of organic residues, including sludges. SITA also operates a 10-tunnel composting facility at its Spring Farm Advanced Resource Recovery Park in South-Western Sydney, which processes 30,000 tpa of garden organics from the Macarthur Regional Organisation of Councils (MACROC).

The Remondis Organic Resource Recovery Facility (ORRF) in Port Macquarie receives source separated organics from Port Macquarie Hastings Shire Council, which is shredded and blended with biosolids and loaded into one of eight tunnels.

Western Composting Technology processes domestic organic residues in a tunnel composting facility in Shepparton, Victoria. The facility is licensed to accept 2,000 tpa, but the modular nature of the operation (partially precast concrete tunnel) makes it easy to progressively increase throughput as the supply in the region increases.



Inside a composting tunnel with aeration channels

4.2 Box and Container Composting Systems

Box and container composting is fundamentally identical to tunnel composting. Boxes and containers, however, are smaller and tend not to be in enclosed buildings. Containers are mobile and can also be used for transporting organic residues from disposal points to the composting site. If a roll-on roll-off system is used, containers can be easily transported and emptied at the point of further processing.

As far as the authors are aware, no commercial box or container composting systems are currently operated in Australia or New Zealand. Nevertheless, the Herhof Box Composting System and the BIODEGMA Box Composting System, for example, are used widely in Europe, while Green Mountain Technologies supplies the North American market with its Containerised Compost System.



Containerised composting system

4.3 Vertical Composting Silos

Vertical composting units (VCU) are typically tall silos in which the organic material is contained in a vertical 'chamber' with a grid or perforated base that enables air to flow through. VCUs do not have forced aeration, with air flow instead driven by temperature gradients. The advantage of VCUs is their small physical foot print and energy efficiency. VCUs do not require agitation, bio-filtration, external heating or air injection. With minimal moving components, maintenance and operating costs are also very low.

The VCU prototype was tested at Long Bay Correction Centre (Malabar, NSW) in the mid-1990s, with subsequent units being established at the University of NSW (composting of catering residues) and at Lord Howe Island (composting of septic tank waste and food organics). Sydney's Royal Botanic Gardens uses a VCU to convert vegetation residues into compost. Waitakere City Council in New Zealand installed a 10 chamber plant in 2001, benefiting from the VCU's small footprint on their urban site. Wingecarribee Shire Council (NSW) trialled a 3,000 tpa VCU system in 2003, but did not retain it. Today, VCUs are primarily installed and operated in Europe.

4.4 Rotating Drum Composting Systems

There is no composting facility in Australia that employs Rotating Drum Composting technology for the processing of source segregated garden and kitchen organics. However, three Bedminster facilities in Port Stephens (NSW), Cairns (QLD) and Perth (WA) use composting drums for the processing of organics contained in household residual waste.

4.5 Other In-vessel Composting Systems

The HotRot composting unit is a longitudinal, fully enclosed continuous in-vessel composting module. Each unit incorporates a u-shaped concrete hull section with a sealed lid. A central tine bearing shaft runs longitudinally through the vessel. This shaft rotates periodically and slowly, mixing, and assisting with aeration and the physical breakdown of the composted material. Grinding or shredding of food and animal residues can generally be avoided.

In 2005 Selwyn District Council (New Zealand) bought two HotRot composting units to service its initial move into kerbside collection of garden and household organics. The Australian National University (ANU) in Canberra installed an 800 tpa HotRot unit on an 18 month trial basis in 2007. In early 2012, Melbourne Zoo installed a HotRot composting unit and feed system to manage animal bedding and other organic materials generated around the grounds.



Two medium size HotRot composting units

5 Fully Enclosed Composting

Fully enclosed composting systems represent technologies where composting takes place in a large building or section of a building, without containing the material in a separate, enclosed composting vessel. The pre-processed organic material is typically fed into the system at one end, and the compost is extracted at the other end. This flow-through system, enhanced by agitation and turning, minimises loss of production capacity due to volume reduction during the composting process.

Fully enclosed composting systems usually employ underfloor negative aeration to reduce condensation in the composting hall, while also extracting exhaust air overhead. Ducting for under-floor aeration and leachate collection is often combined, but can be cause for problems.

5.1 Agitated Bed Composting Systems

In agitated bed composting systems, organic residues are composted in 'beds' contained by long channels with concrete walls. A turning machine, travelling on top of the beds, agitates and moves the materials forward. Forced aeration is provided through the floor of the channel. As the top of the channel is open, agitated beds are usually located in an enclosed building. To reduce the volume of exhaust air to be deodorised and to improve working conditions inside the building (such as during loading and unloading operations), some systems have plastic curtains around the perimeter of the bays (and in some cases a further 'drop ceiling'). These measures also help to contain the moisture and ammonia being released from the composting materials, which contribute to corrosion of the building.

The Biomass Facility at Coffs Harbour (NSW) processes 55,000 tpa of garden organics, food organics and biosolids in an agitated bed composting system. Physical contaminants are removed from the incoming organic materials in the receival hall. In the composting hall, decontaminated material is composted in agitated beds for 21 days.

5.2 Agitated Pile Composting Systems

Enclosed agitated pile composting is very similar to agitated bed composting systems, except that there are only one or two very large rectangular beds. Feedstock is loaded into the composting hall at one end, and is extracted at the other end.

Starting at the discharge end the agitator / turner moves along the pile, discharging composted material for removal from the hall while turning and moving material in the process. With each pass, material is displaced a set distance (1–4m) toward the discharge side of the composting hall. Pile dimensions, turning frequency, and the distance the material is moved when turned determine the composting period in the hall. Loading and unloading of the hall, as well as agitation / turning, are fully automated processes without staff having to enter the composting hall.

There is no composting facility in Australia that employs this type of technology for the processing of source segregated garden and kitchen organics. However, Global Renewables' UR-3R facility at Eastern Creek (NSW) uses an agitated pile composting system for the processing of organics contained in household residual waste.

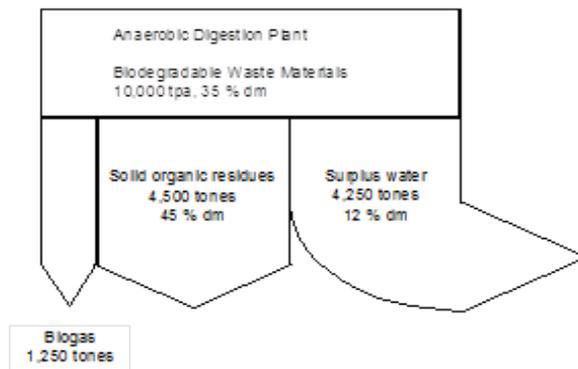
6 Anaerobic Digestion

Anaerobic digestion breaks down organic carbon compounds in an environment that is devoid of oxygen (O₂) and nitrate (NO₃). Anaerobic digestion is a sequential process, which happens in four steps—hydrolysis, acidification, acetogenesis, and methanogenesis. The process generates biogas, containing 50–75% methane (CH₄).

Anaerobic digestion has become a popular choice for treating organic residues in various European countries, and to a lesser degree in North America. The rapid development of anaerobic digestion in European countries is driven by whole-of-government policy settings and significant subsidies for energy generation from renewable resources. Many municipal composting

operations are retrofitted with an additional anaerobic digestion plant.

The main benefit of operating anaerobic digestion plants is that energy can be recovered from organic residues in the form of methane-rich biogas, which can be used to generate renewable power and/or heat. At the same time, solid organic matter (digestate / compost) and plant nutrients are retained and available for land management purposes.



Example of material flow in a dry anaerobic digestion facility that processes mixed garden and food organics

In Australia, anaerobic digestion is primarily used in wastewater treatment plants, food processing operations, and in a piggery (Berrybank, Victoria). Biogas, or landfill gas, is also harvested at more than 60 landfills.

The EarthPower facility in Camellia (NSW) uses wet digestion technology to process various organic residues including source segregated foods and food based residue streams from domestic, commercial and industrial food preparation, processing and consumer activities. When the facility is operational, feedstock arrives in various forms including raw, cooked or processed meats, fruit and vegetables, dairy products, confectionary, bakery products, cereals and grains.

A trial to process combined food and garden residues from Woollahra Council at the EarthPower facility in 2007 was unsuccessful as the woody material caused problems for the system. Leichardt City Council has also trialled processing of food organics at EarthPower.

There are two processing facilities in Australia that have the capacity to use anaerobic digestion for generating biogas from the organic fraction contained in MSW; the Anaeco facility in Perth (WA) and SITA's facility at Jacks Gully (NSW). In each case anaerobic digestion is part of a comprehensive mechanical-biological treatment (MBT) system for unsorted municipal waste.

7 Energy Generation Technologies

Biomass can be converted into energy (heat or electricity) or energy carriers (charcoal, oil, or gas) using both thermochemical and biochemical conversion technologies. Combustion is the most developed and most frequently applied process used for solid biomass fuels – mainly because of its low costs and high reliability – but other technologies, such as gasification, are also becoming available.

7.1 Combustion

By far the most common means of converting biomass to usable heat energy is through straightforward combustion, and this accounts for around 90% of all energy attained from biomass. There are a number of different technologies that can be used for biomass combustion, the main ones being fixed bed and fluidised bed combustion systems.

Different combustion technologies are available to deal with various fuel qualities – less homogeneous and low-quality fuels need more sophisticated combustion systems. For 'economy of scale' reasons, only medium and large-scale systems are suitable for using low quality and cheap biofuels, such as processed and graded garden organics or wood waste.

Co-firing biomass with coal in traditional coal-fired boilers is becoming increasingly popular, as it capitalises on existing investment and infrastructure, while reducing emission of pollutants and net greenhouse gas. Power plants in Lithgow, Liddell and Lake Macquarie (NSW), for example, currently supplement coal with relatively small volumes of wood residues. Biomass energy plants often use different types of fuel to overcome seasonality of supplies and also to minimize supply risks.

Several sugar mills in Queensland and NSW are now complementing bagasse with forestry

residues and woody municipal residues for co-firing their boilers year round.

7.2 Gasification

Gasification is a process that converts carbon-based materials into synthetic gas (syngas). Gasification is achieved by reacting the organic material in a closed reactor at high temperatures (>700°C), without combustion, and with a controlled amount of oxygen and/or steam. The three main gasification technologies are fast pyrolysis, carbonisation and gasification. Each process produces different proportions of liquid, solid and gas in the end product (see table below).

	Liquid	Char	Gas
Fast Pyrolysis	75%	12%	13%
	moderate temperature short residence time		
Carbonisation	30%	35%	35%
	low temperature long residence time		
Gasification	5%	10%	85%
	high temperature long residence time		

A gasification system typically consists of four main stages: (i) feeding, including drying and storage, (ii) gasifier reactor, (iii) gas cleaning (mainly tar removal), and (iv) utilisation of the generated gas.

There are three primary varieties of gasification technologies, namely updraft and downdraft fixed bed gasifiers, as well as fluidized bed gasifiers.

The possibility of using syngas in a variety of ways makes biomass gasification a very interesting technology. Using the syngas is potentially more efficient than direct combustion of the original fuel because it can be combusted at higher temperatures or even in fuel cells. Syngas may be burned directly in gas engines, used to produce methanol and hydrogen, or converted into synthetic fuel.

Pyrolysis is a form of gasification that is relatively well known and advanced in Australia. Slow pyrolysis technology produces solid (charcoal), liquid (bio-oil), and gas (medium BTU) from biomass, in almost equal measures.

Slow pyrolysis, or carbonisation, creates the highest proportion of char, which can be used as a soil amendment for carbon sequestration to mitigate climate change. This appears to be the main focus of pyrolysing biomass in Australia. Pacific Pyrolysis, which is currently building Australia's first commercial biomass pyrolysis plant in Melbourne, makes relatively little mention of gas or electricity generation, and no mention at all of liquid bio-oil. Pacific Pyrolysis says its technology can deliver thermal or electrical energy outcomes in a modular format, which can be scaled depending upon the availability of feedstock and product markets. Energy output is directly linked to factors such as volume, type and moisture of feedstock.

The company's slow pyrolysis technology claims to be advantageous when dealing with:

- ✓ Low grade feedstock with a combination of high ash content, low ash melting points, high moisture content and varying and large particle size, including for example paper and waste water sludge, municipal green waste, animal manures, and crop residues
- ✓ Variability in feedstock supplies caused by seasonality or uncommitted feedstock
- ✓ The need for multiple revenue streams to de-risk the project from an over-reliance on any one type of revenue (i.e. gate fees, energy and/or biochar sales)
- ✓ Low emissions profile
- ✓ Agricultural or horticultural demand for biochar products.

Understanding the possible risks

This factsheet discusses the risks that might arise when introducing an organics collection service and includes a risk matrix outlining the potential risks and possible mitigation measures, as well as lessons learnt from other councils on what and what not to do.

Circumstances that might impact negatively on a food and garden organics collection service may include the following (bold formatting indicates extreme and high risks):

- ✓ Inadequate project management
- ✓ Poor communication
- ✓ Bungled roll-out of service
- ✓ Difficult properties
- ✓ **Householders not participating**
- ✓ **Contamination**
- ✓ **Nuisance factors (vermin, pests, malodours)**
- ✓ Impact of home composting
- ✓ Contractual issues
- ✓ **Cost overruns**
- ✓ **Lack of demand for generated products.**

1 Inadequate project management

Planning and introducing an organics kerbside collection service, possibly in conjunction with other changes to waste management and recycling service delivery, requires proper project management. Once the decision is made to provide an organics collection service, a period of at least 12 to 18 months is generally needed for planning and introducing the scheme, possibly including the following tasks:

- ✓ Purchasing / leasing additional vehicles (if in-house service is provided) or negotiating a new collection contract
- ✓ Designing collection routes and calendars for organics and residual waste

- ✓ Selecting and purchasing collection bins, kitchen caddies and possible liners and education material
- ✓ Delivering bins, kitchen caddies and liners
- ✓ Developing and delivering a communications and education strategy, including design of print media, and establishment of feedback lines
- ✓ Establishing a licensed processing facility or negotiating a processing contract with skilled operational staff, ensuring adequate capacity for expected demand
- ✓ Developing a monitoring and evaluation plan including contamination management.

Project management includes resource planning (finance and staff) as well as the development and controlling of a detailed project management plan.

2 Poor communication

The success of source separation recycling schemes will largely depend on the active support of waste generators. Consequently, it is of utmost importance that residents are well informed about the new organics collection scheme, and motivated to actively participate. It can be difficult to rectify problems caused by lack of information or misinformation among residents.

The communications and community engagement strategy needs to be long-term, which means coming into effect well before the scheme starts and continuing throughout the scheme to maintain participation levels and the quality of collected materials.

Community Education and Engagement is further discussed in Factsheet 4 and Factsheet 11.

3 Bungled roll-out

It is important that the roll-out of the service (such as delivery of bins, caddies and information material) runs smoothly and legitimate grievances of residents are dealt with promptly. Major problems with the roll-out, or the first collections, can result in dissatisfied residents and negative press, putting at risk the success of the organics recycling scheme, at least in the short term.

4 Difficult properties

Flats, apartments and other multiunit dwellings (MUDs) need special consideration for organics recycling services. This concerns primarily collection of food organics.

Food organics collections in MUDs present a number of additional challenges including:

- ✓ Smaller kitchens – householders often have less space to sort and separately store food scraps and therefore may not want a bench top kitchen caddy for organics in the kitchen.
- ✓ Remote waste storage areas – residents usually have to carry recyclables downstairs to a room / area where shared bulk bins are located. A non-leaking and non-tearing, easy to carry container or compostable liner bag will be needed.
- ✓ Food organics dominate – organics collected from MUDs will be comprised primarily of food organics with little or no garden material
- ✓ No existing organics service – MUDs often have limited or no existing service for garden organics. If an existing garden organics service is expanded to include food scraps, additional bins have to be provided to MUDs and collection routes have to be modified to cater for the additional pick-ups.
- ✓ Matching bin numbers to generated waste and recycling volumes – occupants of MUDs often share bulk bins. While use of a food organics service will decrease the need for residual waste storage, balancing the numbers of different bins to maximise recovery and minimise contamination may be difficult.
- ✓ Excessive weight of organics bin – food organics have high bulk density and a full 240L bin containing food organics may be too heavy to easily manoeuvre within the shared waste storage area or wheel to the collection point.
- ✓ Shared bins – householders may feel discouraged from using the service if others within the building do not also use the service and take care with contamination and cleanliness of the shared bins.

It might also be particularly difficult to establish an organics collection service at properties with transient populations, such as holiday lettings or short term accommodation.

Considerations regarding collection efficiencies (kg of collected material per driven km) forces non-metropolitan councils to decide how far out of town they want to extend the organics collection service. Some rural properties do not receive any kind of waste and recycling collection service, but there is also a view that people living on acreage do not need an organics collection service, as they can utilise most or all organic residues on site. However, there might be occasions when householders that are excluded from receiving the organics collection service complain about this fact, particularly if they feel they are paying for this service through their council rates.

Councils may be able counter potential criticism by actively supporting home composting and on-site organics recycling, particularly for those properties that do not have access to the organics collection service. This could be done for example by providing free kitchen tidies and/or subsidised compost bins, encouraging conservation gardening, or facilitating the hiring of garden shredders at reduced rates.



Multiunit dwellings (Hyder)

5 Householders not participating

As with any source separation recycling system, the success of an organics collection scheme depends on the support and active participation of residents. Participation rates and impurity levels often reflect the level of community support a recycling scheme has. The level of support for organics recycling can be boosted by:

- ✓ No additional direct charges for organics collection service
- ✓ Convenient collection service
- ✓ Supply of kitchen caddy and compostable bags
- ✓ Long-term communication with the community
- ✓ Helping the community understand the need for and benefits of an organics collection scheme.

Voluntary organics recycling schemes naturally have lower participation rates than schemes where bins are delivered to every household. Several councils in South East Queensland offer voluntary garden organics collection schemes under a user-pays scheme, with participation rates between 5–40%. Voluntary schemes usually have higher collection yields per participating household, but overall diversion of organics from landfill is lower and efficiency of collection is lower.

Even when participation is compulsory (therefore every household has to have an organics bin), very few councils have a bylaw prohibiting residents from putting organics in their residual rubbish. In other words, organics diversion is voluntary at the household level, and probably with good reason, as it cannot be ‘policed’.

Socio economic and other factors also impact on participation levels. For example, residents living in semi-rural areas or on acreage often do not see the need for an organics collection service. If such households accept an organics bin, they might use it only infrequently. Hence, there are two aspects to householder participation, and both need to be high for satisfactory outcomes:

- ✓ Delivery of organics bins and kitchen caddies
- ✓ Use of the delivered kitchen caddies and bins (set out rate).

Many kerbside organics collection schemes and trials in Australia have been characterised by average levels of participation of approximately 60%. This is similar to data from Germany, which shows 55% to 60% of all residents in local government areas with compulsory garden and kitchen organics collection schemes actually participate in these schemes.

6 Contamination

Collection of source separated organics was pioneered in Europe in the early to mid-1980s to enable production of high quality soil amendments. When going through the trouble and expense of establishing an organics collection service for this purpose, it is important that the collected material contains low levels of physical impurities, such as plastic, glass, metals, or rocks. The level of physical contamination is often mirrored by the level of chemical contamination. Collecting material with low impurity levels helps to decrease processing costs associated with decontamination efforts, ensures the product meets regulatory requirements, and aids the marketability and use of compost products without causing detrimental effects to the user or the environment.



Contamination tag for kerbside bin (WRAP UK)

Contamination is less of a problem in garden organics collection schemes, with impurity levels generally being below 1% by weight. Combined garden and food organics usually harbour more impurities, possibly up to 10% or more. However, there are also examples where co-collected garden and food organics are very clean with less than 1% impurities.

Various types of plastic are usually the main contaminants in source segregated organics, with plastic bags being dominant in material that contains food residues. Plastic bags may sometimes be used by residents to line bench top kitchen caddies and the organics bin. Residents may not use compostable bags for reasons including they:

- ✓ Received inadequate information about which bags they should use
- ✓ Are unable to identify compostable bags and/or differentiate between compostable, degradable and biodegradable bags
- ✓ Are unable to get compostable bags at their local shops
- ✓ Do not want to pay extra for compostable bags.



Contamination (WRAP UK)

Contamination management is further discussed in the risk matrix at the end of this section and in Factsheet 12 – *Contamination Management* (part of the *Implementing Your Scheme* section).

7 Nuisance factors (vermin, pests and odours)

Residents' negative experience with malodours, seepage, flies and maggots are probably the most important issues undermining the long-term support for organics collection schemes. Although grass clippings can become smelly and create seepage if they sit in the organics bin for too long, most nuisance problems are associated with collecting food organics. In a food and garden organics collection scheme, common complaints are about flies (they are usually small fruit flies or vinegar flies), odours and seepage.

In many cases councils try to minimise these problems by providing aerated caddies and compostable bags that allow gas exchange.

Aerated caddies and adequate emptying intervals (1–3 times per week) should minimise unpleasant odours in the kitchen. If flies (and maggots) are the main problem, this can be alleviated by using a non-perforated kitchen container with a close fitting lid. In that case residents can be given the choice of using newspaper in the base of the container, or to purchasing compostable bags (or both). Newspaper absorbs liquids and seepage, and makes it easier to keep the kitchen container clean.

Odour from the kerbside collection bin is generally less of a problem, except for when no garden material is collected, for example in MUDs and during winter. Councils have the option of using aerated kerbside collection bins to reduce odour risks. Seepage can escape from aerated bins when emptied, especially if they contain only wet kitchen organics. Tying the top of compostable bags, or wrapping food scraps in newspaper, will help prevent this from occurring. Venting systems can often be retrofitted to existing bins or incorporated at the time of manufacture. There are also bin odour/moisture control products available on the market.

Kerbside collection bins can, over time, become soiled and smelly, particularly when food residues are not contained in compostable bags or rolled in newspaper. Compostable bin liners can be used to keep the bin clean. Local bin cleaning services and information on how to clean bins without causing stormwater pollution should be made available.

Lids that fit the kerbside bin body and are kept closed decrease the opportunities for pests and vermin. Not all householders, or waste collection staff, ensure bin lids are kept closed, so education and change of behaviour may be required. Maintenance staff may also be needed to ensure damaged bin lids and ill-fitting lids are quickly replaced. Products such as gravity locks may be of use in areas where possums or dogs are adept at scavenging from bins. However, vermin (mice, rats) are not a common problem with organics collection schemes, where materials are held in plastic containers until collected.



Maggots in compost bin (Hyder)

The frequency of emptying containers (both the kitchen caddy and the kerbside collection bin) is the key to managing many nuisance factors. Most householders empty their caddy between 1–3 times per week, depending on what goes into it. Kerbside organics bins are emptied either weekly or fortnightly, also depending on what goes into it. Garden organics collection schemes commonly employ a fortnightly collection routine, while schemes that co-collect food organics usually have weekly collection intervals. To reduce collection costs, while still managing nuisance factors, councils may possibly opt for weekly collection of garden and food organics in summer, and fortnightly collection in winter.

The decision to have a proactive or reactive strategy for vermin, pests and smells, and whether to initiate local government wide actions or address issues on a house by house basis, will depend on factors including community support for the service, as well as the available budget and resources. These decisions should be considered in the early planning stages of a new organics service.

8 Home composting

On-site management and use of organic garden and kitchen residues through home composting, worm farming or using a ‘Bokashi bucket’ system (jointly referred to as home composting) can be economically and environmentally superior to a centralised organics collection service. Council support for on-site management and use of organics should continue even after introducing an organics collection service.

Well supported home composting schemes, which are widely adopted in a community, offer an important means for reducing organics going to landfill, and to reduce organics quantities that need to be collected, processed and marketed.

Waste minimisation through on-site management and use is notoriously difficult to quantify, and the impacts are usually not accounted for when council-wide organics diversion rates represent a key performance indicator (KPI). The impact may be important when KPIs are expressed in absolute (tonnes organics to landfill) or relative (per cent organics in landfilled waste) terms.

Compared to home composting, many households find a kerbside organics collection service a more convenient and easier option to manage organics. Therefore, a certain proportion of households will give up home composting when a kerbside organics collection service is introduced. Consequently, quantities of organics collected through a kerbside scheme are usually higher than what waste analyses prior to system introduction may suggest.

9 Contractual issues

Depending on the extent to which councils outsource the establishment and operation of an organics collection scheme, the following goods and services might be sourced externally:

- ✓ Project management and introduction of the scheme, including public education, media management, hot line staffing, bin delivery and database management
- ✓ Supply of equipment including organics collection bins, kitchen caddies and possibly compostable bags
- ✓ Provision of organics collection services
- ✓ Provision of organics processing and marketing services.

Planning and implementing a new organics collection scheme represents a significant temporary additional workload for council staff, which may be eased by outsourcing some or all of the associated tasks.

The supply of organics bins and kitchen caddies (and possibly compostable bags) can be combined into one contract. The supply contract has to allow for some degree of flexibility, as the final number of bins and caddies needed depends on the number of households participating in the scheme. This number is particularly difficult to estimate when a voluntary scheme is introduced. If delivery of bins to the premises of participating households is part of the supply contract, clarification is required if kitchen caddies and information brochures can be delivered at the same time.

Alternatively, if a council opts for an intensive public education campaign with door step visits to each household, kitchen caddies and information brochures can be delivered at this occasion.

In either case, provisions have to be made for picking up bins and caddies that were delivered but are not wanted by residents as well as for the replacement of lost, stolen or damaged bins.

Contractual arrangements governing the collection of source segregated organics in a local government area may be part of a wider contract that covers the collection of all waste and recycling materials from residential properties. The organics collection contract may therefore be subject to all standard KPIs related to the collection of recycling materials. Additional contractor costs associated with introducing organics collection, such as vehicle modifications, would have to be considered and addressed.

Unpredictable participation and growth rates in voluntary collection schemes make planning, resource allocation and contractual arrangements difficult. As far as possible, the contract needs to facilitate co-operation between the contractor, council and the organics processor to identify and rectify collection related problems, particularly contamination of organic materials. Minimisation of impurities needs to be a shared responsibility between council, the contractor and the organics processor.

A simple supply contract that specifies type of material supplied, quality characteristics including maximum impurity levels (optional), estimated quantities, unit costs (\$ per tonne or cubic metre) and duration of contract may suffice, if the collected organic materials can be delivered to an existing processing facility. Supply contracts become more complicated when a facility is built specifically for processing material from a kerbside organics collection scheme that has yet to be introduced. Such contracts are usually long-term (10+ years) and specify minimum quantities that have to be supplied. If several councils join to build a processing facility, contracts often become much more complex again.

It is usually the responsibility of the processor to ensure the generated recycled organic products are sold and/or utilised beneficially. Sales and marketing arrangements for recycled organic products are therefore usually not subject to a separate contract. However, the processing contract might specify minimum annual quantities and qualities of compost products council will use internally. There might also be a general requirement that all generated products meet at least Australian Standard AS 4454-2012 quality specifications. If specific cooperative marketing arrangements are pursued, for example exclusive supply of pasteurised compost to farmers, a council may want to benefit from lower processing costs. Such arrangements need to be agreed contractually. On the other hand, where the processor carries the risk of not being able to sell the generated products (or at least not at the desired price) these risks need to be compensated, usually via a higher contract price for the council.

10 Cost Overruns

Careful planning with good contingency plans and flexible contracts can help prevent costs exceeding budget forecasts. However, unexpected additional costs may still be incurred, for example in the following instances:

- ✓ Need for additional community information and education
- ✓ Higher than expected participation resulting in increased purchase of bins and kitchen caddies, and also higher collection costs
- ✓ Higher than expected collection yields resulting in higher processing costs, and possibly also in higher collection costs
- ✓ Lower than expected collection yields might result in contract penalties
- ✓ Higher than expected contamination levels may require extra information and education measures, and may also result in higher processing costs and/or contract penalties
- ✓ Slow sales of generated recycled organic products may require support measures, such as increased use by council, market development aid, or higher processing fees
- ✓ Failure of the selected processing technology could certainly result in a cost blow-out, even if the liability is not directly with council.



Compost (Hyder)

11 Lack of demand for generated products

Many operators would attest that it is easy to make compost, but not so easy to sell it. The key determinants for the sale of recycled organic products are price, quality, product knowledge, and market access to competing products. High quality products have a wider range of potential uses than lower quality products, increasing the chance of developing strong market demand. However, manufacturing of high quality products alone is not a guarantee for the sale and use of all generated material. Considerable marketing efforts are usually required to develop potential markets.

As market development is a long-term undertaking, a council may want to consider preventing the build-up of stockpiles by using large, but declining compost and mulch quantities over the first two or three years of operation, until viable local markets are established.

The urban amenity market is currently absorbing by far the most recycled organic product in Australia. This is the case as most organic recycling schemes are established in urban centres, but also because this market has much higher propensity to pay for products, than say agricultural or rehabilitation markets. Rural and regional composting operations may have to focus more on agricultural and horticultural markets.

Considerable efforts have been made across Australia to demonstrate the efficacy of various recycled organic products in agricultural and horticultural applications. Many scientific and demonstration trials in vegetables, floriculture and perennial crops have shown that compost products provide tangible agronomic and economic benefits compared to standard farming practices. Nevertheless, many farmers are still reluctant to use recycled organic products, which can be for reasons such as:

- ✓ Lack of (independent) information about the costs and benefits of using recycled organic products at farm level
- ✓ Poor image / poor quality of compost products
- ✓ Lack of spreading equipment
- ✓ High purchase, transport and application costs
- ✓ Lack of adequate agronomic advice regarding the capabilities and limitations of various products
- ✓ Unwillingness to change farming system to include regular use of recycled organic products.

To prevent marketing problems and stockpiles, but also to integrate and support the farming sector, many different schemes in Europe were developed in which farmers guaranteed the use of some or all generated compost products. In some cases farmers receive a gate fee when they also compost the collected material, while in other cases they receive the quality assured compost at low or no charges in return for providing guaranteed demand.

Risk matrix - identification and management of risks



Risk	Mitigation	Examples of Risk Minimisation	More information is available in:
Inadequate project management	<ul style="list-style-type: none"> ✓ Once a decision is made to provide an organics collection service, a period of 12-18 months is required for planning – establishment and construction of any new facility will take a minimum of 3 years ✓ A detailed project management plan should be developed, adhered to and maintained ✓ Project management includes resource planning – both finance and staff ✓ Audits of waste streams and surveys of community attitudes should be conducted. 	<p>The 'Groundswell Project' first began in 2004 with a pilot program called 'City to Soil' for collection and composting of food and garden organics in Queanbeyan (NSW). Following initial success, the approach was expanded to other rural areas and received funding over a three year period, from late 2007 to early 2011.</p> <p>A full-time project manager was appointed to coordinate the planning and implementation process across the region, while internal council staff managed day-to-day operations related to both collection and processing. Strong relationships were established with a range of professionals throughout the project, including suppliers, farmers, academics, consultants and government agencies, contributing to planning, implementation and evaluation and ensuring councils could offset service costs through the sale of quality compost. The project provided a model for rural councils in the region to provide significant organics diversion from landfill and achieve cost savings.</p> <p>Extensive information about the composting system, service roll-out, project management and evaluation is published online through the project website and through the Southern Regional Resource Recovery Organisation of Councils.</p>	Factsheet 10 – Scheme Design and Roll-Out
Poor communication	<ul style="list-style-type: none"> ✓ Residents must be kept informed and motivated ✓ Communications and community engagement must be long-term (established well before the scheme starts, and ongoing) ✓ Monitor and evaluate to measure success of communication, and to 	<p>Shoalhaven City Council conducted an innovative organics collection trial in 2009 using a two-bin 'wet and dry' system to determine whether organics recovery could be achieved without further investment in collection infrastructure. Because the trial used such a novel approach, the council consulted extensively with the participating community of Greenwell Point and maintained a visible presence and high level of communication during the trial period.</p> <p>Council collaborated with the local community action group to ensure the roll-out process was successful and education activities included printed materials, provision of trial updates at the</p>	<p>Factsheet 4 – Understanding Community Education and Engagement</p> <p>Factsheet 11 – Conducting Community Education and</p>

PLANNING YOUR SCHEME – **FACTSHEET 6** – UNDERSTANDING THE POSSIBLE RISKS

Risk	Mitigation	Examples of Risk Minimisation	More information is available in:
	<p>provide feedback to stakeholders.</p>	<p>community group's monthly meetings and publishing news and educational articles in the local newsletter. In addition, the council set up a local shop-front which ran three times a week in the community hall to distribute additional supplies of compostable bags and address any questions or concerns. Home visits were also arranged from the shop-front for residents unable to attend or with specific difficulties and concerns.</p>	<p>Engagement</p>
<p>Bungled roll-out of service</p>	<ul style="list-style-type: none"> ✓ Trial an organics service on a proportion of the local government area ✓ Ensure access to appropriate equipment ✓ Have a well-designed public communication and education program ✓ Design efficient rounds that match the capacity of the collection vehicles and collection crew ✓ Measure performance over time ✓ Ensure additional staff during roll out to deliver equipment, answer enquiries, and respond to complaints and issues. 	<p>Ballina Shire Council, on the NSW north coast, rolled out a third bin for urban residents in July 2011 to co-collect food and garden organics. The 240L MGB is collected weekly while residual waste collection was reduced to fortnightly, alternating with recyclables.</p> <p>Council allocated funding from the NSW Waste and Sustainability Performance Improvement Payment (WASIP) scheme to develop a comprehensive public consultation and education program on waste avoidance and organics recovery for 6 months prior to service commencement. The program included print advertisements, media releases, community service announcements on radio, brochures, presentations to community groups and a major 'launch' event through the North East Waste Forum Green House. Through this process the council determined the community was willing to wrap food waste in newspaper or purchase their own compostable liners, which helped reduce the roll-out cost of the service to households. The service has been extremely successful so far, resulting in a 43% reduction in waste sent to landfill in the first two-months of its introduction.</p>	<p>Factsheet 10 – Scheme Design and Roll-Out</p>
<p>Difficult properties</p>	<ul style="list-style-type: none"> ✓ Provide a reasonably priced collection method that is convenient and secure ✓ Consider convenience, storage space constraints, pressures on available space, vehicle access, existing garbage collection arrangements, and acceptability to residents ✓ Ensure container choices are appropriate for the number of households served, the organics segregation arrangements, space availability and collection vehicles ✓ Identify range of properties and identify solutions. 	<p>Leichhardt Council (in the inner west of Sydney) introduced a food organics collection service specifically for multi-unit dwellings (MUDs). The system was based on thorough research of different collection options, including a trial that compared several systems in 2007. Food waste is now collected from MUDs in 240L MGBs that are shared between groups of units and collected on a weekly basis. Council simply replaced approximately one in every 10 garbage bins with an aerated green-lidded bin, a system which was designed to prevent the need for additional bin storage, improve collection efficiency, and prevent odour problems. Participating households are also provided with an aerated kitchen caddy and supplies of biodegradable bags as the trial indicated that this resulted in higher recovery rates.</p> <p>The trial results indicate an average of 1.2 kg of food per week is being recovered per MUD household.</p>	<p>Factsheet 4 – Understanding Community Education and Engagement</p> <p>Factsheet 11 – Conducting Community Education and Engagement</p>

PLANNING YOUR SCHEME – **FACTSHEET 6** – UNDERSTANDING THE POSSIBLE RISKS

Risk	Mitigation	Examples of Risk Minimisation	More information is available in:
Householders not participating	<ul style="list-style-type: none"> ✓ Implement well-defined communication plans, including through local community networks, schools, community boards, residents and ratepayers groups ✓ Ensure convenience by minimising the effort required to separate organics, supplying kitchen caddies and liners to all or some households ✓ No direct additional cost for participating households ✓ Ensure the kitchen caddy and collection bin are easy to keep clean ✓ Make the community understand the need and benefits. 	<p>Gippsland Regional Waste Management Group (GRWMG) in northern Victoria conducted organics collection trials in two communities during 2011 and improved community engagement by partnering with local community groups and involving local composters in the material processing. During planning, GRWMG consulted with key stakeholders in the relevant communities. During the roll-out, the council employed the local Rotary Club, Lions Club and Friends of Mallacoota groups to conduct door-to-door distribution of kitchen tidy bins and education packages. This approach was mutually beneficial as it improved community interest in the objectives of the project while providing some financial support to the local groups. A local cattle farmer contributed to the project by accepting food and garden material collected from the Mallacoota area and composting this in-kind during the trial.</p> <p>Local involvement through many aspects of the project contributed to improved participant understanding of the benefits of organics diversion and high recovery rates during the trial, which resulted in its continuation as a permanent service by the local council.</p>	<p>Factsheet 4 – Understanding Community Education and Engagement</p> <p>Factsheet 10 – Scheme Design and Roll-Out</p> <p>Factsheet 11 – Conducting Community Education and Engagement</p>
Contamination	<ul style="list-style-type: none"> ✓ Conduct thorough community education, including a visit by waste and recycling educators and leaving a ‘contamination tag’ if required ✓ Make sure collection and education staff identify contaminated bins, and report them appropriately ✓ Withdraw organics collection bin and service from non-complying households ✓ Separate contaminants at the processing facility ✓ Develop a contamination management plan considering a range of responses for initial, periodic and entrenched contamination by identified households. 	<p>Canterbury City Council in Sydney’s inner west has a very culturally diverse population. It has achieved unexpectedly low levels of contamination since the introduction of the garden organics service, with the high quality of the organics recovered attributed to a range of factors.</p> <p>Prior to roll-out the council undertook extensive consultation with the community and thoroughly tested education materials and messages, establishing among other things that ‘Garden Vegetation’ (as opposed to ‘green waste’ or ‘garden organics’) was the most widely understood term to prevent contamination. Effective contamination management procedures were developed, involving visual inspection, collection refusal, contamination stickers, warning letters and visits by education staff for repeat offenders.</p> <p>The council found that one of the most important factors in maintaining negligible contamination levels was the vigilance of collection drivers in reporting contamination incidents and the cooperation between council and its collection contractor in managing this issue.</p>	<p>Factsheet 12 – Contamination Management and Compliance Planning</p> <p>Factsheet 11 – Conducting Community Education and Engagement</p>

PLANNING YOUR SCHEME – **FACTSHEET 6** – UNDERSTANDING THE POSSIBLE RISKS

Risk	Mitigation	Examples of Risk Minimisation	More information is available in:
Nuisance factors	<ul style="list-style-type: none"> ✓ Consider providing liners and aerated kitchen caddies to some households ✓ Encourage householders to line their caddies ✓ Encourage householders to empty the caddy regularly ✓ Encourage the use of deodorising spray/pads ✓ Provide local bin cleaning services and replace damaged bins ✓ Ensure that lids fit the kerbside bin properly ✓ Consider seasonality, and possible provision of weekly collections in summer and fortnightly collections in winter (for a combined service or garden organics only). 	<p>In 2009, Penrith City Council implemented a 3-bin collection service to urban single dwellings which consisted of a 240L organics bin collected weekly (the existing garbage bin fitted with a new lid), the existing 240L recycling bin collected fortnightly and a new smaller 140L residual bin collected fortnightly. Residents were also provided with an enclosed kitchen caddy to assist collection of food waste.</p> <p>The council encountered a number of issues during the first year of the service, including negative media coverage, organics bin lids which did not fit the older bin bodies, and a large number of complaints from residents about odour, pests and insufficient residual waste collection capacity and frequency.</p> <p>In 2010, the council resolved to introduce a number of modifications to the new waste service to address residents' complaints. These measures included provision of biodegradable bags in accordance with AS 4736, optional larger and/or weekly residual waste services to residents at an additional charge, optional additional yellow lid recycling bins (at reduced cost) to manage excess recyclables, optional smaller organics bins, use of odour control measures for bins, the option of additional services at Christmas time, and an enhanced community waste reduction education program.</p>	<p>Factsheet 3 – Understanding the Collection Options</p> <p>Factsheet 10 – Scheme Design and Roll-Out</p>
Impact of home composting	<ul style="list-style-type: none"> ✓ Continue to encourage home composting. 	<p>Three councils in the Eastern Suburbs of Sydney received funding in 2009 for a regional education project called 'Compost Revolution' which aimed to promote the reduction of food waste sent to landfill. Woollahra Council already provided a food and garden organics collection service for residents; however a trial was undertaken in neighbouring Waverly and Randwick to measure the effectiveness of an intensive home composting education program.</p> <p>During the 12-month trial program waste audits indicated participants diverted between 1.8 kg and 2.3 kg/hh/week to home compost systems. Since the completion of the trial, an online version of the education program has been developed for full roll-out across the Eastern Suburbs Councils. At least 750 residents have already used the online version and 95% of respondents state that the web resource was sufficient for their needs.</p>	-

PLANNING YOUR SCHEME – **FACTSHEET 6** – UNDERSTANDING THE POSSIBLE RISKS

Risk	Mitigation	Examples of Risk Minimisation	More information is available in:
<p>Contractual issues</p>	<ul style="list-style-type: none"> ✓ Ensure contracts are flexible ✓ Ensure contract is subject to all standard KPIs related to the collection of recycling materials ✓ Facilitate cooperation between the contractor and council regarding collection related problems ✓ Share responsibility of contamination problems. 	<p>Nillumbik Shire Council, in the northern suburbs of Melbourne, introduced the ‘GRO 3-bin system’ (Green, Recycle, Other) in July 2003. The commencement of the weekly combined food and garden organics collection service was accompanied by a reduction in residual waste bin size and collection frequency.</p> <p>The community took time to adjust to the new collection system and a fortnightly residual collection, so there were difficulties in managing contamination. Residents used either biodegradable bags or newspaper, however both of these liners were problematic at first because the original processor had difficulty in dealing with large quantities of newspaper and the biodegradable bags were difficult and expensive to source at the time.</p> <p>Changing to a different processor meant that the new company, ‘Green Planet’, could sort contamination mechanically, reduce the reject rate and improve the composting process, resulting in better resource recovery. However this was short-lived, as circumstances beyond the control of the council led to Green Planet closing down in late 2008, leaving the council searching for an alternative processor that could accept the food content and contamination rate of its organic material.</p> <p>Negotiation with 11 other councils in the region has resulted in the development of the Northern and Western Organics Processing Contract so that a new organics processing facility is expected to be built in the near future. However for several years in the meantime, all organic waste from Nillumbik Shire has been diverted to Hanson Landfill at Wollert, a situation that has not only had an impact on the council’s waste diversion targets, but also the commitment of its residents to resource recovery.</p> <p>At present, the council continues to encourage residents to separate garden organics from residual waste; however there is limited focus on contamination or active promotion of food separation. Unfortunately, when composting of the organics stream eventually recommences, there is a high risk that resident’s disillusion with the local resource recovery system may lead to either low participation or high contamination rates for the future processor to deal with.</p>	<p>Factsheet 10 – Scheme Design and Roll-Out</p>

PLANNING YOUR SCHEME – **FACTSHEET 6** – UNDERSTANDING THE POSSIBLE RISKS

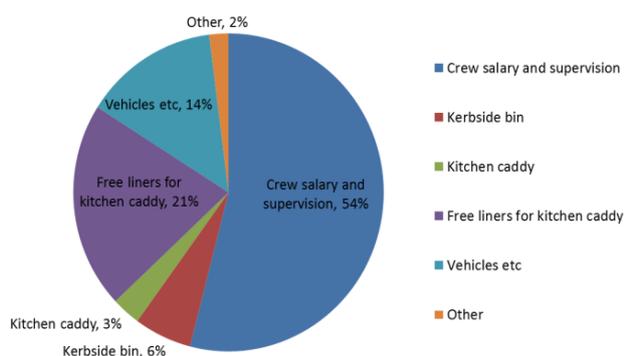
Risk	Mitigation	Examples of Risk Minimisation	More information is available in:
Cost overruns	<ul style="list-style-type: none"> ✓ Plan carefully ✓ Implement sufficient and appropriate contingency plans ✓ Ensure contracts are flexible. 	<p>The Northern Tasmanian Waste Management Group and Dulverton Waste Management (involving 12 member councils in the north and north-west of Tasmania) undertook a preliminary business case assessment of various organics collection options in 2010–11 to determine the most efficient and cost-effective approach for organics diversion in the region. The project resulted in comprehensive financial projections and led to an implementation plan for establishing a pilot trial of the preferred collection scenario. Since that time, a 12-month pilot trial involving 1,000 households has been implemented in collaboration with the Cradle Coast Authority (involving additional member councils in the north-west). The trial is due to be complete in mid-2012 and is providing detailed information on community acceptance, recovery rates, seasonal variations, processing requirements and operational costs. The trial is primarily funded by the regional waste levy; however other costs associated with ongoing planning for future organics collections are able to be distributed among the 17 member councils of Tasmania's north and north-west regions.</p> <p>The thorough long-term planning process undertaken on a regional basis will help ensure future organics collection and processing contracts are robust, with unexpected costs minimised.</p>	<p>Factsheet 7 – Understanding the Costs and Savings</p> <p>Factsheet 10 – Scheme Design and Roll-Out</p>
Lack of demand for generated products	<ul style="list-style-type: none"> ✓ Ensure council departments use generated recycled organic products ✓ Support market development efforts ✓ Control contamination. 	<p>The Groundswell project, conducted in southern NSW and funded by the NSW Environmental Trust, found the sale prices for compost varied over time and between different geographical locations. An economic analysis undertaken during the project indicated the market value of the compost product averaged \$45/m³ across the region, although prices were as high as \$400/m³ (for 25L bags in Condobolin) and as low as \$15/m³ cubic metre. The analysis found that, even at the lowest compost sale price, the payback period for a council investing in the 'City to Soil' organics collection system was 5 years, with a Net Present Value at Year 5 of \$8.63 per household.</p>	<p>Factsheet 5 – Understanding the Processing Options</p>

Understanding the costs and savings

The cost of introducing a kerbside organics collection system will be a key factor for any council considering establishment of a scheme. This factsheet describes the costs that should be considered when planning and budgeting for an organics collection scheme.

The cost of setting up and running a scheme will vary from one council to another, depending on a range of factors such as the type of material collected (garden only versus mixed garden and food), the kind of collection equipment provided, the collection frequency and the amount of community engagement, promotion and education required.

The following pie chart shows an indicative cost structure, based on the proportion of money allocated to different areas of the service for a council-run organics collection scheme. It excludes processing costs, which are addressed under Processing Options (Factsheet 5).



The highest costs are usually associated with salaries for collection crews and their supervision. Other significant costs include equipment (bins and bin liners) and vehicle running costs.

Indicative costs

The following factors will affect the overall cost of a collection scheme and need to be considered during planning and budgeting phases. The list below includes both initial investment costs, which have to be funded when establishing a new collection scheme, and on-going operating costs.

- ✓ Number of additional staff (operational and administration), and local wage levels
- ✓ Purchase / lease of additional collection vehicles
- ✓ Requirement for any modifications of existing or new vehicle fleet
- ✓ Vehicle running costs, including fuel, maintenance and overheads (such as insurance)
- ✓ Type and size of collection bins and kitchen containers provided to residents
- ✓ Type and number of liners for kitchen containers, if provided to residents
- ✓ Intensity and duration of public education and motivation campaign
- ✓ Performance monitoring, including audits and contamination management
- ✓ Additional management and administration.

Organics collection and composting trials rarely provide a direct indication of future roll-out and collection costs, because trials are intensively managed and are primarily conducted for gathering data. It is rare that a collection vehicle would be purchased specifically for a trial. The obtained data (for example take-up and set-out rates, collection yield, and problem areas) should, however, allow council staff to make more accurate predictions of future investment and operating costs.

Many councils already provide a kerbside collection service for garden organics, and are now considering co-collection of garden and food organics. In cases where households already have an organics bin (and associated collection vehicles) initial investment costs to expand the service will be much lower compared to establishing a service from scratch.

Costs for educating and motivating householders should also be lower when community members are already used to the concept of source segregating garden organics.

On-going operating costs, however, should be similar regardless of whether collection of food organics is added to an existing garden organics collection service, or if collection of both materials is introduced simultaneously.

In areas where councils provide collection services, it might be possible for neighbouring local authorities to share the use of a new organics collection vehicle that would not be fully utilised by either of the two councils. This is only feasible if the distance between collection areas is not excessive. The joint establishment and operation of processing facilities is more common, usually managed through regional incorporated bodies that include several local authorities. It is feasible that such regional bodies also take on the responsibility for collecting organics in order to gain greater efficiencies and reduce collection costs.

Some state government agencies (for example Zero Waste South Australia, and the NSW EPA) provide standardised signage and logos for education material, the usage of which might provide some savings for councils.

Based on Australian and international studies, the following table shows indicative costs (in dollar per household per year) associated with organics collection and composting services. These indicative costs represent broad based averages, and councils should seek specialist advice for their specific circumstances.

Item	Indicative costs
Promotions and campaigns	\$15,000 per year
On-going management and logistics	\$50 / hhld / year
Initial education materials (such as collection calendar, brochures, stickers for bin and caddy)	\$3 – \$5 / hhld
On-going education	\$5 / hhld / year
Kitchen caddy	\$3 – \$13 / hhld
Kitchen caddy liners, assuming 3-4 per week	\$8 – \$12 / hhld / year
Kerbside bin (240L)	\$40-\$50 / hhld
Collections	\$0.70 – \$3.00 / lift
Composting ⁵	\$25 – \$130 / tonne

⁵ Costs vary greatly, depending on the type of materials processed, throughput, type of technology, location of the facility, and products generated.

Unit collection costs per household or per tonne of collected material are affected by:

- ✓ Participation and set out rates
- ✓ Level of capture or diversion achieved
- ✓ Collection round efficiencies, governed by distance between pick-up points and crew productivity.

Processing costs are generally governed by:

- ✓ The kind and quantities of organic residues processed
- ✓ The location of the processing facility
- ✓ The selected processing technology
- ✓ The level of contaminants that have to be removed from the delivered material
- ✓ The designated use of generated recycled organic products.

Financial savings

Collecting source segregated organics reduces the amount of waste sent to landfill, resulting in significant financial savings from avoided disposal costs. The level of savings depend on the pricing differential between landfill disposal and resource recovery processing, as well as the quantity and quality of organic materials available for beneficial reuse and sale following processing.

Landfill facilities that emit 25,000 tonnes or more of carbon dioxide equivalent greenhouse gas emissions each year are liable under the carbon pricing mechanism. The carbon price will not apply to emissions from waste deposited prior to 1 July 2012 (known as legacy waste emissions), but legacy waste emissions do count towards determining whether a facility meets the participation threshold. For councils operating larger landfill sites, this could result in liabilities under the scheme. The carbon price will be fixed at \$23 per tonne of CO₂-e in the first year, but beyond 2015 the price will be determined by market forces under a market trading scheme.

Australian councils collecting food and garden organics report an average capture rate of 8 kg per participating household per week, or more than 400 kg per year. This can be a significant portion of total waste generated and diversion of such quantities may significantly reduce landfill disposal fees and levies.

When introducing an organics collection service, most councils seek to modify existing waste and recycling collection services in order to offset at least some of the additional costs. Full integration of organic residues collection into a council's waste and recycling collection services offers opportunities for savings such as:

- ✓ Reducing collection frequency of residual waste from weekly to fortnightly
- ✓ Reducing residual waste bin size to 120L (purchase of new bins) and converting old 240L residual waste bins for collecting organics by fitting new green lids.

If a new organics collection service is not integrated with other services, it might still be possible to reduce the costs of services by rearranging collection routes and reducing the number of vehicles employed for collecting household garbage. This is possible because source separating organics from the waste stream will significantly reduce the volume and weight of this stream and offset the additional routes and vehicles needed for organics collection.

Triple bottom line assessment

The concept of triple bottom line (TBL) assessment refers to the evaluation of economic, environmental and social information in an integrated manner. It is recognised that financial cost is a primary consideration in assessing performance and suitability of waste and recycling services, however considering environmental and social impacts/benefits will provide a broader understanding of different options to help inform council decision making processes. A **TBL** assessment:

- ✓ Provides broader scope and focus – decision making is wider than financial as it considers social and environmental assessment criteria
- ✓ Is transparent – councils have an obligation to disclose their decisions and activities and their impacts to the community
- ✓ Provides integrated planning – in order to achieve economic prosperity, environmental sustainability and social wellbeing, recognition of multidimensional impacts of council's decisions and activities is required.

It is important to quantify the overall **environmental** impacts and benefits resulting from the activities relating to a waste service. Environmental assessments usually build upon the Life Cycle Analysis (LCA) approach, which involves attempting to evaluate all impacts over the full life cycle from creation to final disposal. Environmental performance indicators associated with evaluating environmental impacts include:

- ✓ **Climate impacts** – savings in greenhouse emissions through diversion of organics from landfill and soil carbon sequestration through application of compost, and impacts associated with the composting process and additional collection vehicles
- ✓ **Energy** – potential for beneficial reuse such as energy generation
- ✓ **Resource recovery and diversion** of waste materials from landfill
- ✓ **Conservation of valuable resources** – water usage, replacement of nutrients and materials through the use of compost.



Triple Bottom Line (Hyder)

Social impacts and benefits are complex to analyse and there are many possible measures, which are prone to subjectivity. An organics collection service is inherently reliant on participation of the community to operate successfully. In assessing the suitability of a service, it is recommended to consider social impacts on the community through a qualitative assessment against performance indicators such as:

- ✓ **Equitable** and convenient access to recycling and waste services
- ✓ **Positive behavioural change** – encouragement of sustainable waste practices in the community
- ✓ **Nuisance impacts** (disamenity) such as traffic, noise and odour
- ✓ **Creation of employment opportunities**
- ✓ **Council reputation** and the way council is perceived by its community in terms of its commitment to sustainable and equitable recycling and waste management.

A cost benefit analysis can be difficult to undertake due to the high number of possible variables, and issues with developing the scope of the assessment in terms of what is included and excluded from the analysis. It can also be difficult to establish accurate estimates of various costs and savings during the planning phases of a project, as actual costs will often only be established through a competitive tender process.

Councils may wish to consider seeking advice from an appropriate consultant in undertaking such a cost benefit analysis, as many consultancies have experience in this style of analysis and will have access to a range of benchmark figures that can be used to provide an estimate of likely costs and benefits.

Case studies

Lismore Council Organics Collection Service

Lismore Council in northern NSW was one of the first Australian councils to introduce a domestic collection of food organics. The service was rolled out in 1999–2000 and has been operated within an extremely cost-effective budget since this time, owing to factors such as good contamination management procedures, wide acceptance of materials, and established social norms in using the service.

The collection of food organics is available to all properties with a kerbside garden organics service. The council now services 11,000 households in the Lismore urban zone, and about 4,000 caddies (with liners) have been distributed. Paper and cardboard was initially co-collected in the organics bin until a three bin system was introduced in 2006. Although residents are still encouraged to wrap food in newspaper for collection and disposal, ventilated kitchen caddies started to be introduced free of charge on a voluntary basis after 2009, in order to improve the convenience of the service and reduce plastic bag contamination issues. In 2012, the council began to accept compostable nappies in the organics service.

Residents that wish to use a ventilated kitchen caddy and compostable bags can pick up these resources in person at a council facility, but must also register their contact details and pick up a special bin sticker. The use of compostable liners requires the resident to place the relevant sticker on their bin which alerts the truck driver to expect compostable caddy liners in that bin. The use of the stickers reduces contamination, assists in promotion and the registration process, and allows council to have direct contact with residents who are using the organics service.

In order to be cost-efficient, a one-off kitchen caddy and a limit of 4 rolls of liners per household per year are provided for free. All additional products are supplied at a charge. The ongoing education budget for the service is modest, and consists primarily of local media advertising, use of the council website, a schools program, site tours and displays at events.

Lismore Council currently runs its own processing facility and sells the high-quality recycled organic product.

Lessons Learnt: The urban food and organics collection service offers a cost-effective solution to resource recovery in the Lismore region. The presentation of organics bins is about 91% and average yields are 14 kg/hhld/week of combined food and garden organics. Audits of the residual waste bin suggest a 92% capture rate of food and garden organics is achieved through the organics service, with a contamination rate in the organics bin maintained at about 1%.

The Groundswell Project

The Groundswell project conducted in southern NSW during 2008, 2009 and 2010 built upon an approach called “City to Soil,” which was first trialled in Queanbeyan and is predicated on encouraging the community to ‘close the loop’ by returning source-separated household organics, to help strengthen local food production.



Graphics used in ‘City to Soil’ education resources

Funded by the NSW Environmental Trust and involving Goulburn-Mulwaree City, Lachlan Shire, Queanbeyan City and Palerang Shire Councils, the objectives of the project were for the whole community to be engaged in the recovery process, and for councils and farmers to work together in diverting urban organics from the waste stream back into agricultural soils as high-quality compost. ‘City to Soil’ encompasses branding, a set of tools and a philosophical approach to kerbside collection used by councils involved in the Groundswell project to introduce a combined food and garden organics collection. The Groundswell project combined this collection approach with a simple but innovative small-scale composting process, which has now been adopted by a range of councils in regional NSW and Victoria.

Successful pilot collection services were introduced in both Lachlan Shire and Goulburn-Mulwaree councils during the project, while service implementation was delayed in the other two council areas involved. In the established collections, contamination was consistently low (averaging 0.2%) and the average yield of organics was 9.77 kg/hhld/week, although food comprised only 0.44 kg of this amount. Overall results suggest a high capture rate of about 93% was achieved for garden organics, although only about 16% of food organics was recovered.

As part of the grant-funded project, an economic analysis was undertaken to assess the costs associated with councils adopting the Groundswell process on a per-household basis. This project component also provided an overview of other benefits and costs of adopting this type of system.

The current costs associated with the collection, management and disposal of organics to landfill by the four councils in the study ranged from \$80 per tonne to over \$130 per tonne annually, and the economic analysis calculated this represents an average cost of \$68 per household annually. In comparison, the on-going cost of conducting the Groundswell processing was estimated to be \$46 per household annually.



Application site of finished compost trials

The total annual value of the service to a council was calculated at \$113/hhld/year, comprising a saving in landfilling costs (\$68/hhld) and potential compost revenue (\$45/hhld). The analysis suggests the program, on average, can provide councils with a payback on investment in approximately three years. The Net Present Value after five years (at a 15% discount rate) was calculated as \$109/hhld.

The following tables, from the economic analysis report, provide a guide to the costs of implementing the Groundswell approach for collecting and processing organics into high value compost, based on data available from the participating councils.

PLANNING YOUR SCHEME – FACTSHEET 7 – UNDERSTANDING THE COSTS AND SAVINGS

Council costs to establish a Groundswell collection per household (Year 1) (from Reynolds, 2011)

Equipment and processes	Cost per household
Max Air Bins	\$3.00
240 Litre City to Soil Bin	\$40.00
Bio-bags	\$10.00
Compost Tarps	\$3.50
VRM Inoculants	\$2.00
Compost Testing for Certification	\$5.00
Communications	\$5.00
Total (A)	\$68.50

Council Costs to maintain Groundswell Processes (Annually) (from Reynolds, 2011)

Equipment and processes	Cost per household
Max Air Bins: replacements	\$0.20
240 litre City to Soil Bin: replacements	\$1.20
Bio-bags	\$10.00
Compost Tarps	\$0.40
VRM Inoculants	\$2.00
Compost Testing for Certification	\$1.00
Communications	\$0.80
Compost screening	\$0.60
Total (B)	\$16.20

Total Council Costs for Collection, Plant & Salaries (from Reynolds, 2011)

Plant and salaries	Cost per household
Monthly kerbside collection @ \$1.60 lift ⁶	\$19.20
Plant & Equipment (composting) ⁷	\$2.20
Salaries (composting) ⁸	\$8.30
Total (C)	\$29.70
Total First Year (A+B+C)	\$114.40
Total Annual Ongoing (B+C)	\$45.90

Lessons Learnt: Economic analysis of this three-year project clearly suggests the 'City to Soil' collection and simple 'Groundswell' processing of household organics is a cost-effective way for the participating regional councils to handle their organic waste streams. Although the price of compost on the market can be variable, the results indicate this has little impact overall on service viability, with this model of collection and processing providing a financial advantages for councils even at a lower compost price of \$15/m³.

⁶ Based on average annual cost per lift between Lachlan council (contractor rates) and Goulburn-Mulwaree council (trucks purchased and depreciated, 20% residual value)

⁷ Plant and equipment includes average price of purchase of both small and medium front end loaders, spray plant and associated equipment

⁸ Salaries based on averages between the two councils and compared to composting rates. All rates are averages and based on 25% diversions. As diversion rates increase constant economies of scale occur, hence figures listed will decrease with increased production leading to decreasing total costs.

Understanding monitoring and evaluation

Monitoring and evaluation helps develop an understanding of how a scheme or communications campaign is performing, and may identify opportunities for improvement. This applies to both waste management services and the communications activities undertaken to promote them.

'Monitoring' means regularly measuring outcomes such as customer satisfaction, participation rates, contamination rates and diversion rates. **'Evaluating'** means drawing conclusions from the monitoring data in terms of how well the scheme is performing, or the effect of the communication activity. Monitoring and evaluation are therefore two distinct activities, with monitoring being impartial and factual while evaluation tends to be subjective and value laden.

Most monitoring can be done by someone who does not know the local area, while only someone who understands the context and local environment can do the evaluation, for example someone who has knowledge of previous programs, socio-economics, demographics, and data. This means that, although you can commission somebody to measure what your service is doing, ultimately you need to evaluate whether these outcomes are good, satisfactory or poor.

Monitoring and evaluation help you to:

- ✓ Measure customer satisfaction and user attitudes to establish how these are impacting on the performance of your scheme
- ✓ Measure progress against objectives and targets, so you will know in advance if you are likely to hit or miss them – for example less than 3% contamination, more than 80% participation, more than 60% diversion and 95% customer satisfaction
- ✓ Identify successful systems as well as problems or performance issues, so that you can target your efforts to those neighbourhoods where improvements will make the most impact

- ✓ Assess expenditure and control costs, in terms of anticipated quantity of organics collected, demand for liners, and the impact on education and processing costs of different contamination levels
- ✓ Evaluate return on investment to justify existing budgets or persuade budget holders that more money is required to achieve statutory and local targets
- ✓ Plan scheme expansions and design (or redesign) scheme so that targets are met or exceeded
- ✓ Plan targeted communications to improve performance
- ✓ Address the issues that are really impacting on scheme success.

When to monitor

If you want to monitor the effect of a service change, then you need to monitor both before the service starts or the service is changed, and again afterwards. The purpose of monitoring in advance is to establish a baseline from which you can measure a change.

Your aim

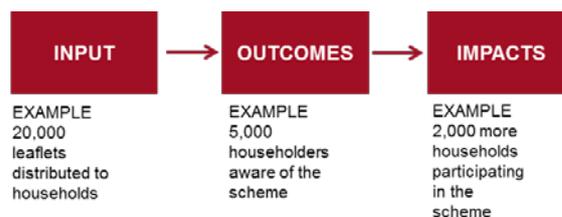
An aim is a broad statement of what you are trying to achieve and there is usually one overarching aim. An example of a monitoring aim would be 'to measure the performance of the organics service':

To capture xx% of the total generated organics in the kerbside organics bin by [xx date].

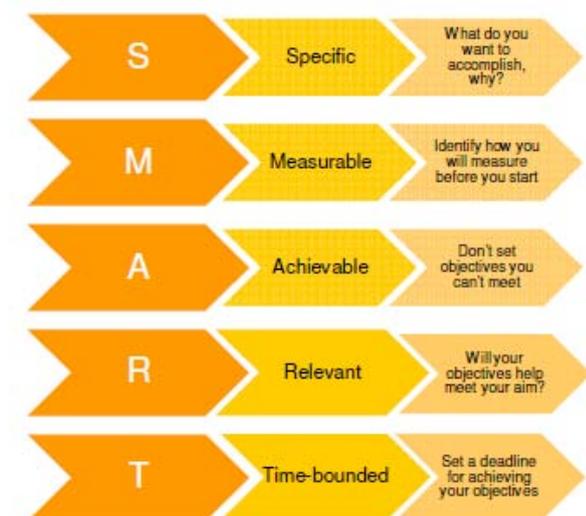
Your objectives

Objectives are a much more specific statement of what you are trying to achieve and it is common to have more than one objective for a monitoring and evaluation programme. You can demonstrate if you have achieved an objective.

There are three types of objectives that relate to the measurement of specific inputs, intermediate outcomes, or final impacts.



Make your Objectives SMART



Key Performance Indicators

KPIs are quantifiable measures that capture critical success factors and are a framework for measuring achievements. They are presented as units of measurement (e.g. number, percentage, tonnage). They are the tools that enable you to monitor the success of your activities. KPIs allow you to convert your monitoring data into something usable and meaningful. Each objective that you set should have at least one related KPI.

Type of objective	Example	KPI
Input	To distribute 10,000 leaflets by [xx date] to 20,000 households on the kerbside organics collection scheme	Number of leaflets
Impact	To decrease the organics disposed in the garbage bin from xx kg/hh/year to yy kg/hh/year	kg per household per year (kg/hh/year)

Example of objectives and KPIs

The methods

There are various methods that can be employed to demonstrate the effectiveness of a scheme, including:

- ✓ Tonnage data analysis, for example increased tonnage of organics and decreased residual waste tonnage
- ✓ Waste auditing per bin, or aggregated via a visual waste audit, or physical waste characterisation
- ✓ Set out and participation rate monitoring, for example identifying 80% of all organics bins are put out for collection but only 50% of them contain food organics
- ✓ Organics capture analysis
- ✓ Stakeholder feedback
- ✓ Communication evaluation.



Resource Recovery Officer tagging bin (Bankstown City Council)

1 Tonnage data analysis

The relevant processing facility can usually provide information about daily yields of organics. This data can be logged in a spreadsheet, with trends observed over time. This method can also be employed to monitor the effectiveness of new communication campaigns as the scheme progresses, as well as identifying and targeting contamination by measuring weight per truck run and comparing effectiveness between different areas.

2 Waste auditing

A visual waste audit involves inspecting bins and truck loads in order to estimate the percentage of each waste type in the bin or load. A limitation of a visual assessment is that it does not allow for compaction of the waste, which impacts on the accuracy of results. However, it is less time consuming (and therefore less expensive) than a physical waste audit.

The most detailed and robust waste data can be obtained by auditing. A household by household audit, or aggregated sampling, will enable you to measure household generation of waste, recyclables and organics; determine the composition of each waste stream, and assist in monitoring the performance of the scheme.

It is recommended that an audit of the residual waste stream be conducted prior to the implementation of the scheme. This will provide you with baseline data for the total amount of waste produced, and the type and volume of organics currently in the residual waste stream. The residual waste stream should then be audited, using the same metrics, seasonally (at least summer and winter) to obtain the best data for comparison of results.

It would also be beneficial to audit the organics and recyclables schemes to determine whether the introduction of the scheme has had any other impacts, such as reduction in total waste produced, and material capture rates.

Specialist companies are available to conduct waste audits and it is advised that council commission audits by a third party.

3 Set out rate and participation rate analysis

Set out rate is defined as the number of households putting out organics bins for collection within a target area, divided by the total number of households within that area that have been supplied with an organics bin.

Set out rate monitoring can be undertaken by council, contractor staff, or an external consultant, simply by visiting the target area on the collection day (immediately prior to normal collection time) and completing a tick list per property of bins presented before applying the formula:

$$\frac{\text{No. households recorded as setting out on a given day}}{\text{No. households monitored on that day}} \times 100\%$$

Participation rate provides similar information, but takes into account the fact that some householders may not set out a collection container on a specific day, for example because they are away on holiday or do not have sufficient materials to put out for collection. It is defined as the number of households within a target area that participate in an organics collection at least once during the monitoring period (typically three consecutive collections), divided by the total number of households within that area.

$$\frac{\text{No. households recorded as setting out at least once in a defined period}}{\text{No. households monitored in that period}} \times 100\%$$

Participation rate monitoring can be used to identify non-participating households so they can be targeted for door to door communications or promotional work to provide additional information on the scheme. Further participation monitoring can be done after a campaign in order to understand the impact it has had on the scheme.

4 Capture rate analysis

The capture rate is defined as the percentage of the targeted material that is actually captured from participating households during a collection. Organics capture rates can be determined by collecting refuse and organics from a representative sample of households and taking it to an appropriate venue for sorting, classification and weighing. Although this only provides a snapshot of a limited number of properties, it provides useful data on the amount and type of organics being recycled and remaining in the waste stream. This type of analysis needs to be conducted by a professional.

A waste audit can be undertaken in demographically representative areas of the local government area before a new organics collection scheme starts. At the end of the trial, the audit can be repeated to establish capture rates. This will establish a baseline and may inform where to target extra communications activity in order to ensure good scheme understanding and participation.

5 Residents' feedback

There are various methods of obtaining feedback from residents. Focus groups can be conducted to gather opinions, or surveys can be undertaken. Although surveys can be distributed and returned by post or online, this approach does not generally achieve a high response rate. Door to door surveys can help ensure questions are appropriately delivered and understood, and that a representative demographic of respondents is obtained.

It is also important to gather feedback from processors and collection crews to ensure operations are suitably evaluated and adjustments made as necessary.

Recycling food waste saves heaps

Food Waste Recycling SURVEY

All surveys completed will be entered into a draw to win an Organic Food Hamper to the value of \$100

PLEASE NOTE: You must be aged 18 years or over to participate in this survey.

- How many people are in your household? _____
- Do you currently put garden organics (eg. grass clippings, prunings & other garden waste) into your garden organics bin (green lid bin)?
 YES NO
 If yes, what do you put in your garden organics bin?
 Grass Clippings Small pieces of wood
 Leaves, small branches and/or prunings Other _____
 If no, why not?
 I do not produce any garden organics The bin gets too smelly
 I use garden organics in my compost Other _____
- On average, how often do you put your garden organics bin out for collection?
 Every fortnight Less than once per month
 Once per month Very rarely or never
- On average, how full is your garden organics bin when you put it out for collection?
 About ¼ full About ½ full
 About ¾ full Full
- What do you currently do with your fruit vegetable scraps and other food waste?
 I compost them I have a worm farm
 I put them in my garbage bin (red lid) I give them to my chickens/dogs etc.
 Other _____
- Do you think it is important that Council investigates how best to recover the food waste in your garbage bin (red lid) and reduce the amount of food waste that ends up in landfill?
 YES NOT SURE NO
- Did you know that waste sent to landfill stays there forever & cannot be recovered or reused?
 YES NO
- Did you know that food waste can be reprocessed into valuable compost and electricity?
 YES NO
- True or False? It costs the community more to dispose of food waste in a landfill than it does to process it into compost and electricity?
 TRUE FALSE
- Would you be willing to separate your food waste on an ongoing basis (after the trial has finished)?
 YES NOT SURE NO
 WHY NOT? _____
- Do you have any comments or questions for Council on the Food Waste Recycling Trial?

For more information visit our website, www.thehills.nsw.gov.au/Waste-Service.s.html or phone 9843 0310

Food Waste Recycling Trial

THE HILLS Shire Council

Example of survey (Hills Shire Council)

6 Communications evaluation

It is highly advisable to monitor and evaluate the effectiveness of all communication methods used. This will help ensure future communication activities benefit from lessons learned regarding ways of targeting different audiences and the ability of different formats to get a message across and stimulate the biggest response.

Target population

Monitoring and evaluation activities can be tailored to suit a variety of situations, such as covering all participating households, random households across the trial/service area, or a target area deemed representative.

It is important to have good knowledge of the target population from which the sample is to be taken. Target population characteristics are to be defined in light of those likely to have most influence on the topic under investigation. When food organics is being investigated, household size and income levels are key factors, and the household profile of the target population must therefore be known so that a representative sample is sampled. For a combined food and garden organics collection service, it is also important to consider the average size of gardens and seasonality impacts.

Demographic profiling can be used to help identify a subset of the target population which is representative of the wider population. Profiling can provide useful insights about the population and give detailed socio-demographic information for categories such as age, gender, social grade, ethnicity, employment status, income levels, housing types and tenure.



Resource Recovery Officers talking to a resident about his recycling bin (Bankstown City Council)

More information on implementation is outlined in Factsheet 13 – *Understanding Monitoring and Evaluation*.

Case Studies

Bankstown Council

Evaluating the ‘Recycle Right!’ Contamination Reduction Strategy

Bankstown Council in Sydney’s south-west has a large, culturally diverse population with a high proportion living in high density dwellings. Recycling contamination rates in the dry recycling bin have been extremely high, even after 20 years of experience with kerbside recycling collections. Financial penalties have been placed upon council for disposal of contaminated feedstock supplied to the recycling facility. Responding to these issues, the council recently instituted a program to systematically test and evaluate the effectiveness of several resources and strategies to improve contamination in the dry recycling bin. A similar approach could be adopted to address contamination in organics collection schemes.

The ‘Recycle Right’ Contamination Reduction Strategy commenced in 2010 and involved the following stages:

- ✓ Develop aims and objectives of the campaign, aligned with relevant council and contractor policies and strategies
- ✓ Undertake a literature review of Bankstown waste audit results, government reports, studies into recycling, behavioural change research and other literature on fundamental behavioural psychology principles
- ✓ Design a range of strategies and resources to trial in both houses and units, based on the literature review findings
- ✓ Conduct community consultation through a series of focus group sessions to test the supporting material and determine the effectiveness of designs, images and messages for community members
- ✓ Test and monitor the strategies, refine resources in several problem areas for contamination over a nine month period, and document the results
- ✓ Evaluate the results from the trial strategies and community engagement sessions to recommend the most effective strategy in achieving recycling behaviour change

- ✓ Develop a final Contamination Reduction Strategy, including standard and extended contamination management procedures and refined education resources for both houses and units to be implemented across the rest of the Local Government Area
- ✓ Conduct continuous monitoring and review of the strategy through bin inspections, waste auditing and community consultation.

By the end of the trial period in May 2011, council officers had inspected and given feedback to over 1,400 households, and ‘offenders’ in each area received feedback over a three month period, including, two rounds of personal visits, and a letter warning that bins could be removed if contamination continues. Over this time, only four bins were removed.

The trial stage of the program was successful, but the on-going implementation has seen even more dramatic results. Average starting contamination levels were 40% across the identified ‘contamination hotspots’ involved in the trial. By the end of each standard contamination management procedure being implemented in an area, the average contamination rate dropped to 18% and, by the end of the extended contamination management procedure, it dropped to 6%.

Community consultation and qualitative evaluation were critical elements of the campaign. In total, 700 evaluation forms were completed by households with a 4% response rate, providing valuable feedback on the community’s response. In addition, two rounds of focus group testing were undertaken to inform the design and then redesign of the ‘Recycle Right’ education resources. Results of the multilingual focus groups indicate the community will respond best to the following elements:

- ✓ Use of multicultural children to convey messages (aged 8–12 years)
- ✓ Inclusion of bins in photographic designs
- ✓ Use of smiley faces and ‘thumbs up’ symbols
- ✓ Simple and self-explanatory designs
- ✓ Strategies that are informative and appear cost-effective
- ✓ Cooperative approaches that show council is working with community
- ✓ Council showing appreciation to residents for doing the right thing.

Based on the results achieved and the comprehensive research and evaluation process that was put in place, the program was recognised as:

- ✓ Winner of the 2011 LGSA Excellence in the Environment Awards (Community Education & Improvement)
- ✓ Winner of the 2012 Communications Australia Awards (Best Community Engagement)
- ✓ Highly commended in the 2011 Keep Australia Beautiful Sustainable Cities Award (Environmental Education).



Artwork for the 'Recycle Right Program' (Bankstown City Council)

Lessons Learnt: The trial provided a reliable evidence base for the council's new approach to dry recycling education and contamination management procedures for both single and multi-unit dwellings, and the process of ongoing monitoring and review will ensure that it can be revised and refined to maintain its effectiveness. While the system was introduced to manage contamination in the dry recycling bin, a similar approach could be adopted for organics recycling services.

Further information:

Detailed information on the contamination management strategies and results can be found in Factsheet 12. Also refer to the Council website at: www.bankstown.nsw.gov.au.

Waverly, Randwick and Woollahra Councils

Using a Planning Framework for Developing an Evaluation Strategy – 'The Compost Revolution'

The councils of Waverly, Randwick and Woollahra in Sydney's eastern suburbs received NSW Environmental Trust funding for a collaborative project to investigate options for more sustainable management of organic waste over a three year period, ending May 2011.

Randwick and Waverly councils were interested in exploring the feasibility of home composting and waste avoidance programs as key waste management strategies, and developed the 'Compost Revolution' program as a 12-month trial to test a new educational approach.

Monitoring and evaluation of the project was built in at the project planning stage, based on the 'Outcomes Hierarchy Model', which is an evaluation framework recommended for NSW Environmental Trust grant recipients, which can be accessed using the following link: to [Does Your Project Make a Difference](#). This framework was used as a tool to plan activities and evaluation methods to meet the 'desired outcomes' of the project at three stages: short-term 'Immediate' outcomes; medium-term 'Intermediate' outcomes; and long-term 'Ultimate' outcomes. 'Desired outcomes' were defined as the changes that they wanted to see (and measure) in their environment or target audience as a result of activities undertaken in the project.

From the start, the councils identified the 'Ultimate' desired outcome was to reduce greenhouse emissions from waste in the region, including reducing the amount of organic waste produced and the amount sent to landfill. To achieve these objectives, the councils identified several 'Intermediate' outcomes to guide the overall structure of the project plan. Once these were established, 'Immediate' outcomes were developed by the project team as ways to achieve results.

Individual project activities could then be planned to meet these three levels of outcomes, and suitable evaluation methods were chosen to measure the effectiveness and appropriateness at each stage.

Because the desired outcomes had been clearly identified at the start of the project, the team found developing the comprehensive monitoring and evaluation plan was very straightforward. Some elements of the 'Outcomes Hierarchy' for the project are included in the table on the next page.

Lessons Learnt: Detailed forward planning using the ‘Outcomes Hierarchy’ framework allowed the team to monitor and revise activities along the way. The results have supported decision-making for long-term waste management in the Sydney Eastern Suburbs region, and the effectiveness of this program has also led to implementation of the program in other council areas of NSW.



Practical workshop being conducted with trial participants (Waverly, Randwick and Woollahra Councils)

Further information:

<http://compostrevolution.com.au/>

‘Compost Revolution’ Outcomes Hierarchy (abridged version)

Project stage	Desired outcomes	Evaluation Methods
Immediate	Engage at least 300 households to participate and start home compost in the trial	Trial participation rates (about 600 households) Trial drop-out rates less than 10% Workshop and event participation rates
	Develop effective education resources and workshops to meet the needs of participants	Phone/email enquiries & feedback Website visitors and downloads Number of resources distributed at events
Intermediate	Improve participant skills and knowledge in composting	Trial participant surveys during and after program Workshop feedback surveys Comparison with non-participants
	Raise participant awareness of behaviour changes that lead to reduced food waste	‘Food waste tallies’ recorded by participants Results of Food Diary study Website visitors and downloads
	Develop a model program to increase home composting rate in region	Online quiz results News articles and advertisements published
Ultimate	Reduce organic waste disposed to landfill	Analysis of compositional bin audits before, during and after the trial
	Reduce household production of food waste	Analysis of food waste composting tally system Analysis of ‘Food Diary’ study
	Reduce greenhouse emissions from waste	Economic and environmental modelling analysis undertaken after trial completion

Conducting and evaluating a pilot trial

Kerbside organics collection systems should be trialled before full-scale implementation in order to identify local issues and knowledge gaps. A trial can encourage community debate and be used to fine tune program / service components, such as education, communication and infrastructure.

Another option is a sequential implementation of the collection system to iron out any problems, although detailed research on the type of system is still required beforehand. A sequential rollout of services may be easier for householders. For example, this may involve establishing a fortnightly kerbside garden organics service and building up good participation rates, recovery rates and low contamination levels before introducing food organics. Another example would be having the combined food and garden organics service well established before reducing residual bin size or collection frequency.

The results of a well-designed pilot trial provide council with specific information to undertake detailed cost-benefit analysis, for example a triple bottom line assessment, comparing the effectiveness of an organics service to other options. The pilot area has to be well-chosen in order for you to extrapolate the results to the rest of the area being considered for the service.

How well the pilot is received by residents will have a significant impact on a possible subsequent full scale rollout. If there is support for the scheme, this will act as a great advertisement. Effective and appropriately resourced implementation – with staff that can respond promptly to enquiries – is therefore essential. This will help prevent initial issues developing into difficult complaints, which may generate negative publicity and impact on a subsequent acceptance of the scheme.



(WRAP UK)

A pilot trial can help to test the following characteristics of an organics scheme:

- ✓ Participation rates
- ✓ Diversion rates
- ✓ Contamination rates
- ✓ Different types of caddies, with or without liners
- ✓ Householder attitudes and satisfaction
- ✓ Effectiveness of communication/education strategy
- ✓ Collection frequencies.

Pilot trial planning

This section provides information on the main stages involved in planning a pilot trial, including:

Planning Stages	Key information required
<ul style="list-style-type: none"> ✓ Assessing the waste diversion potential 	<ul style="list-style-type: none"> ✓ Area specific compositional analysis will provide an understanding of the available organics ✓ Only a proportion of the available organics will be captured in a collection service.
<ul style="list-style-type: none"> ✓ Choosing the right collection system(s) to test 	<p>Four typical collection options:</p> <ul style="list-style-type: none"> ✓ Garden organics only ✓ Food organics only ✓ Food and garden organics, but in separate containers ✓ Food and garden organics co-collected in a single container.
<ul style="list-style-type: none"> ✓ Locating a suitable treatment facility 	<p>When planning an organics collection trial, it is important to consider how and where the collected material will be processed.</p>
<ul style="list-style-type: none"> ✓ Choosing containers and other supporting tools 	<p>It is important to provide practical and convenient methods to make organics collections easy for householders.</p> <p>Consider factors such as dwelling types, storage spaces, household sizes, garden sizes, climate, time of year, and cultural issues.</p>

Planning Stages	Key information required
Identifying the trial design and sample area	<p>Some decision factors include:</p> <ul style="list-style-type: none"> ✓ Number of variables to be tested ✓ Representative demographics ✓ Sufficient sample size ✓ Use of a control area ✓ Ease of distribution and collection.
Identifying appropriate collection vehicles and trial logistics	<ul style="list-style-type: none"> ✓ Ensure the capacity of the collection vehicle is appropriate to the tonnage collected ✓ Ensure proposed collection schedules are compatible.
Communicating with stakeholders	<p>An effective education and engagement strategy is essential to the success of an organics collection trial.</p> <p>Remember to inform and consult with other important stakeholders that may be affected by the trial, or may influence, the results.</p>
Monitoring and evaluation	<p>Monitoring and evaluation before, during and after the trial will help to demonstrate the performance of the trial. This may include waste audits, visual inspections, participant surveys, and economic analysis.</p>
Applying the results	<p>Decision-making should be influenced by a wide range of environmental, economic and social factors.</p> <ul style="list-style-type: none"> ✓ Quantitative figures such as participation rate, capture rate and contamination can be used to determine overall diversion potential across the LGA ✓ Economic information and participant satisfaction results can indicate the ease and cost-effectiveness of fully implementing a system.

1 – Assessing diversion potential

It is not advisable to rely on national or jurisdictional compositional waste data when planning an organics collection scheme, because different amounts of organics are generated by different sectors of the community. Area specific compositional analysis will provide a more accurate picture of the available organics – the waste audit process, including case studies and examples of guidelines, is further explained in Factsheet 2 – *Understanding Your Waste Stream*, part of *Planning Your Scheme*.

It can be expected that only a proportion of the available organics will be captured in a collection service. This will depend on a number of factors, for example community commitment to recycling, cultural influences on cooking habits, home composting rates, and amount of food left in packaging.

The proportion of garden organics in MSW is an important factor influencing collection strategies. The main issues to consider if you are evaluating how much garden organics will be presented for collection are:

- ✓ Proportion of properties with gardens – many urban councils have high proportions of housing stock with either no gardens or small gardens, where a separate garden waste collection service may deliver small amounts of garden organics
- ✓ Garden size – properties with larger gardens will produce more garden materials
- ✓ Garden age – the age of a garden will affect the amount of garden material produced
- ✓ Seasonality – garden organics usually increases in spring/summer/autumn and reduces in winter. On the other hand, food organics volumes show little seasonal variation.

In areas where limited garden organics are available, consider less frequent collections and alternatives to bin services such as tied and bundled collection, chipping services, or provision of drop off centres. However, it should be noted that provision of a bin service allows the flexibility to add food organics later.

2 – Choosing the right collection system to test

A council considering introducing an organics collection service typically has four general collection options:

- 1 Collect garden organics only
- 2 Collect food organics only
- 3 Collect food and garden organics, but in separate containers
- 4 Co-collect food and garden organics together in a single container.

Many Australian councils offer kerbside collection of garden organics. Those councils collecting both food and garden organics often prefer to co-collect the material in a single bin because this avoids the need for an additional receptacle and collection service.

Collection frequency and configuration of other collection services also need to be considered. Food organics generally requires more frequent collection than garden organics, in order to address potential odour issues. Councils in Australia usually collect combined food and garden organics on a weekly basis while separated garden organics tends to be collected fortnightly. Some councils in Europe have opted for a weekly organics collection in summer and a fortnightly collection in winter, but this may require more elaborate communication with the community.

The configuration of other waste collection services can have a significant impact on the success of the organics collection. For example, a trial in South Australia showed that reducing residual waste collection frequency from weekly to fortnightly resulted in greater food recovery rates via the weekly organics collection. If a future change to the frequency or size of other waste services across the LGA is being considered, then the likely impact is important to test in the organics pilot trial.

2.1 Collection costs

The **absolute collection costs** of a trial will be affected by the:

- ✓ Number of additional staff and local wage levels
- ✓ Purchase / lease of additional collection vehicles
- ✓ Requirement for any vehicle modifications of existing or new fleet
- ✓ Vehicle running costs, including fuel and maintenance
- ✓ Type and size of collection bins and kitchen containers provided to residents
- ✓ Type of liners for kitchen containers provided to residents
- ✓ Intensity of public education and motivation campaign
- ✓ Performance monitoring, including contamination
- ✓ Additional management and administration.

Factsheet 3 – *Understanding the Collection Options* and Factsheet 10 – *Scheme Design and Roll-Out* provide more detailed information on the common organics collection options and appropriate equipment, while Factsheet 7 – *Understanding the Costs and Savings* provides more information on the TBL process and the various costs and savings associated with a collections service.

3 – Locating a treatment facility

When planning an organics collection scheme, it is important to consider how and where the collected material will be processed.

The type of organics collection scheme introduced (such as food organics only, or food organics combined with garden organics) will have a major impact on the treatment options. Sites receiving food and garden organics separately may be better positioned to manage the blend of input material for processing, allowing greater control over the quality of end products. Depending on their chemical and physical characteristics, different types of organic residues lend themselves better for combustion (including gasification), composting or anaerobic digestion (refer to Factsheet 5 – *Understanding the Processing Options*).

When introducing a collection scheme, it is advisable to:

- ✓ Seek to fix treatment costs by securing gate fees (or a portion of gate fees) for the organics over the duration of the trial
- ✓ Ensure the facility is licensed to process the quantity and type of material to be collected
- ✓ Check that outlets have been secured for the finished products
- ✓ Ensure arrangements for dealing with contamination are specified in the contract (for example contamination limits, responsibilities, and who pays if loads are rejected).

4 – Choosing containers and other supporting tools

Factsheet 3 provides detailed information on containers and liners. Important points to remember when implementing your pilot trial are:

- ✓ 120–240L wheeled bins are best for co-collection of food and garden organics. The size depends on collection frequency and the average garden and household size and type of dwelling.
- ✓ Smaller sized MGBs (60L and 80L) suit confined spaces and use in MUDs and / or smaller families. Where food organics are collected separately on a weekly basis, a 20-25L container will be sufficient for the majority of households.



Kerbside organics bin (Crows Nest Shire)

- ✓ Providing households with bench top kitchen caddies encourages participation and increases food organics capture rates as a caddy will help residents to easily segregate food organics from other waste.
- ✓ Compostable liners that fit inside kitchen caddies and meet the Australian Standards (AS 4736-2006) aid cleaning, storage and disposal and reduce leakage and spills. It should be noted that liners can become unreliable if stored for extended periods.

5 – Identifying the trial design and sample area

5.1 Identifying the trial design

The design of a pilot trial is primarily dependent on the number of variables that need to be tested. In some cases, a single collection system may already have been determined as the most feasible and therefore a homogenous trial area is suitable to determine the recovery potential of this option. In most cases, however, the council may want to compare two or more options for any or a combination of the following:

- ✓ **Collection system** for example food-only versus co-collected food and garden
- ✓ **Service configuration** for example weekly residual waste collection versus fortnightly residual waste collection
- ✓ **Container type** for example enclosed versus aerated MGB and/or kitchen caddy
- ✓ **Supporting tools** for example use of compostable bags versus newspaper as a caddy liner.

A separate trial area should be defined for each different combination of trial variables so that differences in results between each area can be attributed to a single variable.

Remember to keep these variables to an absolute minimum. Consider that, as the number of tested variables increases, so does the complexity of other trial aspects such as communications, distribution, collection logistics and even data analysis. Each of these factors can have significant cost implications.

5.2 Selecting the sample area

Identifying the right sample area or areas is a critical decision in the trial planning process.

The participating households in a trial should be carefully chosen to ensure it is an accurate representation of the target population. It must mirror the profile of the population, therefore the demographics of the participating households should reflect the demographics of the council area overall.

The sample size should always be as large as possible but will depend on key factors such as the project budget and the level of precision required for the intended use of the results. As a simple rule, a sample of 1,000 households or more will generally provide an overall recovery rate that is sufficiently reliable. However, if testing a number of variables, then the total number of participating households is less important than the number in each different trial area. In general, try to avoid using test area samples smaller than 200 households as the results are unlikely to be representative of the entire population.

Factsheet 13 provides more information on factors to consider in selecting a trial sample.

6 – Identifying appropriate collection vehicles and trial logistics

Organics have a different bulk density and compactability than MSW. It is therefore crucial to ensure the capacity of the collection vehicle is appropriate to the tonnage collected. Monitoring the quantity of organics loaded into the truck is recommended, so as to avoid overloading, particularly when the proportion of grass clippings is high, or in high density housing areas where the proportion of food organics is high. Vehicles should be leak proof with apertures that close when not being loaded.

It is also important to consider how the collection schedule for the trial area (or areas) will fit into the existing waste collection schedules and routes or how it will be affected by other issues such as traffic, parking and school hours.

The planning and timing of procurement is critical to the trial start date. There may only be one or two suppliers of the type of infrastructure chosen and current stock may be limited, so orders may have a 2–3 month lead time. As a contingency, caddies, liners and bins need to be **procured well before trial commencement** so consider storage requirements until distribution to householders.

About two weeks before the start date of the program, the equipment should be distributed to the participating households. Instructions leaflets, stickers, calendars etc. should be distributed in conjunction with the required equipment.

7 – Communicating with stakeholders

An effective education and engagement strategy is essential to the success of an organics collection trial. So that residents are given the knowledge and skills to participate and to effect behavioural change, it is important community communications are well researched, planned, and adequately resourced.

7.1 Communications plan

It is recommended that councils prepare a plan to guide communications and community engagement activities. The plan should focus on practical actions and:

- ✓ Identify target audiences, including non-English speaking residents, council customer service officers, media and other stakeholders
- ✓ List key messages
- ✓ Identify key issues and how these will be addressed
- ✓ Summarise communications strategies for each of the target audiences and project phases (pre-pilot, during the pilot, post-pilot)
- ✓ Outline roles and responsibilities of council and other project partners
- ✓ Outline budget and timelines for actions.

7.2 Pre-launch communication

It is essential that all householders are provided with information about the new service prior to the trial commencing. Pre-launch communication usually commences 3–6 months before the trial is rolled out, and should include an information leaflet, with an advertisement or notice informing residents about the trial. It should address:

- ✓ What the new service is, when it will be introduced and why (including benefits for the resident and community)
- ✓ What householders will be able to recycle, and how
- ✓ Who to contact with queries (for example helpline and website)
- ✓ Clear messages to minimise the contamination of the organics bin.



Information brochure (The Hills Shire)

7.3 New service communication

To follow up the pre-launch leaflet, councils should produce another communication to support the launch of the service. This can be delivered with the new containers. This communication usually takes the form of a service leaflet and should include the following:

- ✓ How householders can participate (in terms of collection dates and what to do with their collection container)
- ✓ What they will be able to recycle
- ✓ Who to contact if they have a query (for example helpline and website)
- ✓ Practical advice on how to make the most of the system and deal with any potential problems.

7.4 Communications materials

Communications materials for residents should include (but not be limited to):

- ✓ Information brochure
- ✓ Collection calendar
- ✓ Sticker for the kerbside bin lid – the sticker will remind residents what goes in to the bin and identify participating homes in the trial for the collection contractor
- ✓ Explanatory sticker for the kitchen caddy to remind residents what to put into the bin
- ✓ ‘Thank you’ letter following the conclusion of the trial, detailing trial outcomes and next steps to be undertaken by council.

All communication should be presented using simple and clear language, and the use of pictures is encouraged.

7.5 Scaling communications

During a pilot or trial, the roll-out stages occur over a shorter period of time and with a smaller target audience. Therefore it is important to test communication and engagement methods that can be replicated at a larger scale to ensure the pilot trial results are comparable. However, also consider that some methods used in the pilot trial may need to be modified during the full roll-out.

7.6 Other Stakeholders

Although householders in the trial area are the key players, do not forget to communicate and consult with other important stakeholders in the trial process.

Stakeholders to consider are those that may be affected by the trial, or who may influence the results. This may include stakeholders such as:

- ✓ Waste collection contractors
- ✓ Residual waste processor
- ✓ Councillors
- ✓ Customer service staff
- ✓ Council outdoor team
- ✓ Schools or businesses in the trial area.

Detailed information on communication, education and engagement options is provided in the Planning section in Factsheet 4 – *Understanding Community Education and Engagement* and in the Implementing section, Factsheet 11 – *Community Education and Engagement*.

8 – Monitoring and evaluation

It is recommended to conduct the following monitoring and evaluation before, during and after the trial:

- ✓ Waste audit of the residual waste stream to be carried out pre-trial, mid-trial and the end of trial. Conducting audits in summer as well as winter will reveal seasonal variations in diversion and composition.
- ✓ Bin set-out rate audit to be conducted mid-trial and end of trial.
- ✓ Householders' satisfaction and participation surveys to be conducted mid-trial and end of trial.

The trial also presents an opportunity to test the effectiveness of various communication techniques. For example, it may be worthwhile targeting selected areas with door-knocking campaigns, monitoring and comparing participation and contamination rates with areas not subject to the door-knocking campaign.

Detailed information on monitoring and evaluation can be found in Factsheet 8 – *Understanding Monitoring and Evaluation*, in the Planning section and in the Implementing section, Factsheet 13 – *Conducting Monitoring and Evaluation*.

9 – Applying the results

The pilot trial planning stage is the most important time to start thinking about how the results of the trial will be used. Sometimes this consideration is neglected until the trial is complete, by which time it is too late to change anything if the trial was not designed to answer the right questions. Consider the following:

- ✓ Quantitative figures such as participation rate, capture rate and contamination are used to determine overall diversion potential across the LGA
- ✓ Economic information and participant satisfaction results indicate the ease and cost-effectiveness of implementing the system council-wide

- ✓ Qualitative information from focus groups, surveys and other forms of participant feedback provide guidance for improving the system design and inform risk management planning for the future roll-out phase.

Activities that may be based on the results of pilot trial may include some of the following:

- ✓ Planning for carbon price and levy liabilities
- ✓ Changes to residual waste services
- ✓ Financial review of waste services
- ✓ Community consultation on waste services
- ✓ Development of new waste management and/or waste education strategy
- ✓ Development of new collection contract
- ✓ Feasibility analysis of new processing facility
- ✓ End-product market assessment.

Although financial cost is a primary consideration for local governments in assessing performance and suitability of waste services, considering environmental and social impacts/benefits will provide a broader understanding of the long-term value of different options.

In order to gain a comprehensive understanding of the comparative performance of the different options tested and help inform the decision making processes, council can conduct a triple bottom line (TBL) assessment. A TBL refers to the detailed evaluation of economic, environmental and social information in an integrated manner.

Pilot trial checklist

This section provides a checklist of some steps involved in planning and implementing a pilot trial.

Pre-planning

- ✓ Assign a project manager and identify a team with specific roles
- ✓ Gather information on the demographic mix of households in the council area and select representative sample areas for participation
- ✓ Consider health and safety implications of different systems.

At least 3 months prior

- ✓ Procure caddies, liners and/or bins as early as possible.
- ✓ Check compatibility of proposed organic waste collection with existing collection runs, vehicle fleet capacity and processor acceptance requirements.
- ✓ Prepare the communications plan. Engage a specialist if in-house expertise and experience is not available. Establish the budget and program. Engage designer and printer to ensure the materials are ready in time for the start date. Plan the distribution of equipment.

About 2 months prior

- ✓ Recruit the collection crew – this may require new staff to be recruited or existing employees to be re-deployed. Ideally, roles should already be agreed with the contractor at an earlier stage. Implement a training program with the relevant crew.
- ✓ Prepare the monitoring and evaluation plan. Engage a specialist if in-house expertise and experience is not available and ensure that data collected addresses the right questions and is able to provide the desired results.
- ✓ Plan an affordable and achievable distribution program for bins, caddies and education materials. Ensure storage of equipment prior to distribution is arranged.

6 weeks prior

- ✓ Finalise design and printing of education resources such as brochures, stickers, and calendars as early as possible.
- ✓ Provide plenty of advance notice to residents by distributing an introductory letter or flyer to households in the trial area, stating that they have been specially 'selected' and informing them of how the project will occur. Engaging with residents as early as possible, and throughout the process, will help to lessen the need for reactive communication during rollout.

4 weeks prior

- ✓ Compile the education and supporting materials into prepared kits ready for distribution, such as a letter, printed resources, stickers, compostable

liners and other tools or incentives. This kit may also include the kitchen caddy if relevant.

- ✓ About a week before delivery of bins, send out an information letter to remind participants about the trial commencement and the distribution schedule for each trial area.

2 weeks prior

- ✓ Send out press releases for the roll-out in the trial areas
- ✓ Distribute bins, caddies, liners and instructions to residents on how to use the service.

Up to 1 week after commencement

- ✓ Conduct an initial survey of trial participants to provide baseline results for later surveys. This is sometimes done in person during delivery of education packs and caddies. Where staff resources are limited, include a survey and 'reply paid' envelope in the education pack, ideally with a small prize (such as a chance to win a free movie ticket) to motivate participants to complete the survey.
- ✓ Hold an information session for trial participants to answer questions, address concerns and increase awareness of the project.
- ✓ Commence and advertise an incentive program for improving participation and reducing contamination levels, such as distribution of prizes based on visual bin inspections on collection day.

During trial

- ✓ Gather key information on the likely future impact on existing refuse and recycling collections, such as by auditing the entire waste stream at the start, middle and end of the trial
- ✓ Implement other identified monitoring and data collection procedures, such as visual inspections and collection vehicle driver log-books
- ✓ Conduct a second participant survey later in the trial to capture information on participation, understanding, behaviour and satisfaction once households are fully experienced with the system
- ✓ Continue to monitor participation and contamination levels throughout the trial and implement a planned contamination management strategy as interest and engagement with the project can drop off over time.

Around the completion time of the trial

- ✓ Analyse and communicate results as soon as possible to maintain community and council momentum
- ✓ Conduct focus groups or other forms of consultation to compare and gain greater insight into the perceptions of both participants and the wider community towards the organics service.

Case Studies

Hills Shire Council

The Hills Shire Council is a rapidly growing area in Sydney's north-west, with about 80% of its 55,000 households living in single dwellings. The council's domestic waste collection contracts are due to expire between 2012 and 2014, and the council has been thoroughly investigating options for future services since setting up a Resource Recovery Task Group in 2010. A major component of its research and community consultation process was to conduct a food organics collection trial which took place over a 10 week period from late September 2011.

A typical Hills Shire household's residual waste stream contains 33% food and a further 17% is other organics including garden waste and soiled paper, so the trial aimed to determine the potential amount that could be diverted from landfill through a combined food and garden organics service.

In the trial, residents were permitted to place food into the existing 240L garden organics bin, which was then collected weekly. The residual waste remained a weekly service and the dry recycling a fortnightly service. The trial consisted of 250 properties in each of the four Wards of the council area to test four different variations on the collection system. The sample sizes and a control group of 250 properties were chosen for statistical reliability of results. The different test groups allowed participant satisfaction to be measured for system variables, such as ventilated compared to enclosed kitchen caddies, biodegradable bags compared to newspaper or no liner, and single dwellings compared to multi-unit dwellings.

Monitoring and evaluation of the trial was conducted through a number of methods. During the roll-out, education packs were delivered through door-knocking and a face-to-face survey was conducted with households. Participants also received a phone call near the end of the trial as a reminder that the trial was ending and to conduct the post-trial survey. Three focus groups were held (including both participants and non-participants) to further explore attitudes, perceptions and behaviour. Audits of 100 residual and organics bins were conducted during weeks 1, 5 and 10 to provide quantitative waste data.

There were a number of unexpected results of the food organics trial. Firstly, participants were much more positive about the service than the council had expected – there were no complaints received from any of the 1,000 participating households as a result of the trial service. Secondly, feedback on odours was minimal, and mainly raised by households that did not use a lined container. Contamination was almost zero, which was surprising given contamination has been a major issue for the food organics collection service in the neighbouring council area.

Another interesting trial result was that the type of container provided did not have a significant impact on satisfaction or participation – households generally liked the collection system they were given. However, qualitative results showed that a range of options and flexibility to suit individual needs are important factors in the design of the system. Overall, the pilot was so well accepted that many participants were unwilling to go back to their normal service.

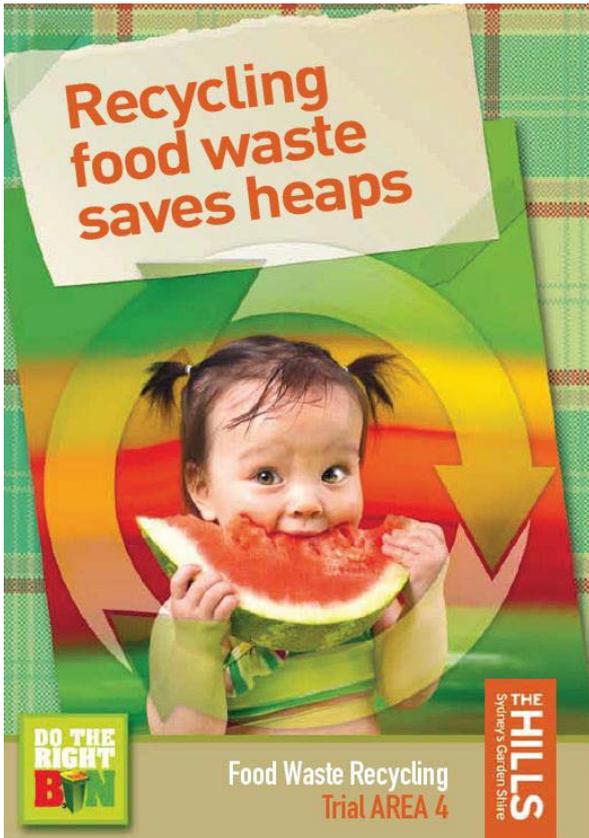
One of the most surprising results for the council was the effect that participation in the trial service had on the avoidance of waste, particularly wasted food. Average yield of food organics was between 0.62kg and 2.66kg per household per week, depending on the collection system, with a maximum capture rate of 40%. Additionally, in one trial area, participants avoided 2.15kg of food waste per week (on average) during the trial. Surveys revealed that this was mainly due to greater recognition by participants of the sheer amount of food wasted by having to separate it from other waste in the kitchen. Taking into account waste avoidance, the maximum diversion of food compared to the control group was 63%.



Organics bin sticker used in the trial

The recovery results of the pilot trial provided council with specific information to undertake a thorough cost-benefit analysis, comparing the long-term effectiveness of a food organics service to other recovery options.

Lessons Learnt: The pilot trial showed the council that expected recovery and contamination rates would be very different to the neighbouring council area if a similar service was introduced. It now has reliable evidence to make informed decisions about future resource recovery options.



Cover of Hills Shire trial brochure for Trial Area 4

REROC Waste Forum

'Cluster Composting Trial'

The Riverina Eastern Region of Councils (REROC) is a voluntary association of 13 councils in the eastern Riverina region of NSW. It covers a large geographical area of about 43,000 square kilometres, but has a small population of approximately 140,000 people.

During 2007 the REROC Waste Forum developed a Regional Organics Management Plan (ROMP) for the region which concluded that a large-scale organics processing facility in the region was not economically feasible due to the extensive travel distances and relatively small quantities of feedstock that could be collected at the kerbside. However, the forum has supported a composting project being conducted by Charles Sturt University (CSU), with the goal of identifying viable, low cost methods for organics recycling in small communities.

The forum decided to develop a pilot trial project which aimed to test the feasibility of a cluster-based approach to composting. The REROC members have a successful history of conducting cluster-based projects and the cluster approach to organic waste collection and processing allowed the members to trial composting processes locally, while spreading the costs of collection implementation and project management across the four participating partners.

The trial commenced in August 2011 and lasted for 12 months in Coolamon, Cootamundra, Gundagai and Junee. Only the first 6 months was intended to be assessed for the purpose of a cost-benefit analysis. Food and garden organics collections were introduced to 800 households (200 in each participating LGA) which represent about 10% of total households that receive a kerbside waste collection.

The timing of the project was to ensure that collections operated over the two hottest periods of the year, spring and summer.

Each participating household was provided with:

- ✓ A bench-top caddy and supply of numbered compostable bin liners
- ✓ A 240L organics/green organics MGB which was collected fortnightly.

The roll-out process took place 2–3 weeks prior to the commencement of the trial. The bench-top caddies were distributed in person by a council officer, including verbal introduction and explanation of the service and an initial survey. Where the householder was not at home an education pack was left with the caddy, which included an introduction letter, 4-page FAQs flyer, and an A5 calendar. Of the homes visited, 193 people participated in the survey. The distribution of the 240L bins occurred approximately a week after the bench top bins were distributed.



Branding of REROC Cluster Composting Trial

The trial compared two different proven composting methods to determine the most cost effective approach for the region. In the first method, which was developed by CSU, compost piles are open to the air and turned on a regular basis. The second method was adapted from the Groundswell project (in southern NSW), in which compost is covered by tarpaulins, turned only once each cycle, and sprayed with inoculant.

Cootamundra Shire hosted the composting facility at its landfill. An agricultural economist from CSU was engaged to provide initial training to landfill operators on managing the processing of food and green wastes into compost. In addition, accredited training on composting was conducted by the Riverina Institute of TAFE for participating council staff.

The councils developed an innovative method for engaging residents, managing contamination and monitoring participation at the household level. Each compostable liner bag distributed was numbered to identify individual households, which allowed the councils to run spot audits, measuring contamination levels and promoting a rewards program where householders could win a prize for low or no contamination. Each fortnight a number was selected from each of the four LGAs and the resident received a prize worth \$50.

Approximately 6.6kg of material per household per week was collected during the first six months of the trial. Across the four council areas, each household currently sends approximately 10kg of organics to landfill per week, thus the trial result represents an approximate organics capture rate of 66%. Both composting methods were found to be successful and resulted in little to no odour; however a cost comparison of the methods had not been completed at the time of writing.



Council staff undertaking training on composting

The (former) Department of Environment, Climate Change and Water NSW contributed \$30,000 to the project, while REROC Waste Forum committed the remainder of funds. Although analysis of final results has not yet been reported, the trial was budgeted at \$110 per household to implement the main elements such as collection, processing and education (but excluding research, evaluation, and consultancy fees). Although the councils' estimated current cost of sending organic waste to landfill is \$44 per household, the cost per household of full implementation would be considerably lower and there is an option to recoup some cost through the sale of compost. The CSU project indicated council could offset costs by up to \$30 per tonne of compost produced.

Lessons Learnt: The pilot trial in the REROC region suggests recycling of source-separated organics collected at kerbside can result in high recovery rates and is likely to be viable even for the small communities of the member councils. Although the financial analysis is yet to be reported, the approach was well accepted by the communities and produced a high quality compost product.

Scheme design and roll-out

It is important that the roll-out of the service runs smoothly, including delivery of bins, caddies and information material, and that legitimate grievances of residents are dealt with promptly. Major problems with the roll-out or the first collections can result in dissatisfied residents and negative press, putting at risk the success of the organics recycling scheme, at least in the short term.

Things to consider prior to roll-out

- 1 **A facility** processing garden organics may not be suitable or licensed for the processing of food organics.
- 2 **Trialling** a combined food and garden organics services on a proportion of the local government area may be useful in encouraging community debate, fine tuning program components such as education, communication and waste infrastructure. Sequential rollout of services may be easier for householders.
- 3 Ensuring **access to appropriate equipment**, such as containers and often liners, is a fundamental consideration for organics collection services. In order to maximise yields, it is important to provide practical and convenient methods to make organics collections easy for householders.
- 4 A **well-designed communication and education program** is essential for explaining why a service change is being implemented and how householders are affected. Councillors, senior council staff, customer service staff, waste staff and community leaders may all be important in conveying messages to and from householders.

Smooth implementation with minimal adverse media coverage may be assisted by commencing the communication and education strategy many months before roll out of the service and ensuring enough people are on hand to answer queries during the initial phases.

- 5 **Designing efficient rounds** that match the capacity of the collection vehicles and collection crew is important, as rounds with too many households risk service quality issues because the crew will struggle to finish rounds on time. Rounds set at low pass rates would mean the overall cost of collection becomes relatively high, as vehicles and crews are not fully utilised.
- 6 Planning of the rollout should **ensure that the timing is appropriate** - impacts such as seasons, potential extreme weather conditions holidays, elections, roadworks or local events should be considered.
- 7 **Measuring performance** over time (for example tonnes diverted and contamination levels) will be important in evaluating the success of the scheme.

It is essential to allow for **flexibility** in services, as it may help cater for a diverse community with different attitudes about organics. For example:

- ✓ Supplying non ventilated bench top kitchen caddies means that they can be used with and without liners
- ✓ Making liner bags available on request for those householders who would like to participate in a food collection services can help address the 'yuk' factor
- ✓ Continuing to support home composting when a kerbside food collection service is available will provide best outcomes
- ✓ Increasing food and garden organics collection frequency during summer when hotter weather may cause increased complaints about odour, fermentation flies and maggots, can help address nuisance issues.

An opt-out style service is recommended where all householders are provided with the service but are under no obligation to use it. This approach may result in some containers not being used, but participation rates will be improved and round efficiencies maximised.

Many issues relevant to a full roll-out are similar to those considered for a pilot trial in Factsheet 9 – *Conducting and Evaluating a Pilot Trial*.

1 Accessing suitable processing facility

The type of organics collection scheme introduced (for example food organics only or food organics combined with garden organics) will have a major impact on the treatment options. It is advisable to engage with as many technology providers as possible, in order to gain a solid understanding of the options available and which might be most appropriate. Sites receiving food and garden organics separately may be better positioned to manage the blend of feed stocks for processing, allowing greater control over the quality of end products. Depending on their chemical and physical characteristics, different types of organic residues lend themselves better for combustion (incl. gasification), composting or anaerobic digestion.

Combustion	Composting	Anaerobic Digestion
Wood		
Tree & Shrub Prunings		
Land Clearing		
Vegetation Management		
Park & Garden Residues (winter - summer)		
Mixed Garden & Food Organics (rural - urban)		
Commercial Organics		
Kitchen Organics		
Food Scraps		

Increasing Moisture Content .

Increasing Porosity and Structural Stability .

Preferred processing options of organics

When introducing a collection scheme, it is advisable to:

- ✓ Seek to fix treatment costs by securing gate fees (or a portion of gate-fees, for example covering core processing costs but not other factors, like landfill levy impacts on residual waste) for the organics over the duration of the trial
- ✓ Check that markets have been secured for the finished compost
- ✓ Ensure arrangements for dealing with contamination are specified in the contract (for example responsibilities, contamination limits, and who pays if loads are rejected).

Detailed information on processing technologies can be found in Factsheet 5 – *Understanding the Processing Options*.

2 Trialling

Any new kerbside organics collection system should be trialled before full-scale implementation in order to identify any local issues or knowledge gaps. Trials can encourage community debate and help fine tune program / service components such as education, communication and infrastructure. Factsheet 9 provides information on the main steps involved in setting up and running a pilot trial.

3 Providing equipment

Delivery of kerbside bins and caddies can be time-consuming and costly. The following items may need to be distributed as part of the organics collection scheme:

- ✓ Kerbside bin
- ✓ Kitchen caddy
- ✓ Liners
- ✓ Education materials (these are discussed in the following section).

Residents must be provided with a rigid plastic bin in which food and garden organics can be stored for collection. The lid should be secure enough to prevent leakage and scavengers (cats, dogs, birds) and vermin from gaining access.

Factsheet 3 provides more information on container types and sizes.



Kerbside bin (Leichhardt City Council)

It is recommended that liners are used and that local authorities provide a free supply of liners at the start of the scheme. If budget is available, then councils can continue to provide liners at the householders' request. The supply and use of 2–3 bags per week is considered typical, although the number may vary depending upon the number of people per household, food storage, preparation and their food consumption. If a council decides to supply liners to residents free of charge, then they should budget for at least 150 liners per household per year. As liners do degrade over time, especially in damp conditions, it is recommended that liners are not kept too long and supplied more regularly rather than annually in bulk.



Bin sticker (The Hills Shire)

With one truck and three staff, containers could be distributed to 500 to 600 households per day. Distribution to multi-unit dwellings can take two to three times longer in comparison to other residential housing.

A collection scheme can be introduced on either an opt-in or an opt-out basis. Under an opt-in system, the householder is given the choice of whether to use the service. Only those households who have expressed an interest will be given a collection container. This approach is not preferred as it is likely to result in a lower overall take up of the service. Lower set out rates will diminish round efficiencies, with more unproductive time incurred travelling between fewer set-outs. An opt-out style service is recommended. All householders are provided with the service but are under no obligation to use it. This approach may result in some containers not being used but participation rates will be improved and round efficiencies maximised.

More information on types of equipment required can be found in Factsheet 3 – *Understanding the Collection Options*.

4 Implementing communication and education

When introducing new services, the education and engagement strategy must be staged and maintained over a period of time. There are a number of clear stages including:

- ✓ Pre-launch communications
- ✓ Information when the service is rolled out
- ✓ A monitoring and evaluation program
- ✓ On-going education and communications to householders throughout the life of the collection service.



Bin sticker (Numurkah - Resource GV)

Key issues to consider:

- ✓ Prepare a communications plan (12 months before service commences) including a budget and scheduling of when activities should take place (and by who)
- ✓ Engage the communications/PR departments of council early on when planning and developing communications
- ✓ Senior council management and councillors need early involvement in planning new services to ensure their support
- ✓ Allow sufficient funding for the first few years of the new service with the resourcing levels decreasing over time
- ✓ Consider a partnership approach with the collection or processing contact to help resource the communications and to obtain their input in communications.

If a pilot trial was conducted, consider that the roll-out stage for the full implementation may occur over a longer period of time, has a much larger target audience and will involve much more time and resources. Therefore it is important to ensure that the pilot trial results are comparable. Although the pilot trial should have tested communication and engagement methods that can be replicated at a larger scale, it may be necessary to modify methods for the full roll-out. For example:

- ✓ Glossy brochures of multiple pages may need to be scaled back to a smaller flyer for the full LGA roll-out to reduce costs
- ✓ The staff time for door to door discussions may mean this communication method needs to be limited to households having troubles with the new service rather than all households receiving the new services
- ✓ Councillors, community leaders and the media may require more in-depth briefing on a new service than what they received for a small trial or pilot
- ✓ Hot-stamping of caddies and bins or more durable stickers may be more appropriate for permanent services
- ✓ Communications material may need to be reproduced in several languages to suit the larger target audience.

Detailed information on communication strategies can be found in Factsheet 11 – *Conducting Community Education and Engagement*.



Communication through door-stepping

5 Designing collection rounds

A key challenge is designing efficient rounds that match the capacity of the collection vehicles and collection crew. Rounds with too many households risk service quality issues as the crew will struggle to finish rounds on time. Rounds set at low pass rates would mean that the overall cost of collection becomes relatively high as vehicles and crews are not fully utilised.

Factors affecting collection rounds include:

- ✓ Travel to start of round
- ✓ Crew breaks
- ✓ Travel to treatment facility
- ✓ Travel back to round or return to depot
- ✓ Ancillary time for vehicle checks and cleaning
- ✓ Demographics and geography of the area
- ✓ Number of set outs
- ✓ Location of set outs
- ✓ Loading time for each set out
- ✓ Work rate of operatives
- ✓ Fill rate of vehicles.



Organics collection truck

Setting out bins in appropriate locations

Giving residents clear guidance on where to leave kerbside bins for collection is important in reducing the amount of time spent collecting bins. It is also important to leave emptied bins in a tidy manner and in the same place they were presented. This reinforces good behaviour by residents in setting out their bins, and helps to maximise levels of satisfaction with the collection service.

Collection crew

The most significant cost element of running a collection service is related to the number of staff and their salaries. Ensuring good crew productivity is very important. When determining crewing levels it is also important to ensure that staff can carry out their work safely and efficiently.

The collection crews are ambassadors of the service, both by providing an efficient service on the street and in dealing with queries or concerns about the collections and explaining the service to residents. Providing good and appropriate training can help to foster a positive attitude amongst collection crews, enabling them to have ownership and pride in the service.

6 Appropriate timing

Planning of the rollout should ensure that the timing is appropriate. Consider impacts of the seasons, potential extreme weather conditions and ensure that the commencement period does not coincide with holidays, elections, roadworks or local events. A staged roll-out occurring progressively for each collection area of the LGA over a period of several weeks will allow for major issues to be identified and improvements made to the process.

7 Measuring performance

One of the main reasons you will undertake monitoring and evaluation is to understand how a service, scheme or communications campaign is performing so that you can identify opportunities for improvement. This applies to both the waste management services and the communications activities undertaken to promote them.

There are various methods that can be employed to demonstrate the effectiveness of a scheme including:

Method	How?
1 Tonnage data analysis	Request data from facility operator
2 Waste auditing	Contract specialist company to undertake composition analysis
3 Set out & participation rate monitoring	Identify area, conduct visual inspection on (3 consecutive) collections, record households who have placed bin(s) out for collection.
4 Organics capture analysis	As method 2, conduct a tailored waste audit
5 Stakeholder feedback	Conduct focus groups and / or surveys (door to door, roadshows, events, public places)
6 Communication evaluation	Compare baseline data and results of above methods in areas you targeted with your communications campaign

Detailed information about monitoring and evaluation can be found in Factsheet 13.

Case Studies

Kempsey Shire Council –

Getting the system right for your own community

Kempsey Shire Council (KSC), located in northern NSW, implemented a food and garden organics collection service in late October 2011. The existing garden organics collection serviced approximately 7,476 households using 240L MGBs. The collection contract with JJ Richards, which commenced several years previously, made allowance for acceptance of food organics and included a \$30,000 per annum education contribution from the contractor. The council's organics processor, the Remondis ORRF facility at Cairncross, already accepted food organics from the neighbouring Port-Macquarie Hastings Council (PMHC) area and so had planned to accommodate the additional input of food.

The council undertook minimal consultation and testing prior to the roll-out because the scheme in nearby PMHC had been working successfully for many years. KSC decided to follow the same system design, providing residents with the same aerated kitchen caddies and Biobag liners. However, in order to simplify the roll-out process, the scheme was made voluntary for households and participation required residents to come in person to the council to receive their starter pack and educational flyer. This arrangement was intended to ensure some interest and commitment from participants and also allowed residents to discuss the scheme with a staff member.

Within a short time of the initial roll-out, problems with the kitchen caddy design became apparent. There were a large number of complaints and returns of the caddies due to the flimsiness of the design, with lids breaking or parts being lost easily. Also, these items were delivered to council in four parts and needed to be assembled by council staff prior to distribution. By early 2012, KSC decided to discontinue use of the initial caddy design and moved to distribution of the 'Source Separation Systems' kitchen caddy. This allowed residents to choose from a ventilated design with biodegradable liner bags or a completely enclosed design that does not required liners. A major advantage of the newer design was that it could be hot-stamped with the council logo and other information as a reminder to participants.

Despite a very minimal initial advertisement of the scheme, by early April 2012 approximately 3,500 households, or over half of the households receiving kerbside collections, had chosen to participate in the scheme. Since the introduction of the new kitchen caddy design (known as the 'Handy Bin'), complaints have decreased significantly and the council now also provides the 'Handy Bin' to every rateable address, including rural properties and businesses.

Lessons Learnt: It was assumed that a system design that had been extremely successful in the neighbouring council area would be equally suitable for Kempsey residents, but this was not the case. Fortunately, the council was able to change its supplier to a more suitable product, which had the unintended benefit of being a useful education and promotion tool.

Woollahra Municipal Council –

Tailoring a collection scheme for high-density populations

Woollahra Municipal Council, in Sydney's Eastern Suburbs, originally started a combined food and garden organics collection trial in 2007, but since then has rolled out a permanent 'Kitchen to Compost' service to the entire council area of over 26,000 residential dwellings.

Most households used their existing garden organics bin, a 240L MGB, for the weekly combined organics collection; however the option of 120L MGB was also made available for properties with less garden waste. Residents were also provided with a 5L enclosed 'kitchen bucket' and were encouraged to use newspaper as lining. Residual waste continues to be collected weekly in a 120L MGB, while dry recyclables are collected weekly in two crates.

Waste audits conducted in 2009 found about 38% of households overall were participating in the service by placing food in the organics bin. About 36% of bins from single dwellings contained food, compared to 52% of multi-unit dwellings. The participation rate was highest in the suburb of Woollahra (60%) and lowest in Watson's Bay (25%). Yields of food organics averaged 2.55 kg/hhld/week for single dwellings and 1.64 kg/hhld/week for multi-unit dwellings, but captured only 14.5% and 9.5% of total food disposed by these dwelling types respectively. Contamination was extremely low at 0.2% overall.

After several years, the council found that although the collection service was extremely popular amongst residents who already used it, a key barrier preventing take-up by residents in dense rows of terrace houses was the size of MGBs and lack of storage area to keep them.

In 2011, the council rolled out a new 60L kerbside bin to single dwellings in the Monday collection area of Paddington, West Woollahra and Edgecliff. The small caddy is used primarily for food organics and is collected manually by council's day labour crew. Some households use the same caddy both in the kitchen and at the kerbside.



60 litre MGB collected from terrace houses

Since this new collection system was introduced, over half of the 3,000 eligible households have taken up the service. Initial survey results indicate that 85% participate weekly and 65% claim that they no longer place any food scraps in the residual garbage bin. Although audits have not yet been undertaken, this indicates a higher participation and recovery rate than the rest of the council area using MGBs for the combined food and garden service.

Feedback from residents suggests the 60L bin is more suitable when used only for food as the lid can be locked closed to reduce odour escape, and it can be easily cleaned indoors. It also captures garden organics from dwellings with small garden spaces that would otherwise not have a garden organics bin.

One draw-back of the 60L collection caddy is the impact on council's waste collection staff. Enclosed bins containing only loose food scraps become very odorous and are unpleasant to empty by hand. Collection is found to be much easier when bins are lined, food is wrapped in newspaper and/or food is mixed with garden organics. Use of biodegradable liners is an improvement that both collection staff and many residents would appreciate for the prevention of odours, although council has chosen not to introduce provision of liners in order to reduce contamination by plastic bags, simplify logistics, and maintain a cost-effective waste service.

Lessons Learnt: By not being locked into a particular collection system, Woollahra Municipal Council has been able to roll out its collection service progressively and tailor its approach over time. Performance of the service has been significantly improved by providing a range of collection options for the wide diversity of dwelling types in its municipality.

Conducting community education and engagement

Householders with the skills and motivation to use the new service are a key component to the success of a new organics service. Factsheet 4 outlines the types of community education and engagement and key issues to consider in preparing a communications plan. The communications plan will include various stages including pre-launch, new service roll-out, and ongoing communication.

During a pilot or trial, these stages occur over a shorter period of time and with a smaller target audience. Therefore the key messages and communication methods tested during a pilot trial may need to be modified during whole of service roll out.

A communications plan for a whole of service roll out will include communication strategies not appropriate for small targeted trials. Newspapers, websites and displays at events may provide more cost effective opportunities for reaching a wider audience. Schools, community groups and clubs may provide opportunities for more in depth workshops about the benefits and operation of the new organics service.



Information leaflet (Leichhardt Council)

The different stages

There are a number of distinct stages to community education and engagement, and the success of these will influence the success and acceptance of your scheme. The stages are:

- 1 Pre-launch communications
- 2 Information when the service is rolled out
- 3 A monitoring and evaluation program
- 4 On-going education and communications to householders throughout the life of the collection service.

Communications plan

To help guide the communications effort it is recommended that councils prepare a plan to guide communications and community engagement activities. The plan should focus on practical actions and:

- ✓ Identify target audiences; residents, non-English speaking residents, council customer service officers, media and other stakeholders
- ✓ List key messages
- ✓ Identify key issues and how these will be addressed
- ✓ Summarise communications strategies for each of the target audiences and project phases; before, during, and after roll-out of the scheme
- ✓ Outline roles and responsibilities of council and other project partners
- ✓ Outline budget and timelines for actions.

Pre-launch communication should commence 3-6 months before the new service is rolled out. The communication informs residents that a new service is being introduced, what the new service is, why it is being introduced, what type of organics householders can recycle and how to get further information. An example of a key message might be:

A green lid bin will be provided to all households in May 2013 for recycling of garden organics such as grass clippings, garden trimmings and weeds. The bin will be collected fortnightly and the material commercially composted to provide a quality product to upgrade local sports fields. This will lead to decreased council waste disposal and sports field maintenance costs as well as multiple environmental outcomes. More information is available at council's website [URL].

The key messages form the basis of simplified pictorial displays and brochures as well as more detailed communications such as media stories and workshops. The aim is for all stakeholders to be aware of the basic messages prior to receiving the new bin and the more detailed service roll out communication about how to use the service.

A more comprehensive pre-launch communication strategy would be required where multiple bin services are changing concurrently, neighbouring councils experienced issues implementing a similar service, or the local trial highlighted specific issues that could be improved.



Roadshow Event (Hyder)

When launching a major system change, other forms of communication such as roadshows, media publications and council displays may also be advisable.

New service communication

To follow up the pre-launch leaflet, councils should produce another communication to support the launch of the service, including more specific details about the new service, for instance when the service will start and how to use it. The new service communication would commence during bin delivery and 2 weeks prior to scheme roll-out and continue until the majority of households are correctly utilising the new service. The delivery of bins more than 2 weeks prior to the first collection runs the risk of householders commencing to use the bins too early and material putrefying.

Delivery of bins and or kitchen caddies provides an opportunity to also deliver information attached to the bin (sticker, stencil, hot stamping), on top of the bin (removal information brochure), within the kitchen caddy (brochures, fridge magnets, stickers, etc.). Delivery of the information material with the bins following the bin collection route can help ensure that the brochures showing collection day as Monday for example are delivered to only the households serviced by a Monday pick up.

New service communication gives the householder detailed information about the types of materials that can be recycled, the day of the week for the collection, who to contact for help, as well as practical advice on how to make the most of the new service and deal with any potential problems. For example:

- ✓ Whether or not meat and bones can be included
- ✓ Whether or not kitchen towel and soiled paper like pizza boxes can be included
- ✓ Whether scraps from dinner plates and processed food past its expiry date are encouraged or just food items like fruit and vegetable skins
- ✓ How to use newspaper as a liner in the kitchen caddy
- ✓ If liner bags are provided – the difference between compostable, biodegradable and recyclable liners, where to get further bags of the correct type, issues and consequences of using the incorrect liners, how often to change the liners
- ✓ How to discourage pests, vermin and odours
- ✓ How to wash kerbside bins without polluting stormwater
- ✓ Who to contact if they have a query (e.g. helpline and website).

IMPLEMENTING YOUR SCHEME – **FACTSHEET 11** –
CONDUCTING COMMUNITY EDUCATION AND ENGAGEMENT

The service roll-out communication plan also needs to respond to any issues that arise during roll-out. Issues such as:

- ✓ Householders using a new liner bag every day thus exhausting their liner allocation
- ✓ An unprecedented hot spell increasing odour and pest issues before householders are familiar and committed to the new service
- ✓ High profile community members or media making incorrect statements about the new service
- ✓ Lack of understanding of the term organics bin to include garden and kitchen ‘waste’.

All communication should be presented using simple and clear language and it is encouraged to use pictures.



Bin Sticker (Zero Waste SA, Adelaide City Council)

A monitoring and evaluation program including seeking householder feedback will enable councils to identify how well the new service is performing, identify individual households or segment groups to focus efforts to improve service outcomes and if the communications have had the desired effect.



Multi-lingual leaflet (Zero Waste SA)

On-going education and communications

to householders over regular intervals throughout the life of the food and garden organics collection service is essential in order to maintain household participation, high diversion rates and low levels of contamination. General feedback in terms of the tonnes of food and garden waste recovered, environmental benefits, quality and use of the composted material, may encourage further efforts by residents. While targeted communication and education may be necessary for particular households or suburbs.



Public Meeting (Hyder)

Key issues to consider in planning effective communications:

- ✓ Prepare a communications plan (12 months before service commences if possible) including a budget, scheduling of when activities should take place and by who
- ✓ Engage the communications/PR departments of council early on when planning and developing communications
- ✓ Senior council management and councillors need early involvement in planning new services to ensure their support
- ✓ Consider a partnership approach with the collection or processing contractor to help resource the communications and to obtain their input
- ✓ A pilot trial provides the opportunity to test communication messages and techniques.

Case Study – Goulburn Valley RWMG

‘Keeping in touch with your community’

Resource GV (Goulburn Valley Regional Waste Management Group) obtained State Government funding through Sustainability Victoria to conduct an organic waste collection trial in Moira Shire, which involved 230 households in Numurkah over a 4 month period in mid-2011. Participating households had an existing kerbside garden organics service but were delivered aerated kitchen bins and liners for convenience.

The trial was extremely successful and achieved an 85% presentation rate, an average yield of almost 3kg per household per fortnight and an additional 23% diversion from the residual waste stream. The service is on-going for the trial participants.

Considerations for community engagement and education were an integral component of the trial. The trial area was selected based on previous research indicating a higher than average organics disposal rate and a population representative of the Shire. Design of critical elements such as printed resources and evaluation were outsourced to professionals and were well-resourced to ensure their effectiveness. The education strategy included:

- ✓ A targeted education package delivered in person to residents to ensure participant understanding
- ✓ A comprehensive support program for participants to provide troubleshooting and gather feedback
- ✓ Use of SMS messaging to provide participants with real-time collection reminders and positive reinforcement
- ✓ Bin inspections with prizes for good performance
- ✓ A compost give-away to demonstrate a closed-loop approach
- ✓ Personal appreciation in writing from the Shire Mayor to trial and survey participants.

Following the successful completion of the trial, market research surveys were undertaken with a total budget of approximately \$18,000. Telephone surveys with 105 Numurkah participants and 100 non-participants provided a benchmark of community attitudes and behaviour, and gauge community acceptance of a potential future service.

The results of the community research and evaluation included:

- ✓ 82% of participants supported the trial prior to commencement
- ✓ Support increased to 96% of participants after the trial
- ✓ Common reasons for support included convenience and ease of disposal using the system
- ✓ The majority of the general community did not see any barriers to the service, however 24% viewed cost as the biggest barrier
- ✓ Participants recognised the benefits of the service more than non-participants
- ✓ \$1 per week appears to be the optimal cost people are willing to pay for the service with 74% of the general community willing to pay this.

Lessons Learnt: The trial demonstrated the importance of selecting innovative communication methods that meet the needs of the participants and of rewarding participants for using the service. It also demonstrated the importance of good project planning to ensure sufficient budget is allocated to thoroughly understand the attitudes, behaviour and expectations of the community in relation to the organics collection service. The trial will provide a thorough basis to inform a possible future decision to implement the service permanently across the Shire.

Contamination Management

Contamination of organics by non-targeted materials can be an issue for some kerbside collection schemes. When introducing a combined food and garden organics service it is important to maintain low levels of contamination, in order to:

- ✓ Decrease processing costs
- ✓ Ensure the products meet regulatory requirements
- ✓ Ensure the composted products can be marketed and used without causing harmful environmental impacts.

Contaminants in organics

Contaminants can be differentiated into:

- ✓ **Physical contaminants**, which comprise non-compostable impurities (e.g. plastic, glass, metal, rocks)
- ✓ **Chemical contaminants**, which include mainly heavy metals and herbicides
- ✓ **Biological contaminants**, which represent plant, animal and human pathogens and also viable plant parts or seeds.

High physical contamination levels usually result in increased contamination with heavy metals and other pollutants. Non-organic materials can contain numerous potential pollutants, some of which will end up in the finished compost. This can happen by way of (i) small particles that are generated during feedstock processing being retained in the compost, or by pollutants being solubilised during the composting process. Examples for this include the potential of car batteries in feedstock to result in elevated lead levels in compost, and generally increased contamination levels in compost from AWT.

There might be occasions where contamination in compost is caused by natural conditions, such as elevated heavy metal concentrations in soil being responsible for high heavy metal concentrations in compost. Heavy metals do not 'disappear' during composting, but are concentrated as the organic material breaks down.

Many, but not all, undesirable chemical compounds are broken down during the composting process. Most herbicides and pesticides are broken down and rendered ineffective during the composting process; however, some may persist. For example, the pyridine herbicides, *Clopyralid* and *Picloram*, are known to persist and accumulate in finished compost. As was seen in the USA and New Zealand, they can cause damage to plants if contained in minute concentrations in compost. These herbicides are used in the agricultural sector in Australia, but are not registered for domestic use. Hence, there is little risk that compost made from kerbside collected organics will contain these herbicide residues.

Biological contaminants, such as weed seeds, plant diseases, mould on spoiled food, or *E.coli* in pet excrements do not pose a problem as they are usually eliminated in well-run composting operations. Elevated temperatures (above 55°C) that are generated during the composting process and maintained for an extended period, inactivate plant propagules and pathogens. According to the *Australian Standard for Compost, Soil Conditioner and Mulches* (AS 4454-2012), composted material can be considered pasteurised if the whole of its mass is subjected to a minimum of three turns with the internal temperature reaching a minimum of 55°C for three consecutive days before each turn. Vermicomposting on its own is not able to generate pasteurised products, which is why these technologies need to incorporate a separate process that ensures elimination of biological contaminants, e.g. composting or heat treatment.

Physical contamination represents a major risk for organics collection schemes (compare Factsheet 6 – *Understanding the Possible Risks*). Potential physical contaminants can include plastic bags, biodegradable but not compostable bags, packaging, glass, cans, cutlery, rocks, garden implements, and misplaced garbage, which can contain anything.

Contamination of kerbside collected garden organics with impurities is relatively low (less than 1% to 3%, weight for weight) in most cases. However, concerns are often raised that co-collection of garden and food organics increases physical contamination of the collected material. Some trials and established schemes support this view, while others have demonstrated that garden and food organics can be collected with very little contamination.

The major contaminant in a food organics collection service is plastic bags. These are used by residents to line the kitchen caddies and transport the food organics to the kerbside organics bin. Occasionally plastic bin liners are also used to keep the organics bin clean. Residents may not be able to differentiate the look and feel of compostable bags from other types of bags or differentiate between the terms degradable, biodegradable and compostable. Householders are often confused by the plethora of environmental based messaging on the packaging of bin liners. In addition, compostable liners for kitchen caddies or bins are often not readily available in retail outlets.

The Australian Standard for Composts, Soil Conditioners and Mulches (AS 4454-2012) stipulates the following key contamination requirements for unrestricted use of recycled organic products:

Physical contaminants

Glass, metal, rigid plastic	≤ 0.5% (w/w)
Plastics – light, flexible or film	≤ 0.05% (w/w)
Stones and lumps of clay	≤ 5% (w/w)

Biological contaminants

Viable plant propagules	0 after 21 days
Salmonella spp	absent in 50 g
Faecal coliforms	<1000 MPN/g

Chemical contaminants

Arsenic	≤ 20 mg/kg
Cadmium	≤ 1 mg/kg
Chromium	≤ 100 mg/kg
Copper	≤ 150 mg/kg
Lead	≤ 150 mg/kg
Mercury	≤ 1 mg/kg
Nickel	≤ 60 mg/kg
Selenium	≤ 5 mg/kg
Zinc	≤ 300 mg/kg

The Australian Standard (AS 4454-2012) quality specifications represent minimum requirements aimed at minimising or avoiding adverse impact on environmental and public health. It does not necessarily mean that customers are happy with contamination levels, even if the product meets the above outlined specifications. Small amounts of plastic film can still make compost products unsightly, and shreds of glass will accumulate over time on the surface of mulch applied in large doses.

At this point in time, it is voluntary to have compost products independently audited against the Australian Standard quality specifications.

Planning for contamination management

A comprehensive contamination prevention and management plan should be developed prior to roll out of a combined food and garden organics service. Planning should be informed by the pilot trial results and local experience with contamination. It should include at least:

- ✓ Education material for householders, including visually appealing lists and stickers of what can and what can't go into the organics bin. Clear symbols (i.e. Ticks and crosses) should be used to ensure the material is easily understood.
- ✓ On-going public education and motivation.
- ✓ Communications material for the local media, councillors, senior staff etc.
- ✓ Arrangements with waste collection personnel regarding contaminated bins and use of contamination tags for individual households not complying, i.e. if the bin contains high levels of physical contamination.
- ✓ Arrangements with the processor regarding contaminated material for the initial roll out of the service and on-going maintenance of the service. This may include penalty payments if contamination levels exceed a certain threshold.
- ✓ Continuous monitoring and evaluation in problem areas through bin inspections, waste auditing and community consultation.

It is often very hard and costly to remedy a situation where collected organic material has unacceptably high contamination levels. Hence, adequate resources need to be made available to prevent this from occurring.

Particular issues related to combined food and garden organics collections include:

- ✓ Whether Councils should elect to promote compostable plastic liners, paper liners or no liners.
- ✓ If liners are promoted whether they will be supplied by council (how many for how long) or if residents have to provide their own.
- ✓ Whether plastic bags and other large impurities are going to be handpicked and removed at the processing facility or not. Hand sorting of incoming material increases processing costs and may also require colouring or marking compostable bin liners so they can be easily differentiated from other plastic bags.
- ✓ Whether a bag shredder will be deployed to rip open compostable bin liners to release food material. This may result in small pieces of non-compostable plastic within the end product if the incorrect types of bags are used by the householder.
- ✓ Whether kerbside collected garden and food organics be shredded, as this will result in small pieces of plastic that are hard to separate from the finished compost and mulch.
- ✓ Whether contaminated bins will be identified, remedial action taken with the individual household and the service ultimately removed if contamination continues. Community and council support for the service may influence acceptance of various options for dealing with households unable or unwilling to correctly use the service.



Contamination tag for kerbside bin

Case Studies

Finding the Drivers to Reduce Contamination – Canterbury Council

The Canterbury Council area is a culturally, socially and economically diverse community in Sydney's inner west. Almost half of its approximately 145,000 residents were born overseas and there is a significant concentration of high density and public housing.

In 2009, Canterbury Council won a Compost Australia Award for the management of contamination in its domestic garden organics collection service. Since the roll-out of the organics service in 2005, contamination in kerbside-collected garden material had been maintained at almost 0% for a number of years.

Canterbury Council consulted its community thoroughly and engaged a research and consultancy group to assist in the design process for education material used in its garden organics service roll-out. The communication strategy was implemented at a modest cost of about \$4 per household. The education package included printed brochures, stickers, a calendar and a DVD which were produced in six of the most common languages spoken in the LGA.

Council's standard compliance program for dealing with contaminated recycling and garden organics bins consisted of the following process:

- 1 Driver reports all contamination incidents to Council (whether collected or rejected)
- 2 Sticker with reason placed on bin if major incident necessitates rejection for collection
- 3 Council sends a warning letter to the property by mail
- 4 If bin is reported on multiple occasions, council field officers visit property in person and provide multi-lingual education material.

Council conducted an audit of every truckload of garden material collected over a two week period. Contamination was found to be consistently below 0.5%. Meanwhile, the co-mingled recycling service which was introduced prior to the organic service, had struggled to control contamination levels, which at times reached 15%.

The council believes that the key to its success in keeping contamination out of garden organics was in fact a set of committed garden organics collection truck drivers who were extremely vigilant in reporting contamination incidents and rejecting excessively contaminated bins. Over several years, council received reports for 2 or 3 garden organics bins on average per day, for which the council then implemented its compliance program. Meanwhile, the drivers of the recycling collection truck rarely reported contamination and so most residents who used the recycling system did not receive feedback on their actions.

Lesson Learnt: Council maintained an excellent relationship with management and drivers of its collection contractor, communicating at least on a daily basis. Their garden organics truck drivers took pride in their work and understood the importance of their role in improving product quality.

The ‘Recycle Right!’ Contamination Reduction Strategy – Bankstown City Council

Bankstown City Council, 20km south-west of the Sydney CBD, is known for its cultural diversity and provides 60,000 domestic waste services, spread between 50,434 single dwellings and 1,356 unit complexes.

Bankstown City Council has provided a recycling service to residents for about 20 years and waste education has been used as a strategy with some success to promote and inform residents about recycling. In 2009–2010, Bankstown residents diverted 48% of their total household waste from landfill through the three-bin system; however contamination rates in some areas of the LGA were as high as 30%.

To address this issue, the council’s Resource Recovery Team developed a campaign based on behavioural psychology to investigate the drivers behind the required behaviour change and to develop an understanding of the individual and situational factors that motivate or constrain residents’ recycling behaviours.

The ‘Recycle Right’ Contamination Reduction Strategy commenced in 2010 and involved thorough research, community consultation, several stages of monitoring and evaluation, and ultimately reviewing and refining of strategies. Nine different ‘education strategies’ were tested during the campaign to reduce contamination in recycling bins which were:

- 1 **Personal Feedback:** Officers place a ‘Well Done’ or ‘Oh No’ themed feedback postcard in the letterbox after bin inspection
- 2 **Flag & Tag:** Officers hang a ‘Well Done’ or ‘Oh No’ themed feedback tag on the bin handle after bin inspection
- 3 **Door Hanger:** Officers hang a ‘Well Done’ or ‘Oh No’ themed feedback door hanger on resident’s individual front door
- 4 **Feedback by Poster:** Officers hang a ‘Well Done’ or ‘Oh No’ themed poster in the bin bay area
- 5 **Changing Recycling Bin Lids:** Officers remove existing recycling bins and replace with bins that have a small square hole in the lid (hence discouraging disposal of bagged recyclables in the bin)
- 6 **‘I Pledge’:** Officers door knock to enlist residents’ support in taking a ‘Pledge’ to Recycle Right
- 7 **Recycling Tub:** Officers door knock and deliver a yellow recycling collection tub
- 8 **Bulk Recycling Bin:** Officers replace existing 240L recycling bins with 660L recycling bins
- 9 **Door knocking:** Officers door knock residents to answer any recycling questions and confirm they understand how to use the bins correctly.

The most successful strategy overall was the ‘Personal Feedback’ strategy which reduced contamination levels by 31%. This result is consistent with other research that the council reviewed as part of the project, indicating that people want positive feedback and like to feel that they are doing what everyone else is doing – ‘the right thing’.

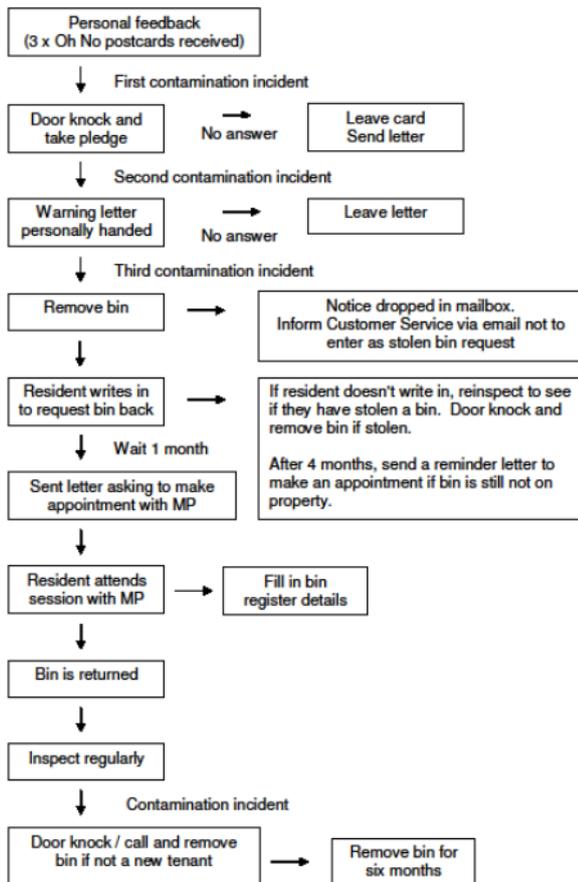
For residents in multi-unit dwellings, ‘Changing Lids’ and ‘Feedback by Poster’ were the most effective in achieving contamination levels below 10%.

The ‘Bulk Recycling Bin’ strategy was the least successful approach and actually led to higher rates of contamination in the area tested.

IMPLEMENTING YOUR SCHEME – FACTSHEET 12 – CONTAMINATION MANAGEMENT

The council analysed the results of the trial, community consultation, surveys and demographic data to determine the most effective community engagement strategy for contamination management, developing new standard procedures which are now being implemented across the LGA for three types of properties: SUDs, small MUDs (<25 units) and large MUDs (>25 units). The figure below shows the procedure followed for SUDs.

Contamination Management Process



Bankstown City Council's new Contamination Management Strategy for SUDs, revised and finalised after the 'Recycle Right' trial.

A financial analysis found that the campaign costs on average \$2.38 per household to implement, which includes providing households with an information pack, bin sticker and 6 collections of feedback costs. However personal feedback, door knocking (verbal) and door hangers are the cheapest strategies to run while strategies such as bulk bins and recycling tubs cost significantly more due to the infrastructure required.

The council has also used key findings from the community consultation sessions to redesign the education campaign resources to feature a range of local children with the red, yellow and green bins. These images are being incorporated into resources such as:

- 1 Individual feedback postcards
- 2 A media campaign
- 3 Truck panel decals
- 4 Brochures, flyers and Council website.

Factsheet 8 provides more detail on the design and results of the education campaign and trial.



Artwork for the 'Recycle Right Program' (Bankstown City Council)

Lessons Learnt: The trialling and subsequent implementation of the final strategy has provided a reliable evidence base for the Council's new approach to recycling education and contamination management procedures for both single and multi-unit dwellings and the process of ongoing monitoring and review will ensure that it can be revised and refined to maintain its effectiveness.

Further information:

www.bankstown.nsw.gov.au

Conducting Monitoring and Evaluation

One of the main reasons to undertake monitoring and evaluation is to understand how a service, scheme or communications campaign is performing so that you can identify opportunities for improvement. For example, quantifying the amount of garden and food organics currently collected in the residual waste bin and assessing this in terms of the season, alternate garden organics services and programs, and local commitment to recycling, will provide an understanding of the amount of organics likely to be collected by a new service.

Careful monitoring and evaluation of data collected from trials may provide useful information on which to base decisions when designing a new full service. For example: whether the communication material and methods are effective in encouraging participation and ensuring low contamination levels and whether investment in caddies and liners is necessary for all households.

There are fundamental differences between monitoring and evaluating a trial and the full implementation of a new service. Thousands rather than hundreds of houses will be receiving the new service, the service will be offered for numerous years rather than weeks or months, and the purpose of the evaluation is more likely to be for fine tuning a service rather than to evaluate the costs and benefits of delivering the service. This means that monitoring of a full scheme using the following indicators:

- ✓ Number of and nature of phone calls received on help line
- ✓ Gross tonnage of organics received at the processing facility
- ✓ Feedback from waste collection staff and organics processor on suburbs or collection routes regarding impressions of contamination and participation rates

may be more appropriate than direct measurements such as:

- ✓ Door to door and focus group discussions with residents

- ✓ Household by household compositional audits of bins.

Following the initial role out period of a new service, customer service staff, and waste education and collection staff may not be as busy delivering material or responding to inquiries and issues. There may therefore be more resources available to do more detailed monitoring and evaluation of the new system such as visual inspection of individual bins to get a snapshot of participation rates and variation in contamination levels between households.

Both in the first few months of a new service and at least yearly, it is valuable for decision makers and householders to be made aware of the progress made; for example: x tonnes of organics diverted from landfill, generating x cubic metres of compost, x % of householders participating, and x % contamination. Celebrating householder efforts may encourage further participation, increased diversion and closer consideration of contamination.

Rewarding and recognising householders for doing the right thing with their organics recycling can motivate people to continue their positive behaviours and take further action. Rewards could include financial rewards, for example vouchers, donations to charities, cash or discounts on goods and services. Recognition could, for instance, include personalised feedback about how much a household has recycled, or a letter about how donating an item for reuse has helped the local community.

Choice of ongoing monitoring and evaluation methods will depend on the Key Performance Indicators (KPIs) chosen for the new service. During the planning stages, SMART objectives will have been set thus informing the type of monitoring that will be undertaken on an ongoing or periodic basis (see Factsheet 8).

The level of monitoring and evaluation will change throughout the life of the project. Initially monitoring and evaluation may be undertaken regularly until the KPI are consistently met. Monitoring may then become more periodic. Towards the end of a collection or processing contract monitoring may be again increased in order to inform the decisions about whether to inform, modify or discontinue the service.

Monitoring methods

There are various methods that can be employed to demonstrate the effectiveness of a scheme including:

Method	How?
1 Tonnage data analysis, for example increased tonnage of organics and decreased residual waste tonnage	Request data from facility operator
2 Waste auditing, per bin, or aggregated via a visual waste audit, or physical waste characterisation	Contract specialist company to undertake composition analysis
3 Set out and participation rate monitoring, for example identifying 80% of all organics bins are put out for collection but only 50% of them contain food organics	Identify area, conduct visual inspection on (3 consecutive) collections, record households who have placed bin(s) out for collection.
4 Organics capture analysis	As method 2, conduct a tailored waste audit
5 Stakeholder feedback	Conduct focus groups and / or surveys (door to door, roadshows, events, public places)
6 Communication evaluation	Compare baseline data and results of above methods in areas you targeted with your communications campaign

In the initial weeks of implementing a service it might be beneficial to use monitoring techniques that allow for rapid evaluation and response. Data from a compositional audit may take several weeks to analyse, whereas a visual assessment of the level and type of contamination in a truck load of waste deposited on the floor of a processing facility is instantaneous. The less accurate but instantaneous data can be fed into the contamination and risk management plans developed in the program planning stages, and corrective measures can be taken before incorrect recycling behaviours become entrenched.

When to Measure	How
1 Pre- campaign (identify a baseline)	Tonnage Data Participation rates
2 During the campaign	Set-out rates Capture rates
3 Post Campaign	Contamination rates

Sampling

Conducting monitoring often requires collection of data from a sub-set of the population of interest. Sampling is the process of identifying a sub-set that will mirror the population of interest. This will enable making reliable generalisations about the whole population. The steps in a sampling process are as follows:

- ✓ Define (profile) the population of interest – decide which factors are important. Use socio-demographics.
- ✓ Decide how to obtain a sample that is reflective of this profile.
- ✓ Decide how precise the results should be – the required sample size will depend on this. For participation monitoring and questionnaire surveys, 3% precision (with a 95% confidence interval) is sufficient which means a sample size of 1,100. Sample sizes smaller than 1,100 are viable but the results become less precise as the sample size gets smaller.
- ✓ Design the monitoring in a way which reduces bias.
- ✓ Conduct the monitoring and collect the data.
- ✓ Weight the data to match the target population.

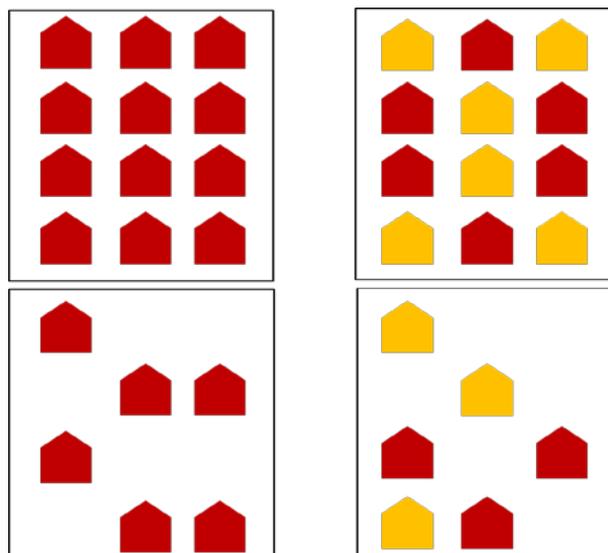
Target population

Demographic profiling can be used to ensure that the sample is representative of the target population. Profiling is the process of describing the target population from which the sample will be drawn. How the target population is profiled will depend on which factors have been decided to be important to the study. Profiling provides useful insights about population and gives detailed socio-demographic information for categories such as age, gender, social grade, ethnicity, employment status, income levels, housing types and tenure. This information provides a good basis for defining key characteristics of the target population, which can be taken into account when selecting the sample. Property types and the urban/rural property mix will also be relevant when characterising the target population.

Representative sample

When undertaking detailed monitoring such as household compositional audits it is important to understand the principles of sample selection as it will be too costly to audit all households. Samples should be randomly selected from areas representative of the total population being analysed and be of sufficient number that variation between samples can be accurately measured. For example sampling only committed recyclers from larger households and with large gardens will result in higher organics figures in terms of kg/hh/wk, than single person households living in multiunit dwellings. Similarly with questionnaires and surveys, although these may be distributed to all households return rates will usually mean you have a sample only. Evaluation of the results needs to take into account whether the respondents are representative.

The sample must be made up of households or people with an overall profile (social/demographic) that matches the target population. This is called a representative sample. The results from observing or speaking to a sample of the target population can be generalised to that population provided the sample is representative.



All households in the local authority, 50% red, 50% yellow and the representative sample, 50% red, 50% yellow

Sample size

The sample must be of a sufficient size in order to be confident the results obtained for the sample can be generalised to the target population.

If the sample chosen is not representative of the target population with respect to a key factor of relevance to the topic being monitored, there is risk of biasing the results.

For surveys where people can choose whether to participate or not, you will have to try to contact more people than the required final sample size. The expected response rate for the survey will indicate how many people you might need to contact. The response rate depends on the type of survey and how it is presented.

Evaluation

The information you collect during monitoring is only useful if you spend some time analysing it to understand what it is telling you. You will need to interpret the data by comparing it with other information such as previous data of the same type or findings from other areas.

Looking at changes over time

You should be looking to compare the monitoring data with the same type of data from any previous monitoring you've done to identify any patterns or trends such as increases or decreases in figures over time. The previous information, or baseline data as it is sometimes known, provides a useful benchmark against which to compare subsequent results. It is important to have baseline data if you want to measure impact (for example, before and during a pilot trial).

It is also important to understand the changing context when comparing data over time, as other factors can influence the data set. For example, changes in behaviour including increased waste avoidance can reduce the amount of material diverted.

Looking at differences between areas

As well as looking at differences over time, you may want to compare similar data across different areas that have different types of systems and/or different demographics.

Looking at different types of data together

In addition to comparing similar types of data to each other, you will also need to look across all the different types of data you have collected to see if they tell you anything useful about the underlying causes or factors that might be affecting performance. If, for instance, you have a scheme that is poorly performing on a particular round, you may want to look at different bits of data to understand why. It may be, for instance, that participation rates are generally quite high but that contamination is also high, resulting in rejection of containers by crews and therefore low capture. You can only establish this by looking at different sets of data for that round, such as participation rates, tonnage figures and capture rates.

Identify areas for improvement?

As well as identifying potential service changes to improve performance, by looking at the monitoring data you are also in a position to identify any useful lessons learned.

Having obtained and analysed the data, you should be in a position to identify potential areas for improvement. Consider, for example:

- ✓ Are there areas with particularly low tonnage figures?
- ✓ Do you have any areas with low participation rates, low capture rates or high levels of contamination?
- ✓ Is there a particular type of contamination affecting the service / scheme?

In addressing these types of questions about performance levels, you will need to spend some time identifying the issues that are affecting the service / scheme.

- ✓ Do households have everything they need to participate effectively (for example the right container, the right information, knowledge of collection days)?
- ✓ Are the collections happening effectively or are there service problems (for example missed collections, overflowing communal bins)?
- ✓ Are there extraneous factors that may be affecting performance (for example vandalism of storage sites, an increase in population following an influx of migrant workers)?

To answer some of these questions you need to look at sources of data such as surveys, complaints and feedback to call centres, and focus groups. You may find that you don't have enough information to form an opinion and need to do some more data gathering before you can draw any conclusions. Be sure to do so before pressing on to decide on potential improvements.

Case Study – Waverley and Randwick councils

Waverley and Randwick councils jointly implemented a home composting trial in 2009 called the ‘Compost Revolution’ involving 580 residents over 12 months. The trial involved providing the sample of residents in both single and multi-occupancy dwellings with a compost bin or worm farm (or access to a communal compost bin) and a 7.5 L kitchen caddy to use in the kitchen. The compost revolution ‘brand’ was developed along with a series of training workshops, group events and educational resources.

The key objectives of the project were to:

- ✓ Trial a method of diverting food waste from landfill other than a food waste collection system
- ✓ Determine an approach that is effective in a densely populated urban area
- ✓ Demonstrate the social, environmental and economic benefits of home composting
- ✓ Develop effective methods to assist residents in avoiding food wastage.

Monitoring and evaluation was built into the project planning, allowing on-going adaptive management and adjustment of the program activities and approach. Monitoring of changes in the quantity of food organics disposed was the most challenging part of the evaluation strategy. Several methods were used in combination to determine quantitative results relating to food waste diversion and these included:

- ✓ **Garbage bin audits** – bin composition including the weight of food disposed to garbage bins in main categories and sub-categories was measured before, during and after the trial
- ✓ **Food composting tallies** – volumes of food disposed to composts were tallied on-the-spot and then reported online by participants every 3 months through a detailed feedback survey
- ✓ **Food behaviour diaries** – detailed diaries of food purchasing, preparation and disposal habits were kept by a subsample of trial participants.

Unfortunately due to budget constraints, the methodology used for the bin audits did not produce statistically rigorous data. Further, some of the bins audited were no longer part of the trial and other variables such as seasonal variation were not accounted for. To counter this, results were cross-checked with other projects and NSW averages to rule out anomalies.

Another complication that arose in measuring the effectiveness of the program was to account for the impact of *avoided* food waste. The use of both a ‘compost tally’ system and a ‘food diary’ study provided information to estimate not only the amount of food that was composted but also the degree to which households changed behaviour to reduce the overall amount they wasted. While waste is normally measured by weight, the councils found that volume was easier for participants to measure themselves in the home. Participants were to use their 7.5 L kitchen caddy and a “caddy recorder” (a fridge magnet) to tally the number of buckets they emptied into the compost each week. In the ‘food diary’ study, households were requested to record a range of food-related activities on a daily basis over a week, which provided an insight into the behaviours that resulted in food waste avoidance or the use of the compost system.

After the success of the initial 12-month trial, the councils decided to roll out the program to the wider community. In mid-2011 they developed an online tutorial of the practical composting workshops to improve the cost-effectiveness of the approach. Initial results indicate that the online version is very effective, with at least 90% of the 600 people who viewed the online tutorial still using their compost or worm farm 8 months later. The website and program branding has now been made available to other councils in Australia for a small fee.

The quantitative results relating to food waste diversion which were measured through the above three methods are outlined in the following table:

Table 1: Food organics diversion results

Information Source	Average amount diverted	Comments
Compositional Bin Audit results	1.8-2.3 kg per week per household	Results differed between the audits, 1.8kg was thought to be lower than actual due to wrong bins being included in sample in the final audit, 2.3kg was the mid-trial result
Participants 'food waste Tally' results	3.75 kg per week per household 4.55 kg for SUDs 2.95 kg for MUDs.	Converted from volume to weight based on 240L food waste weighing 100kg
'Food Diary' results	5.01 kg per week per household	Actual results from weighing discarded food

Lessons Learnt: A key lesson that the councils learnt through this project was to use methods that actively involved participants in the evaluation process. This not only led to collection of more useful data but also served as an effective tool to improve engagement, deepen the learning experience and promote a feeling of empowerment and contribution.

Further information:

www.compostrevolution.com.au

PART FOUR: ELECTRONIC PRESENTATIONS

Factsheet 1 – Why Collect Organics?



Social Benefits

- Potential behaviour change
 - A 3rd bin for collection of food and garden organics can influence increased recycling and waste minimisation
- Social capital
 - An organics collection may help strengthen the local community and stimulate interest in environmental and sustainability initiatives

Other Benefits

- Conserving landfill space
 - Reducing the amounts of waste sent to landfill will preserve its lifespan

Factsheet 2 – Understanding your waste stream

Understanding your waste stream

FACTSHEET 2

Organics availability?

- A typical Australian household bin:

Material	Percentage
Food organics	35%
Garden organics	16.5%
Other organics & residuals	7.5%
Paper & cardboard	13%
Metals, plastic, glass & other inert material	28%

Waste Audit Data

- Existing Australian waste data:
 - The National Food Waste Assessment Report (2011)
 - The National Waste Report (2010)
 - NSW Results of Waste Audits of Household Kerbside Collection Systems 2007–08
 - VIC Kerbside Garbage Composition: Recent Findings

Waste Audit Process

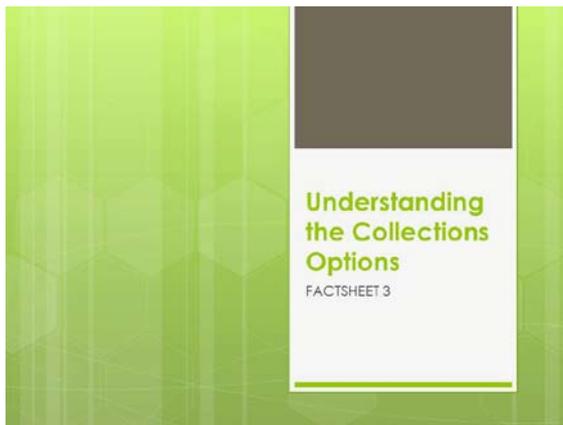
- Waste audits can be used to:
 - Quantify and understand your waste stream
 - Gather critical information to help achieve the best outcomes from an organics collection system.
 - Provide a breakdown of the amounts and types of organics wasted and help you to understand the composition of waste going to landfill, and what could be recovered for recycling or composting.

How much can be diverted?

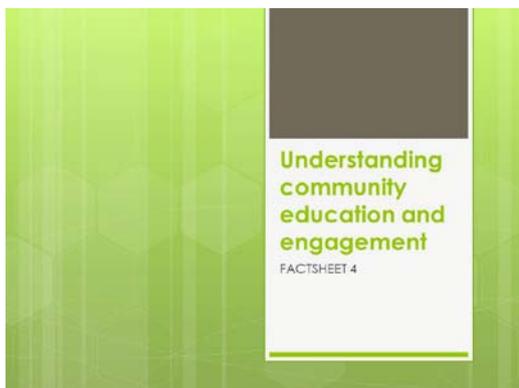
- Summary of Australian case studies:

Key Collection Statistic	Overall average value
Participation rate	66%
Contamination rate	3%
Total organics yield	8.0 kg /hhid/week
Food organics yield	1.8 kg /hhid/week
Garden organics yield	7.7 kg /hhid/week
Food organics capture rate	33%
Garden organics capture rate	96%
Combined organics capture rate	55%

Factsheet 3 – Understanding the Collections Options



Factsheet 4 – Understanding community education and engagement



Approaches to Communications

- **Information Giving** – announcing your intent, e.g. a brochure or leaflet in the mail outlining the benefits of a food and garden collection scheme.
- **Information Gathering** – a market research form of engagement, e.g. engaging individuals via interviews or questionnaires.
- **Consultation** – seeking of views on a prepared proposal, system or plan. There is an intention to listen to responses and for amendments to be made.

New Service Introduction

- Pre-launch communications
- Information when the service is rolled out
- A monitoring and evaluation program
- On-going education and communications to householders throughout the life of the collection service.

Pre-launch communications

- Before the scheme:
 - Provide householders with information about the new service.
 - Methods include: information leaflet, advert or notice informing residents that a new service is being introduced.
 - Messages include:
 - **why** the new service is required (the 'need')
 - **what** the new service is, including types of organics householders will be able to recycle
 - **when** it will be introduced
 - **who** to contact with queries (for example the number for a helpline, and a website address).

Information when the service is rolled out

- Scheme launch: produce communications materials to support the launch of the service, e.g. a 'service leaflet' outlining:
 - how to participate, i.e. dates and frequency of collection, container use etc.
 - types of organics to recycle
 - who to contact with any queries
 - practical advice on how to make the most of the system and deal with any potential problems.

Monitoring and evaluation program

- Monitoring and evaluation program should be considered before scheme inception to:
 - establish a baseline from which outcomes from the scheme can be measured.
 - identify the effectiveness of the communication methods used.

On-going education and communications

- It is essential to continue education and communications to householders over regular intervals throughout the life of the organics collection service.

Factsheet 5 – Understanding the processing options

Understanding the processing options

FACTSHEET 5

Organics processing options

- There are three general treatment options for organic residues:
 - combustion (including gasification)
 - composting
 - anaerobic digestion

Choice of processing option

- The choice of processing technology is primarily governed by:
 - What outcomes council and the community expect to achieve
 - Location and size of proposed site and associated environmental constraints
 - Type and quantity of expected feedstock
 - Investment and operating costs
 - Type of products to be manufactured
 - Sustainability issues (such as measured through LCA or carbon footprinting)

Processing technology types

- Vermicomposting
- Open windrow composting
- Aerated static pile composting (with or without covers)
- In-vessel composting (tunnel, box, vertical silo, drum)
- Fully enclosed composting (agitated bed, agitated pile)
- Anaerobic digestion (wet, dry)
- Combustion (including pyrolysis and gasification)

Processing technology comparison

Technology	Aeration	Air purification	Investment cost	Land area required
Vermi-composting	Passive	No, but possible	Low to medium	Large to medium
Windrowing	Turning, passive aeration	No	Low	Very large
Aerated static pile	Positive/negative forced aeration	No, but possible	Medium	Medium
In-vessel composting	Agitation, mechanical turning, forced aeration	Yes, but exceptions	Large	Medium to small
Fully enclosed composting	Agitation, mechanical turning, forced aeration	Yes	Very large	Medium to small

Points for consideration when choosing a technology

- Investment costs (\$ / tonne throughput)
- Operating costs (\$ / tonne throughput)
- Operational experience
- Options for process management
- Options for achieving desired product quality
- Risk of emitting odour / bio-aerosols and releasing leachate
- Ability to process different feedstock
- Options for expanding processing capacity
- Footprint (tonne annual throughput per square meter)
- Energy and water use

Factsheet 6 – Understanding the possible risks

Understanding the possible risks

FACTSHEET 6

Organics collection risks

- Potential risks are as follows:
 - Inadequate project management
 - Poor communication
 - Bungled roll-out of service
 - Difficult properties
 - Householders not participating
 - Contamination
 - Nuisance factors (vermin, pests, malodours)
 - Impact of home composting
 - Contractual issues
 - Cost overruns
 - Lack of demand for generated products

Risk Matrix: identification & management

Risk	EFFECT			
	Low	Medium	High	Extreme
Inadequate project management	<ul style="list-style-type: none"> ✓ Once a decision is made to provide an organics collection service, a period of 12-18 months is required for planning – establishment and construction of any new facility will take a minimum of 3 years. ✓ A detailed project management plan should be developed, adhered to and maintained ✓ Project management includes resource planning – both finance and staff ✓ Audits of waste streams and surveys of community attitudes should be conducted. ✓ Residents must be kept informed and motivated 			
Poor communication	<ul style="list-style-type: none"> ✓ Communications and community engagement must be long-term (established well before the scheme starts) and ongoing ✓ Monitor and evaluate to measure success of communication, and to provide feedback to stakeholders. 			
Bungled roll-out of service	<ul style="list-style-type: none"> ✓ Trial an organics service on a proportion of the local government area ✓ Ensure access to appropriate equipment ✓ Have a well-designed public communication and education program ✓ Design efficient rounds that match the capacity of the collection vehicles and collection crew ✓ Measure performance over time ✓ Ensure additional staff during roll out to deliver, equipment, answer enquiries, and respond to complaints and issues. 			

Difficult properties	<ul style="list-style-type: none"> ✓ Provide a reasonably priced collection method that is convenient and secure ✓ Consider convenience, storage space constraints, pressure on available space, vehicle access, existing garbage collection arrangements, and acceptability to residents ✓ Ensure container choices are appropriate for the number of households served, the organics segregation arrangements, space availability and collection vehicles ✓ Identify range of properties and identify solutions.
Householders not participating	<ul style="list-style-type: none"> ✓ Implement well-defined communication plans, including through local community networks, schools, community boards, residents and neighbours groups ✓ Ensure convenience by minimising the effort required to separate organics, supplying kitchen caddies and liners to all or some households ✓ No direct additional cost for participating households ✓ Ensure the kitchen caddy and collection bin are easy to keep clean ✓ Make the community understand the need and benefits ✓ Conduct thorough community education, including a visit by waste and recycling educators and leaving a 'contamination tag' if required ✓ Make sure collection and education staff identify contaminated bins, and report them appropriately ✓ Withdraw organics collection bin and service from non-complying households ✓ Separate contaminants at the processing facility ✓ Develop a contamination management plan considering a range of responses for initial, periodic, and entrenched contamination by identified households
Contamination	<ul style="list-style-type: none"> ✓ Consider providing liners and aerated kitchen caddies to some households ✓ Encourage householders to line their caddies ✓ Encourage householders to empty the caddy regularly ✓ Encourage the use of deodorising spray/pads ✓ Provide local bin cleaning services and replace damaged bins ✓ Ensure that lids fit the kerbside bin properly ✓ Consider seasonality, and possible provision of weekly collections in summer and fortnightly collections in winter (for a combined service or garden organics only).
Nuisance factors	

Impact of home composting	<ul style="list-style-type: none"> ✓ Continue to encourage home composting
Contractual issues	<ul style="list-style-type: none"> ✓ Ensure contracts are flexible ✓ Ensure contract is subject to all standard KPIs related to the collection of recycling materials ✓ Facilitate cooperation between the contractor and council regarding collection related problems ✓ Share responsibility of contamination problems.
Cost overruns	<ul style="list-style-type: none"> ✓ Plan carefully ✓ Implement sufficient and appropriate contingency plans ✓ Ensure contracts are flexible.
Lack of demand for generated products	<ul style="list-style-type: none"> ✓ Ensure council departments use generated recycled organic products ✓ Support market development efforts ✓ Control contamination.

Factsheet 7 – Understanding the costs and savings

Understanding the costs and savings

FACTSHEET 7

Organics collection costs

- Example cost structure for a council-run organics collection scheme (excluding processing costs)

Category	Percentage
Crew salary and supervision	54%
Free liners for kitchen caddy	21%
Kitchen caddy	7%
Kerbside bin	6%
Vehicles etc.	6%
Other	2%

Capital & Operational Costs

- Investment and on-going operational costs include:
 - Number of additional staff (operational and administration), and local wage levels
 - Purchase / lease of additional collection vehicles
 - Requirement for any modifications of existing or new vehicle fleet
 - Vehicle running costs, including fuel, maintenance and overheads (such as insurance)
 - Type and size of collection bins and kitchen containers provided to residents
 - Type and number of liners for kitchen containers, if provided to residents
 - Intensity and duration of public education and motivation campaigns
 - Performance monitoring, including audits and contamination management
 - Additional management and administration

Indicative costs

- Indicative costs associated with organics collection and composting services

Item	Indicative costs
Promotions and campaigns	\$15,000 per year
On-going management and logistics	\$50 / hhhd / year
Initial education materials (such as collection calendar, brochures, stickers for bin and caddy)	\$3 – \$5 / HHhd
On-going education	\$5 / hhhd / year
Kitchen caddy	\$3 – \$13 / hhhd
Kitchen caddy liners, assuming 3-4 per week	\$8 – \$12 / hhhd / year
Kerbside bin (240L)	\$40-\$50 / hhhd
Collections	\$0.70 – \$3.00 / hh
Composting	\$25 – \$130 / tonne

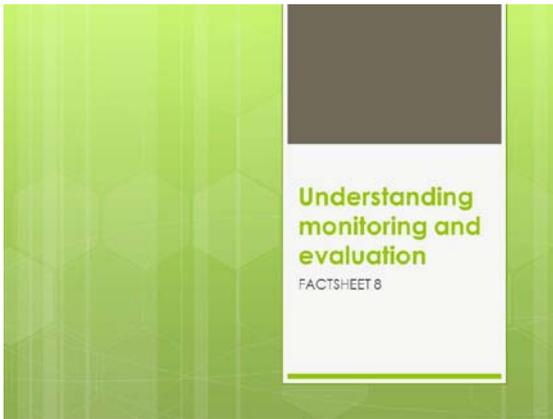
What affects collection costs?

- Unit collection costs per household or per tonne of collected material are affected by:
 - Participation and set out rates
 - Level of capture or diversion achieved
 - Collection round efficiencies, governed by distance between pick-up points and crew productivity.
- Processing costs are generally governed by:
 - The kind and quantities of organic residues processed
 - The location of the processing facility
 - The selected processing technology
 - The level of contaminants that have to be removed from the delivered material
 - The designated use of generated recycled organic products.

Potential Financial Savings

- Collecting source segregated organics reduces waste to landfill resulting in potential financial savings from:
 - avoided disposal costs
 - avoided carbon price liabilities
 - collection efficiencies, e.g.:
 - Reducing collection frequency of residual waste from weekly to fortnightly
 - Reducing residual waste bin size to 120L

Factsheet 8 – Understanding monitoring and evaluation



Monitoring & Evaluation

- **'Monitoring'** means regularly measuring outcomes such as customer satisfaction, participation rates, contamination rates and diversion rates.
- **'Evaluating'** means drawing conclusions from the monitoring data in terms of how well the scheme is performing, or the effect of the communication activity.

Why monitor & evaluate?

- Measure customer satisfaction and user attitudes to establish how these are impacting on the performance of your scheme
- Measure progress against objectives and targets, so you will know in advance if you are likely to hit or miss them
- Identify successful systems as well as problems or performance issues, so that you can target your efforts to those neighbourhoods where improvements will make the most impact
- Assess expenditure and control costs, in terms of anticipated quantity of organics collected, demand for liners, and the impact on education and processing costs of different contamination levels
- Evaluate return on investment to justify existing budgets or persuade budget holders that more money is required to achieve statutory and local targets
- Plan scheme expansions and design (or redesign) scheme so that targets are met or exceeded
- Plan targeted communications to improve performance
- Address the issues that are really impacting on scheme success.

When to monitor?

- To monitor the effect of a service change, you need to monitor both before the service starts or the service is changed, and again afterwards.
- The purpose of monitoring in advance is to establish a **baseline** from which you can measure a change.

What are your aims?

- **Your aim**
- An aim is a broad statement of what you are trying to achieve and there is usually one overarching aim.
- An example of a monitoring aim would be 'to measure the performance of the organics service':

To capture xx% of the total generated organics in the kerbside organics bin by [xx date].

What are your objectives?

- Objectives are a much more specific statement of what you are trying to achieve.
- There are 3 types of objectives:

INPUT

EXAMPLE
20,000 leaflets distributed to households

OUTCOMES

EXAMPLE
5,000 households aware of the scheme

IMPACTS

EXAMPLE
2,000 more households participating in the scheme

Defining objectives...

- Make them SMART!

S	Specific	What do you want to accomplish, and?
M	Measurable	Identify how you will know you've made your aim?
A	Achievable	Don't set objectives you can't meet!
R	Relevant	Will your objectives really make your aim?
T	Time-bounded	Get a deadline for achieving your objectives

Key Performance Indicators

- KPIs are the tools that enable you to monitor the success of your activities

Type of objective	Example	KPI
Input	To distribute 10,000 leaflets by [xx date] to 20,000 households on the kerbside organics collection scheme	Number of leaflets
Impact	To decrease the organics disposed in the garbage bin from xx kg/hh/year to yy kg/hh/year	kg per household per year (kg/hh/year)

Monitoring & Evaluation Methods

- **Tonnage data analysis**, for example increased tonnage of organics and decreased residual waste tonnage
- **Waste auditing** per bin, or aggregated via a visual waste audit, or physical waste characterisation
- **Set out and participation rate monitoring**, for example identifying 80% of all organics bins are put out for collection but only 50% of them contain food organics
- **Organics capture analysis**
- **Stakeholder feedback**
- **Communication evaluation.**

Factsheet 9 – Conducting and evaluating a pilot trial



Pilot trials

- A pilot trial can help to test the following characteristics of an organics scheme:
 - Participation rates
 - Diversion rates
 - Contamination rates
 - Different types of caddies, with or without liners
 - Householder attitudes and satisfaction
 - Effectiveness of communication/education strategy
 - Collection frequencies

Planning your trial

Activity	Key considerations
Assessing the waste diversion potential	Only a portion of the available organics will be captured in a collection service.
Choosing the right caddy (or caddies) to test	<ul style="list-style-type: none"> Four typical collection options: <ul style="list-style-type: none"> garden organics only food organics only food and garden organics, each in separate containers food and garden organics co-collected in a single container
Locating a suitable treatment facility	When planning an organics collection trial, it is important to consider how far where the collected material will be processed.
Choosing materials and other supporting items	<ul style="list-style-type: none"> It is important to provide practical and convenient methods to make organics collection easy for households. Consider factors such as: dwelling type, storage spaces, household size, garden size, climate, time of year, current issues, etc.
Identifying the trial design and sample area	<ul style="list-style-type: none"> Some garden factors include: <ul style="list-style-type: none"> number of vegetables/fruit trees responsiveness to demographics sufficient sample size level of participation ease of identification and collection Ensure the capacity of the collection vehicle is appropriate to the volume collected Ensure proposed collection routes are complete
Communicating with stakeholders	An effective education/engagement strategy is essential to the success of an organics collection trial. Remember to then 'roll out' with other householders that may be affected (anyway) during the results of the trial.

Planning your trial (continued)

Monitoring and evaluation	Reporting the results
<ul style="list-style-type: none"> Monitoring and evaluation should be planned and implemented before the trial begins. This should include: <ul style="list-style-type: none"> the performance of the trial against targets and success criteria, along with safety, contamination, and economic analysis among other methods. 	<ul style="list-style-type: none"> Results should be influenced by a wide range of environmental, economic and social factors. Quantitative figures such as participation rates, volume collected and contamination rates can be used to determine general diversion performance across the trial. Qualitative information and participant feedback results can include the ease and cost effectiveness of trial implementation.

1. Assessing diversion potential

- The main issues to consider if you are evaluating how much garden organics will be presented for collection are:
 1. **Proportion of properties with gardens** – many urban councils have high proportions of housing stock with either no gardens or small gardens, where a separate garden waste collection service may deliver small amounts of garden organics
 2. **Garden size** – properties with larger gardens will produce more garden materials
 3. **Garden age** – the age of a garden will affect the amount of garden material produced
 4. **Seasonality** – garden organics increases in spring/summer/autumn and reduces in winter. On the other hand, food organics volumes show little seasonal variation.

2. Choosing the right collection system

- An organics collection service typically presents four general collection options:
 1. Collect garden organics only
 2. Collect food organics only
 3. Collect food and garden organics, but in separate containers
 4. Collect food and garden organics together in a single container

2. Choosing the right collection system: costs

- The **absolute collection costs** of a trial will be affected by the:
 - Number of additional staff and local wage levels
 - Purchase / lease of additional collection vehicles
 - Requirement for any vehicle modifications of existing or new fleet
 - Vehicle running costs, including fuel and maintenance
 - Type and size of collection bins and kitchen containers provided to residents
 - Type of liners for kitchen containers provided to residents
 - Intensity of public education and motivation campaign
 - Performance monitoring, including contamination
 - Additional management and administration

3. Locating a treatment facility

- During the trial, it is advisable to:
 - Seek to **fix treatment costs** by securing gate fees (or a portion of gate fees) for the organics over the duration of the trial
 - **Ensure the facility is licensed** to process the quantity and type of material to be collected
 - **Check that outlets have been secured** for the finished compost
 - **Ensure arrangements for dealing with contamination** are specified in the contract (e.g. responsibilities, contamination limits, and who pays if loads are rejected).

4. Container choice

- Important points to remember when implementing your pilot trial are:
 - **120-240 L wheeled bins** are best for co-collection of food and garden organics. The size depends on collection frequency and the average garden and household size and type of dwelling.
 - Smaller sized **wheeled bins (60L and 80L)** suit confined spaces and use in Multi Unit Dwellings and / or smaller families. Where food organics are collected separately on a weekly basis, a 20-25L container will be sufficient for the majority of households.
 - Providing households with bench top **kitchen caddies** encourages participation and increases food organics capture rates.
 - **Compostable liners** that fit inside kitchen caddies and meet the Australian Standards (AS 4736-2006) aid cleaning, storage and disposal and reduce leakage and spills. It should be noted that liners can become unreliable if stored for extended periods.

5. Identifying the trial design and sample area

- **Identifying the trial design** - compare two or more options:
 - **collection system** e.g. food-only versus co-collected food and garden
 - **service configuration** e.g. weekly residual waste collection versus fortnightly residual waste collection
 - **container type** e.g. enclosed versus aerated Mobile Garbage Bin and/or kitchen caddy
 - **supporting tools** e.g. use of compostable bags versus newspaper as a caddy liner.

5. Identifying the trial design and sample area (continued)

- **Identifying the sample area:**
 - Participating households should be carefully chosen to:
 - ensure accurate representation of the whole target population
 - it must mirror the profile of the population
 - the demographics should reflect the demographics of the council area overall.
 - Sample size should be as large as possible and will depend on key factors such as:
 - project budget
 - level of precision required for the intended use of the results.
 - as a simple rule, a sample of 1,000 households or more will generally provide an overall recovery rate that is sufficiently reliable.

6. Identifying appropriate collection vehicles and trial logistics

- Consideration must be given to:
 - **Vehicle capacity:** calculate and monitor tonnages; vehicles must be leak proof
 - **Collection scheduling:** consider existing collection schedules and routes
 - **Planning & timing of procurement:** purchase containers, caddies, liners early!

7. Communicating with stakeholders

- Communications is essential to the success of your trial:
 - Produce a communications plan
 - Conduct communications at the following intervals:
 - Pre-trial launch: what's coming and why
 - New trial launch: how to participate
 - Post-trial: is the scheme continuing, are there any changes?

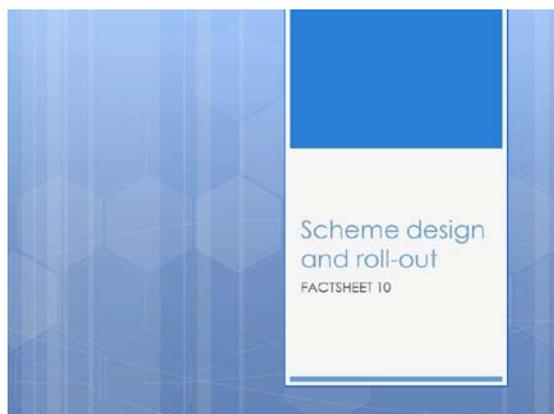
8. Monitor and Evaluate

- It is recommended to conduct the following monitoring and evaluation before, during and after the trial:
 - Waste audit of the residual waste stream to be carried out pre-trial, mid-trial and the end of trial. Conducting audits in summer as well as winter will reveal seasonal variations in diversion and composition
 - Bin set-out rate audit to be conducted mid-trial and end of trial
 - Householders' satisfaction and participation surveys to be conducted mid-trial and end of trial

9. Applying the results

- Consider the following:
 - Quantitative figures such as participation rate, capture rate and contamination are used to determine overall diversion potential across the LGA
 - Economic information and participant satisfaction results indicate the ease and cost-effectiveness of implementing the system council-wide
 - Qualitative information from focus groups, surveys and other forms of participant feedback provide guidance for improving the system design and inform risk management planning for the future roll-out phase.
- The results will inform full LGA roll-out and improvements required to do this
- See Factsheet 9 for Pilot Trial Checklist

Factsheet 10 – Scheme design and roll-out



Considerations prior to roll-out

1. Securing a suitable processing facility
2. Trialling your scheme prior to roll-out
3. Ensuring access to appropriate equipment
4. Implement a communication and education program
5. Appropriate design of collection rounds
6. Appropriate timing
7. Measuring performance

Flexibility in service

- Flexibility in service may include:
 - Supplying non ventilated bench top kitchen caddies means that they can be used with and without liners
 - Making liner bags available on request for those householders who would like to participate in a food collection services can help address the 'yuk' factor
 - Continuing to support home composting when a kerbside food collection service is available will provide best outcomes
 - Increasing food and garden organics collection frequency during summer when hotter weather may cause increased complaints about odour, fermentation flies and maggots, can help address nuisance issues

1. Accessing suitable processing facility

- Type of scheme will determine processing requirements
- When introducing a collection scheme, it is advisable to:
 - Seek to fix treatment costs by securing gate fees (or a portion of gate-fees, for example covering core processing costs but not other factors, like landfill levy impacts on residual waste) for the organics over the duration of the trial
 - Check that markets have been secured for the finished compost.
 - Ensure arrangements for dealing with contamination are specified in the contract (for example responsibilities, contamination limits, and who pays if loads are rejected).

2. Trialling

- Any new kerbside organics collection system should be trialled before full-scale implementation in order to identify any local issues or knowledge gaps.
- Trials can encourage community debate and help fine tune program / service components such as education, communication and infrastructure.

3. Provision of Equipment

- Delivery of kerbside bins and caddies can be time-consuming and costly. The following items may need to be distributed as part of the organics collection scheme:
 - Kerbside bin
 - Kitchen caddy
 - Liners
 - Education materials (these are discussed in the following section)

4. Implementing communication & education

- There are a number of clear stages when conducting communications campaigns:
 - Pre-launch communications
 - Information when the service is rolled out
 - A monitoring and evaluation program
 - On-going education and communications to householders throughout the life of the collection service.

4. Implementing communication & education (continued)

- Key issues to consider:
 - Prepare a communications plan** (12 months before service commences) including a budget and scheduling of when activities should take place (and by who)
 - Engage the communications/PR departments** of council early on when planning and developing communications
 - Seek early stakeholder involvement** from senior council management and councillors when planning new services to ensure their support
 - Allow sufficient funding** for the first few years of the new service with the resourcing levels decreasing over time
 - Consider a partnership approach** with the collection or processing contact to help resource the communications and to obtain their input in communications

5. Designing collection rounds

- Factors affecting collection rounds include:
 - Travel to start of round
 - Crew breaks
 - Travel to treatment facility
 - Travel back to round or return to depot
 - Ancillary time for vehicle checks and cleaning
 - Demographics and geography of the area
 - Number of set outs
 - Location of set outs
 - Loading time for each set out
 - Work rate of operatives
 - Fill rate of vehicles.

6. Appropriate Timing

- Consider impacts of:
 - Seasonality
 - Potential extreme weather conditions
 - Public and school holidays
 - Major sporting events, elections, roadworks or local events.
- A staged roll-out occurring progressively for each collection area of the LGA over a period of several weeks will allow for major issues to be identified and improvements made to the process.

7. Measuring performance

Methods to demonstrate the effectiveness of a scheme may include:

Method	How?
1 Tonnage data analysis	Request data from facility operator
2 Waste auditing	Contract specialist company to undertake composition analysis
3 Set out & participation rate monitoring	Identify area, conduct visual inspection on (3 consecutive) collections, record households who have placed bins) out for collection.
4 Organics capture analysis	As method 2, conduct a tailored waste audit.
5 Stakeholder feedback	Conduct focus groups and / or surveys (door to door, roadshows, events, public places).
6 Communication evaluation	Compare baseline data and results of above methods in areas you targeted with your communications campaign.

Factsheet 11 – Conducting community education and engagement



Stages of communication

- There are a number of distinct stages to community education and engagement, and the success of these will influence the success and acceptance of your scheme. The stages are:
 - Pre-launch communications
 - Information when the service is rolled out
 - A monitoring and evaluation program
 - On-going education and communications to householders throughout the life of the collection service.

Communications Plan

- A communications plan should:
 - Identify target audiences: residents, non-English speaking residents, council customer service officers, media and other stakeholders.
 - List key messages.
 - Identify key issues and how these will be addressed.
 - Summarise communications strategies for each of the target audiences and project phases; before, during, and after roll-out of the scheme.
 - Outline roles and responsibilities of council and other project partners.
 - Outline budget and timelines for actions.

Pre-launch communications

- 3 to 6 months before the scheme:
 - Provide householders with information about the new service.

Methods include:	Messages include:
<ul style="list-style-type: none"> information leaflets adverts or notices roadshows media publications council displays 	<ul style="list-style-type: none"> why the new service is required (the 'need') what the new service is, including types of organics householders will be able to recycle when it will be introduced who to contact with queries (for example the number for a helpline, and a website address).

New service roll-out

- Scheme launch: produce communications materials to support the launch of the service, e.g. a 'service leaflet' outlining:
 - how to participate, i.e. dates and frequency of collection, container use etc.
 - types of organics to recycle
 - who to contact with any queries
 - practical advice on how to make the most of the system and deal with any potential problems.

New service roll-out (2)

- Include detailed information to include:
 - Whether or not meat and bones can be included
 - Whether or not kitchen towel and soiled paper like pizza boxes can be included
 - Whether scraps from dinner plates and processed food past its expiry date are encouraged or just food items like fruit and vegetable skins
 - How to use newspaper as a liner in the kitchen caddy
 - If liner bags are provided – the difference between compostable, biodegradable and recyclable liners, where to get further bags of the correct type, issues and consequences of using the incorrect liners, how often to change the liners.
 - How to discourage pests, vermin and odours
 - How to wash kerbside bins without polluting stormwater
 - Who to contact if they have a query (e.g. helpline and website).

New service roll-out (3)

- Your communications plan also needs to respond to any issues that arise during roll-out, such as:
 - Householders using a new liner bag every day thus exhausting their liner allocation
 - An unprecedented hot spell increasing odour and pest issues before householders are familiar and committed to the new service
 - High profile community members or media making incorrect statements about the new service
 - Lack of understanding of the term organics bin to include garden and kitchen 'waste'

Monitoring and evaluation program

- Monitoring and evaluation program should be considered before scheme inception to:
 - establish a baseline from which outcomes from the scheme can be measured.
 - identify the effectiveness of the communication methods used.

On-going education and communications

- It is essential to continue education and communications to householders over regular intervals throughout the life of the organics collection service.

Key issues for consideration

- When planning your community engagement:
 - Prepare a communications plan (12 months before service commences if possible) including a budget, scheduling of when activities should take place and by who
 - Engage the communications/PR departments of council early on when planning and developing communications
 - Senior council management and councillors need early involvement in planning new services to ensure their support
 - Consider a partnership approach with the collection or processing contractor to help resource the communications and to obtain their input
 - A pilot trial provides the opportunity to test communication messages and techniques

Factsheet 12 – Contamination management



The importance of low contamination

- It's important to maintain low levels of contamination, in order to:
 - Decrease processing costs
 - Ensure the products meet regulatory requirements
 - Ensure the composted products can be marketed and used without causing harmful environmental impacts.

Contaminants in organics

- Contaminants can be differentiated into:
 - Physical contaminants**, which comprise non-compostable impurities (e.g. plastic, glass, metal, rocks)
 - Chemical contaminants**, which include mainly heavy metals and herbicides
 - Biological contaminants**, which represent plant, animal and human pathogens and also viable plant parts or seeds.

Contamination management

- A contamination management prevention plan should be developed and include:
 - Education material for householders, including visually appealing lists and stickers of what can and what can't go into the organics bin. Clear symbols (i.e. ticks and crosses) should be used to ensure the material is easily understood.
 - Ongoing public education and motivation.
 - Communications material for the local media, councillors, senior staff etc.
 - Arrangements with waste collection personnel regarding contaminated bins and use of contamination tags for non-compliant households.
 - Arrangements with the processor regarding contaminated material for the initial roll out of the service and on-going maintenance of the service. This may include penalty payments if contamination levels exceed a certain threshold.
 - Continuous monitoring and evaluation in problem areas through bin inspectors, waste auditing and community consultation.

Issues to be aware of

- Particular issues related to combined food and garden organics collections include:
 - Linings:** promote compostable plastic linings, paper linings or no linings.
 - Linings supply:** if linings are promoted whether they will be supplied by council (how many for how long) or if residents have to provide their own.
 - Contaminant removal:** whether plastic bags and other large impurities are going to be handpicked and removed at the processing facility, or not. Hand sorting increases processing costs and may also require colouring or marking compostable bin liners so they can be easily differentiated from other plastics.
 - Use of a bag shredder:** will a shredder be deployed to rip open compostable bin liners to release food material? This may result in small pieces of non-compostable plastic within the end product.
 - Organics shredder:** will kerbside collected garden and food organics be shredded? This could result in small pieces of plastic that are hard to separate from the finished compost and mulch.
 - Communications:** will contaminated bins be identified, remedial action taken with the individual household and the service ultimately removed if contamination continues? Community and council support for the service may influence acceptance of various options for dealing with households unable or unwilling to correctly use the service.

Factsheet 13 – Conducting monitoring and evaluation



Monitoring & Evaluation

- **'Monitoring'** means regularly measuring outcomes such as customer satisfaction, participation rates, contamination rates and diversion rates.
- **'Evaluating'** means drawing conclusions from the monitoring data in terms of how well the scheme is performing, or the effect of the communication activity.

Why monitor & evaluate?

- Measure customer satisfaction and user attitudes to establish how these are impacting on the performance of your scheme
- Measure progress against objectives and targets, so you will know in advance if you are likely to hit or miss them
- Identify successful systems as well as problems or performance issues, so that you can target your efforts to those neighbourhoods where improvements will make the most impact
- Assess expenditure and control costs, in terms of anticipated quantity of organics collected, demand for liners, and the impact on education and processing costs of different contamination levels
- Evaluate return on investment to justify existing budgets or persuade budget holders that more money is required to achieve statutory and local targets
- Plan scheme expansions and design (or redesign) scheme so that targets are met or exceeded
- Plan targeted communications to improve performance
- Address the issues that are really impacting on scheme success.

Monitoring methods

Method	How?
1 Tonnage data analysis, for example increased tonnage of organics and decreased residual waste tonnage	Request data from facility operator
2 Waste auditing, per bin, or aggregated via a visual waste audit, or physical waste characterisation	Contract specialist company to undertake composition analysis
3 Set out and participation rate monitoring, for example identifying 80% of all organics bins are put out for collection but only 50% of them contain food organics	Identify area, conduct visual inspection on (3 consecutive) collections, record households who have placed bin(s) out for collection.
4 Organics capture analysis	As method 2, conduct a tailored waste audit
5 Stakeholder feedback	Conduct focus groups and / or surveys (door to door, roadshows, events, public places)
6 Communication evaluation	Compare baseline data and results of above methods in areas you targeted with your communications campaign.

When to Monitor

When to Measure	How
1 Pre-campaign (Identify a baseline)	Tonnage Data Participation rates
2 During the campaign	Sell-out rates Capture rates
3 Post Campaign	Contamination rates

Sampling

- Sampling is required to identify a sub-set of the population from which to monitor to obtain data. The steps in sampling are as follows:
 - Define (profile) the population of interest – decide which factors are important. Use socio-demographics.
 - Decide how to obtain a sample that is reflective of this profile.
 - Decide how precise the results should be – the required sample size will depend on this. For participation monitoring and questionnaire surveys, 3% precision (with a 95% confidence interval) is sufficient which means a sample size of 1,100. Sample sizes smaller than 1,100 are viable but the results become less precise as the sample size gets smaller.
 - Design the monitoring in a way which reduces bias.
 - Conduct the monitoring and collect the data.
 - Weight the data to match the target population.

Scheme Evaluation

- Evaluate and interpret monitoring data by:
 - Looking at changes over time: establish a baseline and compare new data to identify trends
 - Looking at differences between areas: compare results over different geographical areas and / or demographics
 - Looking at different types of data together: use all data available to you to identify and / or understand issues
 - Identify areas for improvement: including lessons learnt for further scheme roll-out or to share with colleagues

PART FIVE: FREQUENTLY ASKED QUESTIONS

Q Why should I collect organic waste?

A Organic waste may represent 60% of household waste, and implementing organics collection therefore offers great potential for landfill diversion and resource recovery. Refer to Factsheet 1 for more information.

Q What are the benefits of collecting organic waste?

A There are multiple potential benefits associated with organics collections, including reduced landfill costs, increased potential to achieve waste diversion targets, enhanced investment and employment in your region, and a range of environmental benefits. There is also potential for councils or organics processors to gain financial benefits via Renewable Energy Certificates (RECs) if the materials are used for generating 'green' energy. Refer to Factsheet 1 for more information.

Q How much organic waste is available and how much will be diverted?

A The 'typical' Australian household garbage bin comprises over 60% food and garden organics, with food being the single largest component, approximately 35% by weight. Conducting a waste audit will enable a better understanding of the composition of the waste generated in your region, and the quantities of organics available for diversion. Refer to Factsheet 2 for more information.

Q How should organic waste be processed?

A Seven general types of processing technologies for organics are detailed in Factsheet 5. Choice of the more appropriate technologies will depend on a range of factors, such as type and quantity of feedstock, site location and size, regulatory requirements, cost constraints, and anticipated product use.

Q Will the public support food waste collections?

A An effective education and engagement strategy is critical to the success of an organics collection service introduced in your community. To ensure residents are given the knowledge and skills to participate and to effect behavioural change, it is important that community communications are well researched, planned and adequately resourced. Refer to Factsheets 4 and 11 for more information.

Q Should food waste be collected separately or combined with garden waste?

A There are several collection options a council could consider, and choosing an appropriate system will depend on factors including the expected quantities of materials, the type of collection containers used, and the frequency of collections. Refer to Factsheets 2 and 3 for more information.

Q How often should we collect organic waste?

A Organics collections are usually introduced as a weekly or fortnightly service. Garden organics alone are commonly collected fortnightly, but the co-collection of food and garden organics usually requires a weekly collection service. Refer to Factsheet 3 for more information.

Q How much will it cost?

A The cost of an organics collection scheme will depend on a range of variables, such as the services already in place, the type of material collected, the collection receptacles and frequency chosen, the intensity of public education, and the processing system used. Refer to Factsheet 7 for more information.

Q What kind of collection vehicle should I use?

A Organics have a different bulk density and are more compactable than residual household waste. It is important to ensure the capacity of the collection vehicle is appropriate to the tonnage collected. Refer to Factsheet 3 for more information.

Q How do I go about implementing the collection?

A It is important that the roll-out of the service runs smoothly, including delivery of bins, caddies and information material. Legitimate grievances of residents should be dealt with promptly. Major problems with the roll-out or the first collections can result in dissatisfied residents and negative press, putting at risk the success of the organics recycling scheme, at least in the short term. Refer to Factsheet 10 for more information.

Q How can we manage contamination?

A A comprehensive contamination prevention and management plan should be developed prior to roll out of an organics service. Refer to Factsheet 12 for more information.

Q What containers / bins should I provide?

A If food and garden organics are to be collected together, a 120-240L wheeled bin will typically be needed. Where food organics are collected separately on a weekly basis, a 20-25L kerbside bin may be sufficient for the majority of households. The term 'kitchen caddy' is used to refer to an internal container used by a householder to store food organics until it is transferred to an external bin. Caddies should have a wide opening so that plates can be easily scraped clean. The caddies should be large enough to contain at least 2–3 days' worth of discarded food. Refer to Factsheet 3 for more information.

Q Should I provide liners?

A Bin liners can greatly help to combat odour issues, and may therefore increase participation rates. Food does not stick to the inside of the caddy when liners are used, reducing the need for cleaning. They also aid collection as food scraps are more easily emptied from the caddy and food and liquid stays contained in transit and the risk of any leakages or spills is reduced. Refer to Factsheet 3 for more information.

Q How can I assess the success of the organics collection?

A There are various methods that can be employed to demonstrate the effectiveness of a scheme, including: tonnage data analysis, waste auditing, set out and participation rate monitoring, organics capture analysis, stakeholder feedback, and communication evaluation. Refer to Factsheets 8 and 13 for more information.

APPENDIX:
TECHNICAL INFORMATION & BIBLIOGRAPHY

TECHNICAL INFORMATION

Australian Standards

There are three Australian standards that are potentially relevant for composting operations:

- ✓ AS4454 – 2012: Composts, soil conditioners and mulches
- ✓ AS3743 - 2003: Potting mixes
- ✓ AS4419 – 2003: Soils for landscaping and garden use.

The compliance of compost based products with the above standards is voluntary and many composters have either none or only a part of their products certified.

Legislative requirements in relation to the quality of compost made from source segregated organic material are uncertain. In regards to chemical and biological contaminants, AS4454 states that “all products shall fully comply with the chemical, organic and pathogen containment provision of the current federal or state government guidelines, whichever is the most restrictive, for use and disposal on soils of products derived from organic wastes, compostable organic material and biosolids. For retail sale, all products shall meet the Class A classification of the appropriate regulations, for unrestricted use”. Hence, the regulations that govern allowable heavy metal and pathogen levels are the state-based biosolids guidelines. The national and the various state-based biosolids guidelines are outlined below:

- ✓ **National:** NWQMS (2004) Guidelines for Sewerage Systems Sludge (Biosolids) Management.' National Water Quality Management Strategy. Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) and Australian and New Zealand Environment Conservation Council (ANZECC), Canberra.
- ✓ **Australian Capital Territory:** The Actew Corporation employs thermal destruction to convert biosolids into sterilised ash, which is then sustainably used as a soil conditioner or stabiliser. There are no formal guidelines for biosolids disposal.
- ✓ **New South Wales:** Environmental Guidelines: Use and Disposal of Biosolids Products (NSW EPA, 1997).
- ✓ **Northern Territory:** No state guidelines are available. The Health Department employs the National Guidelines to manage biosolids.
- ✓ **Queensland:** Queensland applies the New South Wales Guidelines.
- ✓ **South Australia:** 'Draft - South Australian Biosolids Guidelines for the safe handling and reuse of biosolids' (EPA SA, 2009).
- ✓ **Tasmania:** 'Tasmanian Biosolids Reuse Guidelines' (Department of Primary Industries, Water and Environment: Tasmania, 1999).
- ✓ **Victoria:** 'Guidelines for Environmental Management. Biosolids Land Application.' (Environment Protection Authority Victoria, 2004).
- ✓ **Western Australia:** Western Australian Guidelines for Direct Land Application of Biosolids and Biosolids Products (DoH WA, 2002) & DRAFT Western Australian Guidelines for Biosolids Management (DEC WA, 2010).

EPA license conditions might state that generated compost products have to comply with requirements contained in Australian Standards and have to be fit for unrestricted use (Class A). However, depending on the type of input materials processed, license conditions for a composting operation might include various other compost quality requirements not contained in the Australian Standards or biosolids guidelines, such as hydrocarbons if a facility receives oily wash water or similar.

Organics Collection Trials and Services - Key Statistics

Key statistics published for ten successful Australian kerbside organics collection trials and services have been reviewed for this guide and average values are outlined in the following tables to represent indicative recovery rates possible for food and garden organics.

Table 1 Overall average recovery statistics (of ten Australian collections reviewed)

Key collection statistics	Overall average value
Participation rate	66%
Contamination rate	3%
Total organics yield	8.0 kg /hhld/week
Food organics yield	1.8 kg /hhld/week
Garden organics yield	7.7 kg /hhld/week
Food organics capture rate	33%
Garden organics capture rate	96%
Combined organics capture rate ¹	55%

The following tables provide more detailed recovery statistics for food organics, garden organics and total organics for several subsamples reviewed².

Table 2 Average food organics yield for collection subsamples

Food organics yield	Average of subsamples reviewed (kg /hhld/week)
Yield (in a food-only collection service)	2.5
Yield (in a combined food and garden organics collection service) ³	1.73
Yield (SUDs) ¹¹	2.2
Yield (MUDs)	1.0
Yield (weekly collection)	1.97
Yield (fortnightly collection) ¹¹	1.49

¹ Only includes collections for which separate figures are not reported for food and garden capture rates.

² Note that there were three 'food-only' subsamples included in the review and four subsamples of MUDs included in the collections reviewed.

³ Food organics figures from Groundswell project are excluded due to the inclusion of Goulburn-Mulwaree monthly collection frequency which resulted in low yields of food

Table 3 Average food organics capture rate for collection subsamples

Food organics capture rates	Average of subsamples reviewed %
Capture rate (food-only collection service)	61%
Capture rate (combined food and garden organics collection service) ¹	24%
Capture rate (SUDs)	33%
Capture rate (MUDs)	32%
Capture rate (weekly collection)	38%
Capture rate (fortnightly collection)	22%

Table 4 Average garden organics yield for collection subsamples

Garden Waste Yields	Average of subsamples reviewed kg/hhld/week
Yield (in a combined food and garden collection service)	7.7
Yield (SUDs)	9.4
Yield (MUDs)	2.5
Yield (weekly collection)	7.6
Yield (fortnightly collection)	7.8

Table 5 Average garden organics capture rate for collection subsamples

Garden organics capture rates	Average of subsamples reviewed %
Capture Rate (SUDs)	96%
Capture Rate (MUDs)	94%
Capture Rate (Weekly Collection)	96%
Capture Rate (Fortnightly Collection)	94%

¹ Food organics figures from Groundswell project are excluded due to the inclusion of Goulburn-Mulwaree monthly collection frequency which resulted in low yields of food

Table 6 Average total organics yield for collection subsamples

Total organics yield	Average of subsamples reviewed (kg /hhld/week)
Total yield (SUDs)	8.6
Total yield (MUDs)	3.4
Total yield (weekly collection)	5.5
Total yield (fortnightly collection)	9.3

Processing Technologies

There were more than 187 organics processing facilities in Australia in 2009–10, handling over 5.8 million tonnes of organic residues between them. The feedstock to these facilities included 1.58 million tonnes of garden organics and 211,000 tonnes of food organics (not including food residues in MSW).

NSW and Victoria recycled the bulk of source separated food organics, accounting for 100,000 and 84,000 tonnes respectively. While many facilities were originally designed to process garden organics, most have been modified to enable them to handle other putrescible feedstock such as mixed garden and food organics (as well as other putrescible organic residues), without causing environmental nuisance or harm.

There are three general treatment options for organic residues: combustion (including gasification); composting; and anaerobic digestion. The most suitable method of treatment for a given application will depend largely on the chemical and physical properties of the materials being processed (see table below).

Combustion	Composting	Anaerobic Digestion
Wood		
Tree & Shrub Prunings		
Land Clearing		
Vegetation Management		
Park & Garden Residues (winter - summer)		
Mixed Garden & Food Organics (rural - urban)		
Commercial Organics		
Kitchen Organics		
Food Scraps		

As a general rule, organic residues with high carbon density and low moisture content (such as wood) are better suited to combustion whereas putrescible residues with high moisture content (such as food) are better suited for anaerobic digestion. These types of putrescible materials are also suitable for processing in vermiculture operations, which is not the case for dry and woody material. A wide variety of materials can be composted, although not always on their own. The ability to blend dry and moist, carbon-rich and nutrient-rich materials, makes composting a very versatile processing option.

The choice of processing technology is primarily governed by:

- ✓ What outcomes council and the community expect to achieve
- ✓ Location and size of proposed site and associated environmental constraints
- ✓ Type and quantity of expected feedstock
- ✓ Investment and operating costs
- ✓ Type of products to be manufactured
- ✓ Sustainability issues (such as measured through LCA or carbon footprinting).

A critical aspect of choosing an appropriate processing technology is site location. Even fully enclosed composting facilities can result in odour complaints when poorly operated and located close to residential areas. Negative headlines (for example caused by odour emissions, biosecurity, contamination in output, water contamination, fire or technical problems) can be detrimental to community engagement efforts.

A general rule of thumb is that the more material that is processed at a site and the higher the proportion of putrescible residues (for example food organics, biosolids, food processing residues or liquids), the higher the risk for nuisance and environmental problems to occur.

In some jurisdictions licensing requirements will dictate the design of an organics processing system and may, for example, preclude the use of open, uncovered windrow composting for the co-composting of food organics.

Simple pile composting has been modified and developed over the last sixty years into various mechanised and sophisticated composting technologies. Over the years, many different composting systems were developed and offered in the market place, some of which have endured, while many others vanished. Nevertheless, the basic principles of composting remain unchanged, as the process is governed by the fundamentals of biological and biochemical processes.

In the *Practical Handbook of Compost Engineering*, composting is defined as the biological decomposition and stabilisation of organic substrates under aerobic and thermophilic (>45°C) conditions to produce a product that is stable, free of pathogens and plant seeds, and can be beneficially applied to land. There are seven general types of processing technologies for organics, as outlined below and further explained on the following pages.

- 1 Vermicomposting
- 2 Open windrow composting
- 3 Aerated static pile composting (with or without covers)
- 4 In-vessel composting (tunnel, box, vertical silo, drum)
- 5 Fully enclosed composting (agitated bed, agitated pile)
- 6 Anaerobic digestion (wet, dry)
- 7 Combustion (including pyrolysis and gasification).

Most organics processing facilities can be compartmentalised into pre-processing, processing and post-processing operations. In the case of composting facilities, pre-processing includes segregation of physical contaminants, size reduction of bulky materials, blending of different feedstock, and addition of water, microbial inoculants or other additives that are designed to improve the composting process or the finished product.

The composting process can be divided into a first, high-rate phase, and a second, curing phase. Many composting systems are organised along this divide. The first stage is characterised by high oxygen uptake rates, elevated temperatures, high consumption of easily degradable components, and high odour emission potential.

The second stage is characterised by lower temperatures, reduced oxygen demand and lower odour potential. Traditionally, the intensive composting phase has been more engineered and controlled due to the need to reduce odours, supply high aeration rates and maintain process control. The curing phase is usually less engineered and less process control is applied.

Post-processing in a composting facility can include screening and air-sifting, blending, adding performance enhancing components (nutrients, microorganisms), or pelletising.

Microbial Inoculants

Various microbial inoculants are available on the market, the use of which promises to deliver benefits such as improved / faster composting, reduced odour generation, reduced nutrient loss, or enhanced compost products.

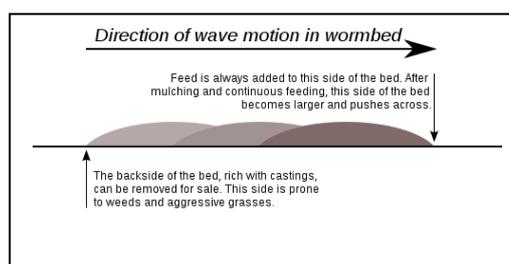
Provided key raw material characteristics (moisture, carbon-to-nitrogen ratio, bulk density, porosity, oxygen content) are within an acceptable range, the composting process is self-starting and also self-regulating (to a certain degree), governed by ever-changing microbial populations and microbiological processes. Given the dynamic nature of the composting process, the rapidly changing environmental conditions (temperature, moisture, food sources) inside composting materials, and the associated changes in microbial populations, it is difficult to see how microbial inoculants can deliver the claimed benefits. Importantly, in most cases there is little or no independent verification of product claims. Hence, before embarking on the full-scale use of microbial inoculants, request independently verified proof of efficacy. Alternatively, you can design and conduct meaningful comparative trials at your own site.

One microbial inoculant (VRM Bio-Logik) has gained some prominence recently through its use in composting large quantities of organic residues in Townsville in the wake of cyclone Yasi, and in the Groundswell Project in NSW. However, the information provided through the Groundswell Project about the VRM aided, anaerobic composting process (fermentation) is not very specific and does not demonstrate the efficacy of the product. Misleading claims about the products capability of eliminating *E.coli* from composted material are concerning.

Vermicomposting

Large-scale vermicomposting is practised in various countries, including Australia. At the turn of the century, there were four or five large vermicomposting operations, processing municipal organics (biosolids, garden and food organics) and animal manures. However, today there are only one such operation left in Australia, in Broken Hill. Fundamentally, vermicomposting requires a higher level of management and is less forgiving than windrow composting. Favourable environmental conditions for worms, e.g. moisture, temperature, pH, ammonia, digestible food, have to be maintained at all times. Although vermicompost is often claimed to be a higher value soil amendment product than standard compost, vermicomposting operations generally face the challenge of pasteurising the product and drying it so it can be screened and packaged / stored.

There are two main methods of large-scale vermicomposting: (i), an extending windrow type system and (ii) the raised bed system. In the extending windrow system, small piles of organic material are provided for worms. More organic material is added to the pile continuously (see diagram). Often the windrows are placed on a concrete surface for ease of operation, and to prevent predators from gaining access to the worm population.



The second type, and state-of-the-art of large-scale vermicomposting is the raised bed or flow-through system. Here the worms are fed by regularly adding a thin layer of fresh material across the top of the bed. Worm castings are harvested from below the bed by pulling a breaker bar across the large mesh screen which forms the base of the bed. A description of this system, as well as of the whole vermicomposting operation is provided by Worm Power, an innovative and successful (cow manure) vermicomposting operation in New York State.

Open Windrow Composting

The vast majority of organics processing facilities in Australia, and indeed the world employ open windrow composting. In Germany for example, which is seen as a leader in organics recycling and processing, 61% of composting operations employ open or covered windrow composting, while the remainder use in-vessel composting technologies (20%), fully enclosed aerated/agitated piles (11%) or other technologies. Open windrow composting is very widely used because it is the cheapest and also the most flexible and reliable means of processing and stabilising organic residues. However, windrow composting offers limited process and odour control, which increases environmental risks, particularly odour and leachate emissions.

In windrow composting, raw materials are set up in long rows, which are then turned regularly either with front end loaders or dedicated windrow turners. The type of turning equipment used determines the size of rows, and hence the area required for processing a given quantity of input material. Compared to other processing options, windrow composting has a relatively low throughput per unit surface area, i.e. demand for land is high. On the other hand, investment and operating costs are relatively low, making windrow composting often the only organics processing technology that is able to compete with low landfill costs.

Covered Windrows

Open windrow composting is obviously difficult in high rainfall areas. This problem can be alleviated by either using windrow covers, or by (partially) covering the operation with a roof.

Use of semi-permeable windrow covers can help maintain acceptable moisture levels in the composted material during heavy rain, and also in very dry conditions. Compost covers need to be deployed and retrieved mechanically, either with a cover roller attached to the turner or a dedicated machine. Proper storage for unused covers is critical for their long-term usability. Standard windrow covers are 4m or 5m wide and 50m or 100 m long, which means that they are suitable for smaller rows turned with a straddle turner, but are too small for large windrows established and turned with front end loaders.



Composting with windrow covers (left) and under roof

Aerated Static Pile Composting

Aerated static pile composting was originally developed for composting biosolids in the USA. In aerated static pile composting, organic residues are mixed together in one large pile instead of rows. To aerate the pile, the piles are placed over a network of pipes that deliver air into or draw air out of the pile. Aeration can be via permanent sub-surface channels or via mobile pipes that are above ground. Air blowers might be activated by a timer or temperature/oxygen sensors.

Aerated static pile composting is suitable for a relatively homogenous mix of organic residues with acceptable moisture, bulk density and porosity characteristics. According to the US EPA, this technology should work well for composting garden and food organics but not so well for processing animal by-products or grease from food processing industries.

Temperatures in the outside layer of the piles do not reach levels that ensure elimination of pathogens and weed seeds. This can be overcome by (i) physical turning of the pile, (ii) windrowing before or after static pile composting, (iii) covering the pile with finished compost or compost covers. Covering the piles also helps reducing the risk of odour emissions. Use of negative aeration (air blower draws air through the pile to the base) and the subsequent filtration of the exhaust air through a biofilter also helps in reducing odour emissions.

Aerated static pile composting typically requires equipment such as blowers, pipes, sensors, and access to electricity, which can be generated on site, or off the grid. The controlled supply of air enables construction of large piles (governed by material characteristics), which results in increased processing capacity per unit of land.

Examples

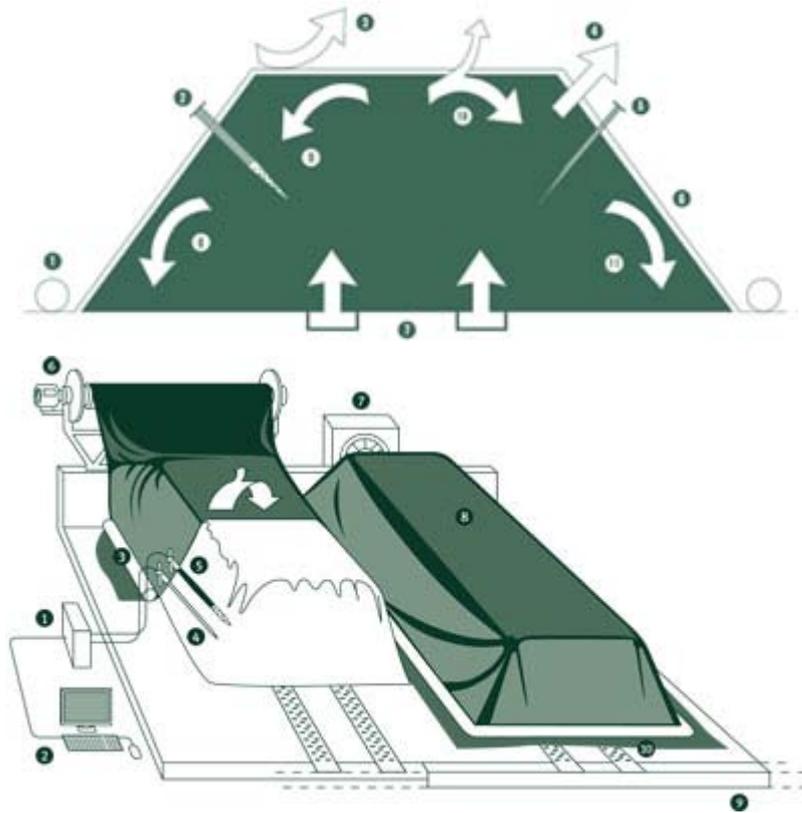
The SITA Organics BioWise ARRT facility in Kwinana (WA) has the capacity to process up to 50,000 tonnes per year of organic material, employing an aerated, static pile system. Processed organic residues include biosolids, shredded garden organics, grease trap waste and food organics. Incoming feedstocks are carefully blended in proportions that ensure the resulting compost meets end use requirements, with parameters including correct moisture content and ratios of nitrogen and phosphorous. Temperature and moisture levels in the composted material are monitored and controlled, optimising the breakdown of the organics and destroying pathogens. After the aerated composting process, the compost is matured and tested.

Over the last five or so years, several composting operations in Australia have integrated static aerated pile composting into their operations. Custom Composts (WA), Peats Soil and Garden Supplies (SA) and Pinegro Products (VIC) for example employ an above ground mobile forced aeration system while Jeffries (SA) opted for a non-mobile static aeration system.

Compost Covers

Managing moisture levels in aerated static piles might be a challenge, since rain water is not shed like in windrows, and forced aeration tends to dry out the composted material. Use of semi-permeable compost covers can help manage both of these problems and enhance the performance of static aerated composting.

The most prominent compost cover for static aerated composting are the GORE® Covers. GORE compost covers consist of GORE-TEX® membrane that protects the composting material from the penetration of rainwater, yet allows CO₂ produced during the composting process to escape. The GORE® Covers act as a physical barrier against gaseous substances escaping from the composted material. In addition, a fine film of condensation develops on the inside of the covers during the composting process, suppressing emission of odours and other gaseous substances. These gases are partly dissolved in the film of water and drop back into the composting material where they continue to be broken down by bacteria. . Biological washing and filtration of the exhaust air is not necessary.



Principle of a GORE® Cover in an aerated static pile (top) and schematic view of operational GORE composting system (bottom)

Microbiological tests have proved that pathogenic microbes can be reduced by >99% under GORE compost covers. The insulating effect of the covers and the pressurisation by which the system ensures even temperature distribution in the whole pile, including the outside layer, means that achieving the necessary temperature for sanitising the material across the entire cross-section of the heap can be guaranteed.

GORE does not only provide compost covers, but an entire oxygen controlled, positively aerated composting system, including aeration pipes, blowers, compost covers, oxygen and temperature monitoring devices, and software.

Use of compost covers prevents the final product being too wet, yet at the same time ensures that there is sufficient moisture retained to allow the material to be decomposed properly, something that is particularly important in arid areas.

Examples

In 2006, Timaru District Council in New Zealand established the first, and so far only GORE cover composting facility in the Southern Hemisphere. Source segregated garden and kitchen organics delivered to the site are ground with a shredder and amended with water. A loader then places the material in 50 m long windrows, each of which is 8 m wide and 3.8 m high, containing approximately 750 m³ of organic residues. The windrows are covered with GORE compost covers, using a cover winding machine. Two subsurface aeration channels underneath each windrow facilitate forced aeration, ensuring the composting process is kept aerobic and high temperatures are maintained.

The site provides space for eight windrows. New material is placed in windrow positions 1 – 4 and composted under GORE covers for four weeks. The cover is then removed and the windrow is moved to positions 5 or 6 for two more weeks of composting, but without covers. This process is subsequently repeated, moving the windrow to positions 7 or 8. After eight to ten weeks, the compost is screened and ready for sale.

In-vessel Composting

When in-vessel composting systems are utilised, the organic materials are fed into a drum, silo, tunnel, box, container or similar where the initial, intensive composting process takes place in controlled environmental conditions (temperature, moisture, and aeration). These systems usually employ forced aeration, a mechanism to turn or agitate the material, or both, to facilitate proper aeration and process conditions. Generally, materials are premixed before being loaded in the vessel, which needs to be done very thoroughly where no agitation occurs during the in-vessel composting phase. Typically, materials are processed 'in-vessel' for periods between one and three weeks before they are further composted and cured in (aerated) windrows or static piles. Most facilities with in-vessel containers only use them for the first phase of the composting process where process control is critical; using containers for the entire composting process would be costly. In-vessel composting equipment can be located in the open, or it can be housed fully or partly in a building to contain odours being generated during unloading and pre-processing of organic residues.

In-vessel composting systems are usually modular; providing flexibility and allowing gradual expansion as input volumes increase. The number of units or modules determines throughput and the scale of operation. Multiple in-vessel units can be used to attain a continuous operation. The modular nature of in-vessel systems allows for parallel use of different processing conditions (raw materials mixing ratio / aeration / turning frequency) depending on input material characteristics and/or intended end-product use.

Forced aeration systems supply oxygen and remove moisture and heat. In most cases, air is introduced at the base of the material, which then flows up through the composted material into a headspace at the top. Subsequently, the exhaust air is deodorised through a biofilter. Most in-vessel systems employ positive aeration (air blown up through the pile) to avoid leachate building up in the aeration manifolds, reducing the flow of air. Many in-vessel systems allow addition of water through overhead sprinklers to counter drying out of the composted material through forced aeration.

A wide range of in-vessel composting systems are available in the market place. They mainly vary in the type of vessel employed, size, aeration/agitation and details such as the control devices, loading equipment and leachate management. The following sections provide more detail on different in-vessel composting systems, as well as examples of different installations.

Tunnel Composting Systems

Tunnel composting systems are essentially long aerated concrete containers that can be closed, have forced aeration through a floor plenum, and allow for internal air circulation. They are loaded and unloaded from one end and operate in batch mode after the tunnel is fully loaded. Materials are loaded and unloaded either with front-end loaders or fully automated conveyer systems.

Examples

In 2000, Natural Recovery Systems established a tunnel composting facility with five units in Dandenong (VIC), which is used to recycle garden organics and a range of food organics. Each tunnel has the capacity to accept approximately 300m³ of initial mix, and annual throughput for each tunnel lies in the range of 4,000 to 6,000 tonnes depending on the types of waste and the time that the mix is retained in the vessel.

The SITA SAWT facility at Kemps Creek (NSW) operates tunnels dedicated to processing source separated food and garden organics from Penrith City Council. Annually, the facility processes in excess of 40,000 tonnes of organic residues, including sludges.

The Remondis Organic Resource Recovery Facility (ORRF) in Port Macquarie receives source separated organics from Port Macquarie Hastings Shire Council which is shredded and blended with biosolids and loaded into one of the eight tunnels. Process air and fresh air is forced into the material at the base of the tunnel and recycled process water is added via sprays at the top of the tunnels when required. The in-vessel composting process takes 3 to 4 weeks, followed by further composting and curing, which takes place in an outdoor area.

Box and Container Composting Systems

Fundamentally, box and container composting is identical to tunnel composting. Boxes and containers however are smaller and tend not to be in enclosed buildings. Containers are mobile and can be also used for transporting organic residues from disposal points to the composting site. If a roll-on roll-off system is used, containers can be easily transported to and emptied at the point of further processing.

Examples

As far as the authors are aware, no box or container composting systems are operated in Australia or New Zealand. Nevertheless, the Herhof Box Composting System and the BIODEGMA Box Composting System for example are used widely in Europe, while Green Mountain Technologies supplies the North American market with its Containerised Compost System.

Vertical Composting Silos

Vertical composting silos are typically tall (e.g., 3.7 m to 4.3 m high) with a small foot print (e.g. 3 m x 3 m). Vertical silos in use for composting municipal organics are passively-aerated, i.e., there is no forced aeration. Instead, the material is contained in vertical 'chambers' that have a grid or perforated base that enables air to flow through, driven by temperature gradients.

Vertical silo technologies are often challenged by the difficulty in providing an even flow of air throughout the composting mass. Therefore, composted materials must contain sufficient structural material (or bulking agent) to allow the passage of air through the material when it is in the chamber. Shredded garden organics, land clearing or wood are typically used as bulking agent. The proportion of bulking agent required depends on the kind of material being processed and typically varies between 15% and 50% by mass. Putrescible organics are mixed with bulking material before being fed into the chamber by conveyor. The mixed feedstock is loaded on the top of the silo and the composted material is extracted at the base, hence providing a continuous composting system.

Examples

VCU Technology supplies modular, insulated, stainless steel-lined composting chambers, measuring 4.5 m high and 2.5 m square. Each chamber, or vertical composting unit (VCU) has a maximum throughput of 10 tonnes per day, subject to nature of feedstocks. The chambers operate continuously on a 'plug-flow' principle. As product is removed daily from the base, new material is fed into the top of the chamber. Typical retention times vary between 4 and 14 days.

Like in any large scale composting operation, heat is generated by the metabolic activity of microbes inside the chamber. This heat energy is harnessed to help create a natural chimney effect that draws in cool air at the open base of the chamber and facilitates aeration of the composting material. Due to the rising heat, temperatures vary between 40°C at the base of the chamber and in excess of 70°C at the top.

The VCU composting system is considered very energy-efficient as it does not require agitation, bio-filtration, external heating or air injection. With minimal moving components, maintenance and operating costs are very low.

The VCU prototype was tested at Longbay Correction Centre (Malabar, NSW) in the mid 1990's with subsequent units being established at the University of NSW (composting of catering residues) and at Lord Howe Island (composting of septic tank waste and food organics). Sydney's Royal Botanic Gardens uses a VCU unit to convert vegetation residues into compost. Waitakere City Council in New Zealand installed a 10 chamber plant in 2001, benefiting from the VCU's small footprint on their urban site. Wingecarribee Shire Council (NSW) trialed a 3,000 tpa VCU system in 2003 but did not retain it. Today, VCUs are primarily installed and operated in Europe.

Rotating Drum Composting Systems

It should be noted that some do not see rotary drums as a composting technology in its own right, as the organic material is retained in the drum only for a short period and another composting method must be used in tandem with a drum. Hence, an important distinction between rotary drums and other in-vessel composting systems is that the latter can be used for the entire intensive composting phase (several weeks), whereas the drums, realistically, can only be used for the initial step.

However, rotary drums are popular because they can serve several purposes: blending, size reduction without shredding, and screening. The composting process is initiated while the organic material is in the drum (several days), providing some degradation of easily degradable feedstocks such as food organics. Air is fed into the drum to aerate the material and exhaust air is deodorised in a biofilter. As material exits the drum, it can pass through a screen, aiding the removal of impurities. If the drum is used for particle size reduction rather than a shredder, it might be easier to extract impurities, especially plastic, as it has not been reduced to small pieces that can keep passing through screening systems.

Examples

There is no composting facility in Australia that employs this type of technology for the processing of source segregated garden and kitchen organics. However, three Bedminster facilities in Port Stephens (NSW), Cairns (QLD) and Perth (WA) use composting drums for the processing of organics contained in MSW.

Other In-vessel Composting Systems

The **HotRot composting unit** is a longitudinal, fully enclosed continuous in-vessel composting module. Each unit incorporates a u-shaped concrete hull section with sealed lids. A central tine bearing shaft runs longitudinally through the vessel. This shaft rotates periodically and slowly, providing mixing and assisting with aeration, and also assisting in the physical breakdown of the composted material. Grinding or shredding of food and animal residues can generally be avoided.

Composting with the HotRot is a continuous process. Coming from a blending / feed hopper, and going through an inclining, covered conveyor, organic residues are added frequently in small amounts at one end of the vessel. This means fresh material is instantly inoculated with actively composting material already in the unit, avoiding a "lag-phase" and speeding up the composting process. Likewise, composted material is extracted in small amounts at the discharge end of the unit, making room for new material.

The generated compost can be used without further maturation, significantly reducing the land area required for the composting facility.

The HotRot systems does not generate leachate, which simplifies operations, removes an environmental risk and reduces operating costs. The company claims that the HotRot does not emit odours, and is willing to offer a contractual OdourFree guarantee.

Examples

In 2005 the Selwyn District Council (New Zealand) bought two HotRot composting units to service their initial move into kerbside collection of garden and household organics. The facility was designed on a modular basis with 15 year future organic residue growth rates in mind. Hence, the front end and feed process were constructed to be able to feed five HotRot units, with two supplied initially and additional units to be added as demand required without major changes to existing infrastructure. This allowed the Council to minimise their initial capital outlay and to spend on additional processing capacity only when demand required it. The Council have recently (2011) purchased a third HotRot unit to cater for the growing levels of organics from kerbside collections and drop-off centres.

The Australian National University (ANU) in Canberra installed a 800 tpa HotRot unit on an 18 month trial basis in 2007. Processed organic residues comprise food organics from the halls of residence, campus restaurants, office kitchens and zero waste events. This averages around 3 tonnes per week, with no waste collected during the December/January break. The second major component that is composted is animal bedding from research departments, at a consistent 1.2 tonnes per week throughout the year.

In early 2012, Melbourne Zoo installed a HotRot composting unit and feed system to manage animal bedding and other organic materials generated around the grounds.

Fully Enclosed Composting

Fully enclosed composting systems represent technologies where composting takes place in a large building or section of a building without containing the material in a separate, enclosed composting vessel. The pre-processed organic material is typically fed into the system at one end, and the compost is extracted at the other end. This flow-through system, enhanced by agitation and turning, minimises loss of production capacity due to volume reduction during the composting process. Fully enclosed composting systems usually employ underfloor negative aeration to reduce condensation in the composting hall, while also extracting exhaust air overhead. Ducting for under-floor aeration and leachate collection is usually combined, but can be cause for problems.

Technology suppliers offer different types of agitation and turning equipment, such as augers, paddle wheels, or lifters that is either mounted on a travelling bridge, or runs along concrete walls. Operation of this equipment is usually fully automated, so that nobody has to be in the composting hall.

The organic material is composted inside the composting hall under fully controlled conditions (aeration, temperature, moisture) for four to eight weeks, which is considerably longer than with most in-vessel composting systems. Nevertheless, despite composting in controlled conditions for extended periods (up to eight weeks), the generated compost is usually matured in (aerated) piles or windrows prior to it being used, except for application in agriculture or site rehabilitation.

Agitated Bed Composting Systems

In agitated bed composting systems, organic residues are composted in “beds” contained by long channels with concrete walls. A turning machine, travelling on top of the beds, agitates and moves the materials forward. Forced aeration is provided through the floor of the channel. As the top of the channel is open, agitated beds are usually located in an enclosed building. To reduce the volume of exhaust air to be deodorised and to improve working conditions inside the building (e.g. loading and unloading operations), some systems have plastic curtains around the perimeter of the bays (and in some cases also a drop ceiling to further contain odorous air). These measures also help to contain the moisture and ammonia being released from the composting materials, which contribute to corrosion of the building.

Raw materials are mixed and loaded in the front end of the channel and discharged at the other end, representing a continuous flow composting system. Starting at the discharge end, the turner moves down the channel toward the loading end. With each pass, material is displaced a set distance (2 m to 4 m) toward the back of the channel until the materials are eventually discharged as compost that has met time and temperature requirements for pathogen and vector attraction reduction. The length of the channel, the turning frequency and the distance the material is moved when turned determine the composting period in the channel (generally 10 to 28 days). Dimensions of individual channels vary among the commercial systems with depths ranging from 1.0 m to 2.4 m, widths of 1.9 m to 3.8 m, and channel lengths typically between 60 m and 90 m. Most applications use a single turning machine for multiple channels, although the number of turning units has to increase in line with the number of channels (at a certain ratio).

Examples

The Biomass Facility at Coffs Harbour (NSW) processes 55,000 tonne per annum of garden organics, food organics and biosolids in an agitated bed composting system. Physical contaminants are removed from the incoming organic materials in the receival hall prior to it being moved into the composting hall, where it is composted in agitated beds for a period of 21 days.

Agitated Pile Composting Systems

Enclosed agitated pile composting is very similar to agitated bed composting systems, except that there is only one or two very large rectangular beds, each of which could measure for example 25 m x 100 m. Feedstock is loaded into the composting hall at one end and is extracted at the other end. Starting at the discharge end, the agitator / turner moves along the pile, discharging composted material for removal from the hall, and then moves toward the loading end, turning and moving the material in the process. With each pass, material is displaced a set distance (1 m to 4 m) toward the discharge side of the composting hall. Pile dimensions, turning frequency and the distance the material is moved when turned determine the composting period in the hall. Loading and unloading of the hall as well as agitation / turning are fully automated processes without staff having to enter the composting hall.

Examples

There is no composting facility in Australia that employs this type of technology for the processing of source segregated garden and kitchen organics. However, Global Renewables' UR-3R facility at Eastern Creek (NSW) uses an agitated pile composting system for the processing of organics contained in MSW.

Anaerobic Digestion

This report does not call for a detailed description of the anaerobic digestion process and in-depth presentation and discussion of various processing options, let alone available digestion technologies. Therefore, the following sections provide merely an overview, based on two more detailed overview reports.

Fundamentals

Anaerobic digestion represents the reduction and break down of organic carbon compounds in anaerobic conditions, an environment that is devoid of oxygen (O) and nitrate (NO₃). Anaerobic digestion is a sequential process, which happens in four steps (hydrolysis, acidification, acetogenesis, methanogenesis) and generates biogas, containing 50% to 75% methane (CH₄).

Before being digested, the feedstock usually has to undergo some kind of pre-treatment. The purpose of such pre-treatment could be particle size reduction (mill, shredder), mixing of different raw materials, removal of impurities, addition of processing water, raising of the feedstock temperature to ensure continuity of the digestion process, and pasteurisation of the input material.

The anaerobic digestion process takes place in a digester, which can be classified in relation to the temperature (mesophilic, 25 – 45 °C; thermophilic, 45 – 60 °C), the water content of the input material (wet and dry digestion) and the number of process stages (single or multi-stage processes).

Single-stage process facilities combine all anaerobic digestion steps in one bioreactor and are therefore relatively simple from a process-engineering point of view. However, the combination of all biological and chemical processes in a single bioreactor represents a compromise since none is operating in optimum conditions. This results in a reduced operating efficiency, which is often compensated by prolonged retention times (two to four weeks). High performance single-stage reactors are unsuitable for the processing of garden and kitchen organics due to their high solids content, leaving agitated reactor vessels, percolation and plug-flow-reactors for single-stage anaerobic digestion of these materials.

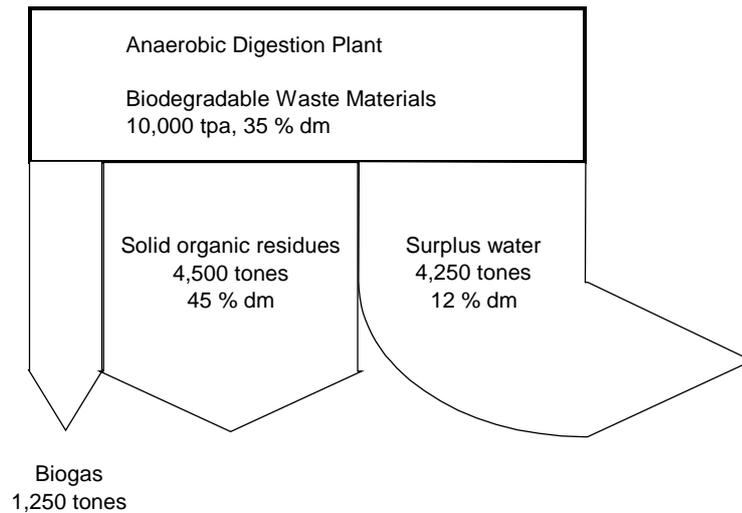
Multi-stage systems are anaerobic digestion facilities where the organic materials pass sequentially through several bioreactors with varying environmental conditions. Commonly, the hydrolysis and acidification phase is separated from the mesophilic or thermophilic digestion. In many cases solids are separated after hydrolysis and only the acid process water that contains suspended solids is digested and used for biogas production in high-performance reactors. Multi-stage process facilities require a higher level of engineering and process control than single stage processes. Reactors in multi-stage facilities are relatively small since the operation in optimum conditions and the transfer only of largely hydrolysed and easily degradable organic components into the digesters, assures high levels of degradation and high throughput rates. Retention times are one to two weeks or less.

The table below provides an overview of various types of anaerobic digestion processes.

Differentiation and characteristics of various types of anaerobic digestion processes

Criteria	Multi-stage wet digestion process	Single-stage wet digestion process	Single-stage dry digestion process
Temperature	Mesophilic or thermophilic	Mesophilic or thermophilic	Mesophilic or thermophilic
Level of degradation	50 – 80 % of organic dry matter	40 – 60 % of organic dry matter	
Retention time	4 – 15 days	12 – 25 days	
Digester 1			
Bio-chemical process	Hydrolysis, acidification	Hydrolysis, acidification, acetogenesis, methanogenesis	
Dry matter content	5 – 15 %		25 – 40 %
Agitation	External pumps, propellers, gas forced into reactor		Propeller, percolation
Supply of material	Continuously, intermittently, batch system		
Digester 2			
Bio-chemical process	Acetogenesis, methanogenesis		
Dry matter content	5 – 10 %		
Agitation	External pumps, propellers, biogas forced into reactor		
Supply of material	Continuously, intermittently		

Anaerobic digestion of organic matter results in the production of biogas and organic residues (digestate) and, depending on the type of digester used, also in more or less surplus processing water. As an example the figure below shows a material flow chart for a dry anaerobic digestion plant in Switzerland.



Example of material flow in a dry anaerobic digestion facility that processes mixed garden and food organics

Anaerobic digestion results in the generation of biogas, which is composed primarily of methane (50% – 75%) and carbon dioxide (25% - 50%) plus trace gases. The amount of biogas generated through anaerobic digestion depends largely on the type of input material processed and its particle size distribution as well as on the efficiency of the digestion process. On average, 40 – 65 % of organic matter is degraded through anaerobic digestion processes. The level of organic matter degradation correlates with the gas and energy yield obtained from anaerobic digestion. Experience has shown that between 300 and 600 L of biogas are generated per kg organic matter (dm), depending on the type of material processed. As a rule of thumb it is expected that 1 tonne of mixed garden and food organics (biowaste) generates 100 m³ of biogas with an energy content of 6 kWh/ m³ (methane content of 60 %). Consequently, a digestion plant with a processing capacity of 10,000 tpa, servicing some 100,000 people would generate about 1 million cubic meter biogas per year with an energy equivalent of 6 million kWh. Broadly speaking, 20 – 30 % of the produced energy is normally used for operating the anaerobic digestion facility and 8 – 12 % is lost, resulting in a gross surplus of 58 – 72 % of energy produced.

Capital costs for establishing anaerobic digestion facilities are relatively high, some of which can be offset through the sale of energy (electricity, heat) and possibly also digestate.

Current Status

Anaerobic digestion has become a popular choice for treating organic residues in various European countries and to a lesser degree in North America. For example, at the end of 2010 there were 5,900 anaerobic digestion facilities in Germany, generating 12.8 Mrd. kWh of electricity, or 2.1% of the country's total electricity demand. However, only 9% of digested raw materials were municipal, commercial and industrial organic residues, the majority being energy crops and animal excrements. The rapid development of anaerobic digestion in European countries is driven by whole-of-government policy settings and significant subsidies for energy generation from renewable resources. Many municipal composting operations are retrofitted with an additional anaerobic digestion plant.

The main benefit of operating anaerobic digestion plants is that energy can be recovered from organic residues in the form of methane-rich biogas, which can be used to generate renewable power and/or heat. At the same time, solid organic matter (digestate / compost) and plant nutrients are retained and are available for land management purposes.

The sale of energy and renewable energy credits can be an additional source of income for anaerobic digestion facilities. However, capital expenditure for anaerobic digestion facilities is generally significantly higher than for composting operations, and the feasibility of this technology will depend largely on economic feasibility, driven either by increasing landfill fees or green energy incentives. Following a recent comparison of the (on-farm) situation in Germany and Australia, Wilkinson concluded that, although anaerobic digestion has considerable potential for application in Australia, it is unlikely to be widely adopted unless new incentives emerge to strongly encourage investment. Stronger Australian regulation (e.g. of dairy effluent) may serve as an incentive to a limited extent in the future. Yet regulation on its own was not sufficient to force large numbers of German farmers to invest in AD systems – this only came about with the introduction of financial incentives such as investment grants, soft loans and fixed-price premiums for utilization of biogas.

Examples

In Australia anaerobic digestion is currently primarily used in wastewater treatment plants, food processing operations, and in a piggery (Berrybank, VIC). Biogas, or landfill gas, is also utilised at more than 60 landfills. However, at this point in time, there is no anaerobic digestion facility that process, or co-processes, source separated domestic garden and food organics.

The **EarthPower** facility in Camellia (NSW) uses wet digestion technology to process various organic residues including source segregated foods and food based residue streams from domestic, commercial and industrial food preparation, processing and consumer activities. The feed stocks arrive in various forms including raw, cooked or processed meats, fruit and vegetables, dairy products, confectionary, bakery products, cereals and grains.

The generated biogas is used to fuel cogeneration engines, which produce green electricity and heat. Surplus electricity is sold into the grid for distribution to domestic, commercial and industrial clients. At full capacity, the facility can produce enough green electricity to power over 3,600 homes. Heat from the cogeneration engines is used in the digestate drying process and to heat the digesters.

A by-product of the anaerobic digestion process is a nutrient rich sludge, or digestate, which is dried and granulated for sale as a fertiliser into the agriculture and horticultural markets.

A trial in 2007 to process combined food and garden residues from Woollahra Council at the EarthPower facility was unsuccessful as the woody material caused problems for the system.

There are two processing facilities in Australia that make use of anaerobic digestion for generating biogas from the organic fraction contained in MSW; the **Anaeco** facility in Perth (WA) and the **ArrowBio** facility at Jacks Gully (NSW). Hence, in each case anaerobic digestion is part of a comprehensive mechanical-biological treatment (MBT) system for unsorted waste, aiming at maximum recovery and utilisation of recyclables and resources contained in MSW.

The Anaeco facility incorporates a fast automatic waste sorting and recycling system, and the patented DiCOM™ System – a hybrid biological process which converts the organic content of solid waste into quality compost and biogas. The facility in Perth achieved completion in November 2008, and was followed by successful independently verified commissioning and performance trials. The DiCOM™ System produces its own heating and electrical energy requirements, with surplus green electricity available for export to the grid.

The ArrowBio facility processes MSW through hydro-mechanical separation / preparation and multi-stage anaerobic digestion. A description of the somewhat intricate separation processes for the various materials is available on the company's website.

After eliminating impurities such as grit, sand, glass and metal pieces from the biodegradable material through filtration and air sifting, the remaining energy rich organic watery solution is sent to the biological reactors. In the biological reactors section the fluid undergoes another two processes, both of which are orchestrated by naturally occurring microorganisms. In the first bioreactor tank, acidogenic fermentation transforms complex organic material into simpler organic acids and fatty acids. This acid rich organic matter is then heated up to 36-40 °C, and transported to the methanogenic fermentation reactor, for anaerobic degradation of the organic materials and the generation of biogas (up to 75% methane), water and digestate. The biogas is stored in inflatable buffer tanks and used for heating the methanogenic tank and is sold for transportation and power generation.

BIBLIOGRAPHY

A Prince Consulting (2009), "Woollahra Council Food and Organics Audit". Unpublished.

AnaeCo. "WMRC Project". [Online]. Available:

http://www.anaeco.com/index.php?option=com_content&task=view&id=14&Itemid=16.

[Accessed April 2012].

Allcrobe. [Online]. Available: http://allcrobe.com/composting_and_trash_breakdown.htm.

[Accessed 20 March 2012].

ArrowBio. "The ArrowBio Process for Unsorted Municipal Solid Waste". [Online]. Available:

<http://www.arrowbio.com/technology/#biological>. [Accessed April 2012].

Ballina Shire Council (2011), "Results of three-bin waste service - Media Release 16 September

2011". [Online]. Available: [http://www.ballina.info/blog/2011/09/16/council-pleased-with-results-](http://www.ballina.info/blog/2011/09/16/council-pleased-with-results-of-three-bin-waste-service/)

[of-three-bin-waste-service/](http://www.ballina.info/blog/2011/09/16/council-pleased-with-results-of-three-bin-waste-service/). [Accessed May 2012].

Bankstown City Council (2012), "Contamination Reduction Campaign Final Report".

Unpublished report prepared by Resource Recovery Team.

Biala, J (2001). "Background information on Bioreactors". Unpublished report for Brisbane City Council.

BIODEGMA. "Biodegma Boxensystem" [Online]. Available:

<http://www.biodegma.de/produkte/boxensysteme.php>. [Accessed April 2012].

Cairncross Organic Resource Recovery Facility. [Online]. Available:

http://www.hastings.nsw.gov.au/resources/documents/cairncross_ORRF.pdf. [Accessed April

2012].

Chalk, T (2011) "Food Waste and Organics: The Penrith Experience". Presentation to OEH Recycled Organic Seminar: Opportunities for the Hunter & Central Coast; 20 July 2011.

[Online]. Available:

http://www.hccrems.com.au/hccrems/media/RESOURCES/Sustainability/OEH_RecycledOrganicsWorkshop_Notes.doc. [Accessed March 2012].

City of Burnside (2006), "Burnside Bio-Organics Trial: Diverting Food Waste from Landfill".

[Online]. Available:

http://www.burnside.sa.gov.au/webdata/resources/files/Bio_Basket_Trial_Outcomes.pdf.

[Accessed March 2012].

Clarence Valley Council (2012), "Waste Newsletter January 2012". [Online]. Available:

http://www.clarence.nsw.gov.au/cp_content/resources/Kerbside_collection_flyer2012.pdf.

[Accessed March 2012].

Coffs Harbour City Council (2004), "Coffs Harbour Domestic Waste Trial". [Online]. Available:

http://www.zerowaste.sa.gov.au/Content/Uploaded/Generic/Documents/pdf/foodwaste/coffs_harbour_domestic_waste_trial_2004.pdf. [Accessed March 2012].

Coffs Coast Waste (2010), "Green Bin Organics Origami". [Online]. Available:

<http://www.coffscostwaste.com.au/themes/ccws2010/assets/pdf/GreenBinOrganicsOrigami.pdf>

. [Accessed March 2012].

Composting Council of Canada. "Composting processing technologies". Toronto, Canada.

CV Compost. [Online]. Available: <http://www.cvcompost.com/?p=ccovers>. [Accessed March 2012].

Department of Environment and Climate Change New South Wales (2007), "Waste Avoidance and Resource Recovery Strategy 2007". [Online]. Available: <http://www.environment.nsw.gov.au/resources/warr/07226WARRreport07.pdf>. [Accessed April 2012].

Department of the Environment, Climate Change, Energy and Water (2010), "Draft ACT Sustainable Waste Strategy 2010–2025". [Online]. Available: http://www.environment.act.gov.au/_data/assets/pdf_file/0009/210501/SustainableWaste_Strategy_WEB.pdf. [Accessed April 2012].

Department of Environment and Conservation New South Wales (2004), "Environmental Guidelines: Composting and Related Organics Processing Facilities". [Online]. Available: http://www.environment.nsw.gov.au/resources/waste/envguidlns/composting_guidelines.pdf. [Accessed March 2012].

Department of Environment and Conservation New South Wales (2007), "Co-Collection of Domestic Food Waste and Garden Organics: The Australian experience". [Online]. Available: http://www.environment.nsw.gov.au/resources/warr/200722_cocollectionorganics.pdf. [Accessed March 2012].

Department of Environment and Conservation New South Wales (2007), "TBL Assessment of (Domestic) Food Organics Management," NSW Department of Environment and Conservation. [Online]. Available: http://www.environment.nsw.gov.au/resources/warr/2007153_tblassessment.pdf. [Accessed March 2012].

Department of Environment and Resource Management (2010), "Queensland's Waste Reduction and Recycling Strategy 2010–2020". [Online]. Available: http://www.derm.qld.gov.au/environmental_management/waste/pdf/waste-strategy.pdf. [Accessed April 2012].

Department of the Chief Minister (2009), "Territory 2030 Strategic Plan". [Online]. Available: http://www.territory2030.nt.gov.au/documents/T2030_Strategic_Plan.pdf. [Accessed April 2012].

Dilkara, S. "Groundswell - Compost Process," [Online]. Available: <http://www.scribd.com/doc/52218938/Groundswell-Compost-Process>. [Accessed April 2012].

Dilkara, S. "Groundswell - Reprocessing to manage E.coli results," [Online]. Available: <http://www.scribd.com/doc/52046086/Groundswell-Reprocessing-to-Manage-E-coli-Result>. [Accessed April 2012].

Dilkara, S. (2011), "The Groundswell Project - Implications & Opportunities for SERRROC". [Online]. Available: http://www.serrroc.nsw.gov.au/InTuneFiles/resources_reports/files/19_SERRROC%20GROUND SWELL%20REPORT%20-%2025-10-2011%20final%20draft.pdf. [Accessed March 2012].

Earthpower. "Creating green energy". [Online]. Available: http://www.earthpower.com.au/creating_green_energy.aspx. [Accessed April 2012].

EM Solutions Australia. [Online]. Available: <http://www.emsolutionsaustralia.com.au>. [Accessed March 2012].

EC Sustainable (2011), "Food Waste Trial Audits 2011". Report prepared for the Hills Shire Council. Unpublished.

EC Sustainable (2010), "Home Composting Trial Report". Report prepared for Waverley Council and Randwick Councils. Unpublished.

Entwicklung Biogasanlagen, Fachagentur Nachwachsende Rohstoffe. [Online]. Available: <http://mediathek.fnr.de/grafiken/daten-und-fakten/bioenergie/biogas/entwicklung-biogasanlagen.html>. [Accessed April 2012].

Environmental Protection Agency New South Wales (1997), "Environmental Guidelines: Use and Disposal of Biosolids Products".

Environment Protection Authority South Australia (2003), "Community Consultation Guidelines for waste management & recycling facilities". [Online]. Available: http://www.epa.sa.gov.au/pdfs/guide_consultation.pdf. [Accessed March 2012].

Farming Focus. [Online]. Available: <http://www.farmingfocus.com.au/effective-microbes/products.html>. [Accessed March 2012].

Global Renewables. "SCT Composting". [Online]. Available: <http://www.globalrenewables.com.au/ur-3rprocess.php?urid=13>. [Accessed April 2012].

GORE Cover for Organic Waste Treatment. [Online]. Available: http://www.gore.com/en_xx/products/fabrics/swt/index.html. [Accessed March 2012].

Government of South Australia, Zero Waste (2011), "Annual Report 2010-11". [Online]. Available: <http://www.zerowaste.sa.gov.au/upload/resource-centre/publications/corporate/4741/ZWSA-AnnualReport2010-11.pdf>. [Accessed March 2012].

Government of South Australia (2008), "Business Case for Councils to Undertake Co-Collection of Food Waste with Garden Organics". [Online]. Available: http://www.zerowaste.sa.gov.au/upload/resources/publications/food-waste/food_waste_collection_business_case_2.pdf. [Accessed March 2012].

Government of South Australia (2008), "Guidelines for Communications Planning Pilot Co-Collection of Food Waste and Kerbside Organics". [Online]. Available: http://www.zerowaste.sa.gov.au/Content/Uploaded/Generic/Documents/pdf/foodwaste/Co-Collection_Communications_20080.pdf. [Accessed March 2012].

Government of South Australia (2010), "Kerbside Performance Plus Food Organics Incentive Scheme – 2010-11 – Guidelines and Application Form". [Online]. Available: www.zerowaste.sa.gov.au/.../Food%20Waste%20Incentives%20Guidelines-July2010.doc. [Accessed March 2012].

Government of South Australia, Zero Waste (2012), "Kerbside Performance Plus Food Organics Incentive Scheme-2011-12". [Online]. Available: www.zerowaste.sa.gov.au [Accessed March 2012].

Government of South Australia, Zero Waste (2010), "Valuing for Food Waste". [Online]. Available: <http://www.zerowaste.sa.gov.au/upload/resource-centre/publications/food-waste/VALUING%20OUR%20FOOD%20WASTE.pdf>. [Accessed March 2012].

Government of South Australia Zero Waste (2010), "South Australia's Waste Strategy 2010–2015 Consultation Draft". [Online]. Available: <http://www.zerowaste.sa.gov.au/About-Us/waste-strategy>. [Accessed May 2012].

Green Mountain Technologies. "Containerized Compost System". [Online]. Available: <http://www.compostingtechnology.com/invesselsystems/ccs>. [Accessed April 2012].

Handy Bin Waste Services. "Processing Facilities". [Online]. Available: <http://www.handybinwaste.com.au/education/processing-facilities>. [Accessed April 2012].

Herlihy, T. "Principles and Practices of Commercial Scale Vermicomposting and Earthworm Husbandry," in NC State Vermicomposting Workshop, Raleigh, NC, USA, 2009.

- HERHOF GmbH. "Composting of organic waste". [Online]. Available: <http://www.herhof.com/en/business-divisions/composting.html>. [Accessed April 2012].
- H. O. Solutions (2011). "HotOff - The Press (HotRot Newsletter)". Issue 37, April 2011. [Online]. Available: <http://www.hotrotsolutions.com/images/stories/Newsletters/hotp%20%2037%20april%202011.pdf>. [Accessed April 2012].
- HotRot Organic Solutions. "Innovative technology for problem organic wastes". [Online]. Available: <http://www.hotrotsolutions.com>. [Accessed April 2012].
- Hyder Consulting (2010), "Zero Waste SA/Oz Harvest - Environmental Assessment of Food Rescue Environmental Benefits of Rescuing Un-Sold Food in Adelaide SA". [Online]. Available: <http://www.zerowaste.sa.gov.au/upload/resource-centre/publications/food-waste/Environmental%20Benefits%20of%20OzHarvest%20Adelaide.pdf>. [Accessed March 2012].
- Hyder Consulting (2011), "Dulverton Waste Management Preliminary Business Case for the Introduction of Kerbside Organics Collection Service: Final Report". [Online]. Available: http://www.northtaswaste.com.au/pdf/kerbside_organics.pdf. [Accessed March 2012].
- Hyder Consulting (2010), "Waverley, Randwick and Woollahra Councils: Evaluation of home composting project". Unpublished.
- Institute for Sustainable Futures for Woollahra Municipal Council (2007), "Food Waste Trial Resident Feedback". [Online]. Available: <http://www.isf.uts.edu.au/publications/partridge2007foodwaste.pdf>. [Accessed March 2012].
- Institute for Sustainable Futures, University of Technology Sydney for Australian Government, Department of Sustainability, Environment, Water Population and Communities (2011), "National Food Waste Assessment: Final Report". [Online]. Available: <http://www.environment.gov.au/wastepolicy/publications/pubs/food-waste.pdf>. [Accessed March 2012].
- JAC Comrie, TJH Management Services & Sustainable Outcomes (2007), "Business case for councils to undertake co-collection of food waste with garden organic". [Online]. Available: http://www.zerowaste.sa.gov.au/Content/Uploaded/Assets/food_waste_collection_business_case.pdf. [Accessed March 2012].
- Kern, M. and Sprick, W. (2011) "Bioabfallvergaerung in Deuschalnd - Potenzial, Technik und Perspektiven," in 5. Biomasse Forum , Bad Hersfeld, Germany.
- Kern, M. Raussen, T. Funda, K. Lootsma, A. & Hofmann, H.(2009). "Aufwand und Nutzen einer optimierten Bioabfallverwertung hinsichtlich Energieeffizienz, Klima- und Ressourcenschutz," Umweltbundesamt, Dessau-Roßlau, Germany.
- KESAB Environmental Solutions (2011), "City of Port Adelaide Enfield Kerbside Bin Audit Report: Draft Report". Unpublished report prepared in July 2011 for City of Port Adelaide Enfield, SA.
- Leichhardt Municipal Council (2007), "Food Collection Trial". [Online]. Available: <http://www.leichhardt.nsw.gov.au/IgnitionSuite/uploads/docs/Item14%20FOOD%20COLLECTIO N%20TRIAL.pdf>. [Accessed March 2012].
- Leichhardt Municipal Council (2012), "Food recycling in units". [Online]. Available: <http://www.leichhardt.nsw.gov.au/Food-recycling-in-units.html>. [Accessed March 2012].
- Lismore City Council. "Lismore Recycling and Recovery Centre". [Online]. Available: http://www.northernriverswaste.com.au/cp_themes/default/page.asp?p=DOC-HFF-51-45-26&c=10. [Accessed February 2012].

- MAF Composting Systems. [Online]. Available: <http://www.maf-compostingsystems.de/index.html>. [Accessed April 2012].
- Massebezogener Substrateinsatz in Biogasanlagen, Fachagentur Nachwachsende Rohstoffe. [Online]. Available: <http://mediathek.fnr.de/grafiken/daten-und-fakten/bioenergie/biogas/massebezogener-substrateinsatz-in-biogasanlagen.html>. [Accessed April 2012].
- Michener, L (2011), "The Compost Revolution in Sydney; Abstract for conference proceedings; Edmonton Waste Prevention and Minimisation Conference 2011". [Online]. Available: http://reduceyourfootprint.com.au/media/uploads/attachments/Sydneys_Compost_Revolution_L_auren_Michener_print.pdf. [Accessed March 2012].
- Monnet, F. (2003). "An Introduction to Anaerobic Digestion of Organic Wastes".
- Natural Recovery Systems. [Online]. Available: <http://www.veoliaes.com.au/recycling-services/resource-recovery-facilities/natural-recovery-systems>. [Accessed April 2012].
- Nillumbik Council (2012), "Kerbside waste collection". [Online]. Available: http://www.nillumbik.vic.gov.au/Living_in_Nillumbik/Rubbish_and_waste/Dates_and_details. [Accessed February 2012].
- NRWF & The Environment Council (2003), "Best Practice Guidelines on Public Engagement for the Waste Sector". [Online]. Available: <http://www.nrwf.org.uk/documents/BestPracticeGuidelines.pdf>. [Accessed March 2012].
- Office of Environment & Heritage New South Wales (2011), "Best Bin Systems", November 2011 [Online]. Available: <http://www.environment.nsw.gov.au/resources/warr/110933BestBinSys.pdf>. [Accessed March 2012].
- Pamphilon, B. & Chevalie, B. Australian Institute for Sustainable Communities, University for Canberra (2011), "The Magic Pudding - understanding the outcomes, impact and futures of Groundswell 2007 to 2011". [Online]. Available: <http://www.scribd.com/doc/54767735/The-Magic-Pudding-understanding-the-outcomes-impact-and-futures-of-Groundswell-2007-2011>. [Accessed March 2012].
- Reynolds, M. (2011), "The Economics of Groundswell. Wagga Wagga: M&M Project Management". [Online]. Available: http://www.lgsa-plus.net.au/resources/documents/The_Economics_of_Groundswell_Report_2011.pdf. [Accessed April 2012].
- R. O. Unit, "Compost Australia," 2011. [Online]. Available: http://www.wmaa.asn.au/director/divisions/compost/Projects/industry_survey.cfm. [Accessed 20 March 2012].
- Shoalhaven City Council (2009), *Two-bin Recycling Collection Trial: March - July 2009*. Unpublished.
- SHOROC (2012), "The New Waste Collection System". [Online]. Available: <http://shoroc.com/2011/new-waste-collection-system>. [Accessed February 2012].
- SITA Environmental Solution, "Kemps Creek SWAT ARRT facility". [Online]. Available: <http://www.sita.com.au/facilities/arrt-facilities/kemps-creek-sawt-arrt-facility>. [Accessed April 2012].
- SITA Environmental Solutions "Kwinana Biowise ARRT Facility". [Online]. Available: <http://www.sita.com.au/facilities/arrt-facilities/kwinana-biowise-arrt-facility>. [Accessed April 2012].

State Government of Victoria (2005), "Towards Zero Waste Strategy". [Online]. Available: http://www.sustainability.vic.gov.au/resources/documents/Towards_Zero_Waste_Strategy_%28Sep_05%292.pdf. [Accessed April 2012].

Sustainability Victoria (2009), "Victorian Recycling Industry Annual Survey 2008–09 - Organic waste recovery". [Online]. Available: http://www.sustainability.vic.gov.au/resources/documents/Victorian_Recycling_Industries_Annual_Survey_2008-091.pdf. [Accessed March 2012].

Sustainability Victoria (2011), "Waste Audits in Multi-unit Dwellings: Summary Report". [Online]. Available: http://www.sustainability.vic.gov.au/resources/documents/PRO111_Waste_audits_MUD.pdf [Accessed March 2012].

TenCate Industrial Fabrics [Online]. Available: [http://www.tencate.com/1151/TenCate/TenCate-Industrial-Fabrics/Region-Europe/en/en-Industrial-Fabrics/Markets--Products/Markets--Products-TenCate-TopTex/Compost-covers-\(waste\)](http://www.tencate.com/1151/TenCate/TenCate-Industrial-Fabrics/Region-Europe/en/en-Industrial-Fabrics/Markets--Products/Markets--Products-TenCate-TopTex/Compost-covers-(waste)). [Accessed March 2012].

The Auckland Organic Waste Working Group (AOWWG) "Options for Kerbside Collection of Household Organic Wastes", [Online]. Available: <http://www.mfe.govt.nz/publications/waste/kerbside-collection-may05/html/index.html>. [Accessed March 2012].

The Australian Institute (2009), "What a waste - An analysis of household expenditure on food", Policy Brief No. 6.[Online]. Available: https://www.tai.org.au/file.php?file=/media_releases/PB%206%20What%20a%20waste%20final.pdf. [Accessed March 2012].

The Australian National University." HotRot Organic Solutions". [Online]. Available: <http://www.hotrotsolutions.com/anu>. [Accessed April 2012].

The Timaru District Council's Gore Cover Compost System. [Online]. Available: http://www.timaru.govt.nz/component/docman/doc_download/148-cover-compost-system.html. [Accessed April 2012].

U. E. P. Agency (2011). "Wastes - Resource Conservation - Reduce, Reuse, Recycle - Composting," [Online]. Available: <http://www.epa.gov/osw/conserves/rrr/composting/static.htm>. [Accessed March 2012].

VCU Europe. "The Process". [Online]. Available: http://www.vcutechology.com/vcu_the_process.htm. [Accessed April 2012].

VCU Technology. "Company Profile" [Online]. Available: http://www.vcutechology.com/company_profile.htm. [Accessed April 2012].

VRM Bio-Logik [Online]. Available: <http://www.vrm.com.au/inoculation/inoculation.htm>. [Accessed March 2012].

Wallace, P. (2011), "Ballina: three-bin drives diversion". [Online]. Available: http://www.ben-global.com/Waste/News/Ballina_threebin_drives_diversion_8873.aspx. [Accessed March 2012].

Waste Awareness Wales (2009), "Biological Treatment Fact Sheet 4". [Online]. Available: <http://www.wasteawarenesswales.org.uk/1561.file.dld>. [Accessed March 2012].

Waste Awareness Wales (2009), "Mechanical Biological and Mechanical Heat Treatment (MBT and MHT) Fact Sheet 5". [Online]. Available: www.wasteawarenesswales.org.uk/1562.file.dld. [Accessed March 2012].

Waste Awareness Wales (2009), "Waste Planning in Wales Fact Sheet 3". [Online]. Available: www.wasteawarenesswales.org.uk/1560.file.dld. [Accessed March 2012].

Waste Management and Environment Media (2011), "Inside Waste Industry Report 2011-12" WME Media Pty Ltd.

Waste Resources and Action Programme (WRAP) UK (2007), "Alternate weekly collections guidance". [Online]. Available: http://www.wrap.org.uk/downloads/AWC_Revised_Final_Report_-_130707.6a4cf67c.4070.PDF. [Accessed March 2012].

Waste Resources and Action Programme (WRAP) UK (2009), "Food Waste Collection Guidance". [Online]. Available: http://www.wrap.org.uk/downloads/food_waste_collection_guidance_-_amended_Mar_2010.533e1ed3.7749.pdf. [Accessed March 2012].

Waste Resources and Action Programme (WRAP) UK (2010), "Final Report: Improving the performance of waste diversion schemes. A good practice guide to monitoring and evaluation". [Online]. Available: http://www.wrap.org.uk/downloads/WRAP_M_E_Guidance_-_Exec_summary_contents.70d4f3c8.9513.pdf. [Accessed March 2012].

Waste Resources and Action Programme (WRAP) UK (2010), "Performance analysis of mixed food and garden waste collection schemes". [Online]. Available: http://www.wrap.org.uk/sites/files/wrap/Food_Garden_Waste_Report_Final.pdf. [Accessed March 2012].

Western Australian Waste Authority (2010), "Draft II Waste Strategy for Western Australia March 2010". [Online]. Available: <http://www.zerowastewa.com.au/whoswho/authority/strategy/>. [Accessed April 2012].

April 2012].

Wilkinson, K (2011). "Development of On-Farm Anaerobic Digestion", BioCycle, pp. 49-50, January 2011.

Woods, K. (2012), "Ordinary Meeting of Council - Residential Waste Collection 28 February 2012". [Online]. Available: <http://www.thehills.nsw.gov.au/IgnitionSuite/uploads/docs/ITEM%2015%2028%20FEB%202012.pdf>. [Accessed March 2012].

Wright Corporate Strategy (2008), "Alternative Waste Technologies - Update Report," ACT NoWaste. [Online]. Available: http://www.tams.act.gov.au/_data/assets/pdf_file/0004/219442/Wright_Report_Alternative_Waste_Technologies_ATT_2.pdf. [Accessed March 2012].

YLAD Living Soils, [Online]. Available: <http://www.yladingcompost.com.au/turners-accessories-sub-inoculants.html>. [Accessed March 2012].

Zero Waste Western Australia (2011), "Recycling Activity in WA 2009-10". [Online]. Available: http://www.zerowastewa.com.au/documents/external_docs/WA_Recycling_Activity_0708_0809.pdf. [Accessed March 2012].