Diverting Food Organics from Landfill in the Hobart City Council

by

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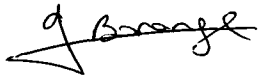
December, 2010

Declaration

This thesis contains no material which has been accepted for the award of any other degree or diploma in any tertiary institution, and to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference is made in the text of the thesis.

Signed 

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Date 11/03/2011

Abstract

Compostable organics represent 62% of all waste sent to landfill in Australia and significantly contribute to the greenhouse gas emissions from the waste sector. With the challenge of climate change and the scarcity of landfill space, the diversion and recovery of the compostable organics waste stream is increasingly important. Food organics is the dominant component of the compostable organics waste stream and the major source of methane production in Australian landfills. However, the national recovery level of food organics is only 10%.

This study examined food organics management amongst 23 businesses in Hobart, Tasmania, Australia through a face-to-face survey in July and August 2010. Information was obtained in order to: (1) determine the volume of organic material generated; (2) examine the methods used to reduce and dispose food organics; and (3) determine the barriers and opportunities for increased food organics diversion in Hobart.

The study determined that measures to avoid the generation of food organics had been implemented to a greater extent than measures for the recovery of food organics. Food organics were mainly diverted by businesses within the Manufacturing and Wholesaling and Food Retailing business group while limited action was taken by businesses in the Accommodation and Food Services and Educational and Health Institutions sectors. Donation of food organics for animal feed was the recovery measure primarily used by businesses followed by donation of surplus food to charity.

The barriers reported by businesses as impeding food organics separation for recovery are primarily financial, including the increase of waste disposal costs and a lack of economic incentive to participate in a separated food organics collection service. The absence of a collection service for food organics and a lack of information on alternative options available to divert food organics from landfill were also reported as barriers to better organics management practices. The survey determined that the majority of businesses are willing to divert food organics but under the condition that it is economically beneficial or at least cost neutral.

Acknowledgments

I would like thank all those who have contributed their time and provided advice and support throughout the preparation of this thesis. In particular I would like to thank the following people for their assistance:

- My supervisor Dr Lorne Kriwoken, thank you for your advice on the issues I have encountered, thank you for your encouragement and for feedback on the thesis.
- My English tutor Andrew Harwood for his advice and great support throughout this project and for the useful comments on my thesis drafts.
- Jeff Holmes and Phil Walker from the Hobart City Council's Waste Engineering Unit, thank you for your advice, support and the great insights I gained during my professional placement.
- Sue Allison-Roger, thank you for your interesting comments and your help to find survey participants.
- My family, my partner and my friends, thank for you invaluable support throughout the thesis.

Acronyms

AD:	Anaerobic Digestion
ANZECC:	Australian and New Zealand Environment and Conservation Council
ANZIC:	Australian New Zealand Industrial Classification
AWTs:	Alternative Waste Technologies
C&D:	Construction and Demolition
C&I:	Commercial and Industrial
CPRS:	Carbon Pollution Reduction Scheme
DELM:	Department of Environment and Land Management
DEPHA:	Department of Environment, Parks, Heritage and the Arts
DEWHA:	Department of the Environment, Water, Heritage and the Arts
DPIPWE:	Department of Primary Industry, Parks, Waste and Environment
EMPCA:	Environmental Management and Pollution Control Act
EPA:	Environment Protection Authority
EPHC:	Environment Protection and Heritage Council
EPR:	Extended Producers Responsibility
GHG:	Greenhouse Gas
HCC:	Hobart City Council
HREC:	Human Research Ethics Committee
LATS:	Landfill Allowance Trading Scheme
LGAT:	Local Government Association of Tasmania
LUPAA:	Land Use Planning and Approvals Act
MSW:	Municipal Solid Waste
NEPC:	National Environment Protection Council
NWMRS:	National Waste Minimisation and Recycling Strategy
NKRS:	National Kerbside Recycling Strategy
RMPS:	Resource Management and Planning System
ROU:	Recycled Organics Unit
SIA:	Sustainable Infrastructure Australia
SWSA:	Southern Waste Strategy Authority
TSCA:	Tasmania School Canteen Association
TSWMP:	Tasmanian Solid Waste Management Policy
WMAA:	Waste Management Association of Australia
WMC:	Waste Management Centre

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Chapter 1 Introduction

1.1 The Issue of Food Organics in Australia

In Australia, waste generation has been increasing at a faster rate than population and economic growth (Engineers Australia, 2009). Prior to the 1970s, waste management focused on ensuring that the disposal of putrescible waste did not adversely impact public health, and disamenities, such as odour, were avoided. The environmental movement of the 1960s and 1970s reflected growing concerns amongst Australians about their productive and consumptive activities and the associated environmental pollution (Productivity Commission, 2006). This concern extended to the disposal of waste in landfills and their management. From the late 1980s, Australian waste management policy began to account for the environmental impacts of waste disposal and associated health issues. From the early 1990s, the Australian community became concerned about the rapid depletion of non-renewable resources and the upstream environmental impact of waste generation. Waste was seen by the Australian public as a 'wasted resource' than merely 'waste', and public support was given for waste minimisation and recycling (Productivity Commission, 2006).

As a response to minimise the amount of waste generated and disposed to landfill the Australian Federal Government introduced the National Waste Minimization and Recycling Strategy (NWMRS) in 1992. Since then, means to divert and recycle inert waste, such as metal, plastic and glass, have been largely successful. However, the diversion of organic waste has remained relatively low in Australia. According to DEWHA (2009), 20.06 million tonnes of organic waste was generated in Australia for the financial year 2006–2007, 32% of which was recovered with the remainder sent to landfill. Organic waste represented 62% of all waste sent to landfill that year. The low recovery of organic waste is of concern given the greenhouse gas (GHG) emissions of the waste sector. In landfill, the decomposition of organic waste in anaerobic conditions generates landfill gas of about 55% methane. This is a greenhouse gas with a global warming potential 20 times that of carbon dioxide (EPHC, 2009a). With the challenge of climate change, the Australian waste sector has to examine its 'carbon liability' in terms of GHG emissions. According to the

Department of Climate Change (2009), the waste sector contributed 2.5% of Australia's national emissions of greenhouse gases in 2008 (15 million tonnes of CO_2-e) with 11 million tonnes derived from landfills.

In November 2009, the Australian Government introduced the new national policy on waste and resource management entitled: *National Waste Policy: Less Waste, More Resources.* The primary aims are the reduction in the amount of waste entering landfill and a reduction of the GHG emissions of the waste sector (EPHC, 2009b). Given the significance of organic wastes as the main source of GHG emissions from landfill and the scarcity of landfill space, one of the objectives of the *National Waste Policy* is to enhance organic resource recovery to assist in reducing GHG emissions from landfills (EPHC, 2009b).

Food organics is the dominant component of the organic waste stream and the major source of methane production in landfills in Australia (Environment, Planning & Resource Recovery Consulting, 2005). It represented 35% of the Municipal Solid Waste (MSW) and 21.5% of the total Commercial & Industrial (C&I) waste that ended up in landfill for the year 2006-2007 (EPHC, 2009a). Green waste, wood waste, paper and cardboard are already largely recovered, either with green waste collection or kerbside collection with recycling rates of 41%, 21% and 46% respectively. However, the recovery level of food organics remains very low nationwide (10%). Because of its contribution to landfill, GHG emissions and the collection issues it poses, food organics remains a significant challenge in waste management (WME, 2009). The diversion of food organics from landfill can reduce pressures on limited landfill space and reduce GHG emissions from the waste sector. Additionally, food organics are a valuable resource, and discarding food is a waste of resources (for example, the energy used to produce, transport and supply food). Options for food organics re-use and recycling include donation for human consumption, donation for animal feed, centralised composting and on-site composting (ROU, 2007a).

In 2009, the Department of Environment, Parks, Heritage and the Arts (DEPHA) released the *Tasmanian Waste and Resource Management Strategy.* In order to meet the Tasmanian Government target of 60 per cent reduction in GHG emissions by

2050 (from 1990 levels). DEPHA (2009, p.16) acknowledged the need to "increase the diversion of organic (green) waste from landfill and develop policies for alternative management of organic wastes". The Hobart City Council currently operates a composting facility at the McRobies Gully landfill site, diverting organic waste from landfill and turning it into mulch, compost and soil conditioners (Hobart City Council, 2009). The bulk of organic waste received at the site is green waste (35,000 m^3 per annum) either collected via the green waste collection service offered by HCC or directly brought by residents and businesses (Hobart City Council, 2009). Most food organics generated in Hobart currently end up in landfill. The composting facility receives food organics from only two providers – fish farms (fish waste and dead seals) and the Cascade Brewery (yeast and blackcurrant extract).

While food organics is the largest component of the organic waste stream (EPHC, 2009a), there are very little data on the recycling levels within the C&I sector in Tasmania. This represents a serious knowledge gap that impedes the development of alternative organic waste management for the C&I sector as proposed in the *Tasmanian Waste and Resource Management Strategy.*

1.2 Aims and Objectives

The thesis has three major aims:

1. Determine the volume of food organics produced by businesses in the C&I sector in the Hobart City Council CBD.
2. Provide an indication of the methods used by these businesses to minimise and dispose of food organics.
3. Assess the barriers and opportunities to divert C&I food organics from landfill.

To address these two aims, the following objectives will be met:

1. undertake a literature review of Australian and Tasmanian waste management to provide a context for the research;
2. undertake a literature review of organic and food organics management in Australia and Tasmania;

3. determine the volume of food organics produced and disposed by a sample of Hobart CBD businesses in the C&I sector;
4. determine the way businesses dispose of food organics, which businesses divert food organics from landfill, and identify the methods used;
5. assess the barriers and opportunities for C&I food organics recovery and reprocessing to further divert C&I waste from landfill; and
6. discuss management and operational implications of the research.

1.3 Significance of the Study

Significant attention, in the form of government led programs, is provided to the Commercial & Industrial (C&I) sector to promote waste minimisation and encourage more effective recycling (ROU, 2007a). The Southern Waste Strategy Authority (SWSA) – an Authority which aims to "facilitate integrated regional strategic planning in southern Tasmania, and to implement the Southern Waste Management Strategy" (SWSA, 2007 p.2) – identified the Tasmanian C&I sector as retaining the maximum priority for the increased recovery of valuable resources. Although food organics represent a smaller fraction of the C&I waste stream as opposed to the Municipal Solid Waste (MSW) stream (35%), in this thesis the focus is on C&I food organics rather than MSW food organics because a relatively small number of businesses in the C&I sector generate most of the material. Waste audits that were conducted in Australian cities revealed that 80% of C&I food organics is generated from concentrated point sources (e.g. hotels, restaurants, supermarkets, health institutions) (Nolan-ITU, 1997). Additionally, C&I businesses tend to have relatively well-structured waste generation systems. Because of these characteristics, the C&I sector is a logical place to establish source separated food organics collection programs and presents economic transportation options between point sources and treatment facilities. Such programs, once in place, may be subsequently extended to residences. There are currently no data on the volume of food organics produced by the C&I sector in Hobart. How food organics from C&I businesses is disposed also remains largely unknown. The data gathered in this study will provide important information to the Hobart City Council which is currently trailing source separated collection of C&I food organics amongst grocery stores. To date, the barriers and opportunities for food organics diversion and source separation in the C&I sector

have not yet been studied. Determining what barriers are encountered by businesses to separate food organics is important if a source separated collection of food organics is to be established.

1.4 Defining 'waste'

The term 'food waste' is commonly used to define food that has been discarded however this 'waste terminology' implies that discarded food is useless, and is criticised for discouraging participation in organics recycling by favouring the 'I don't care about' option (BioCycle, 2008 p.4). As such, wherever possible, the non-waste terminology of food organics used in the Recycled Organics Unit dictionary (such as 'resource' instead of 'waste') will be used throughout this thesis. The same is applied for organic wastes that will be referred as compostable organics.

1.4.1 Defining Commercial and Industrial Waste

Commercial and industrial waste is defined by the Australian New Zealand Industrial Classification (ANZIC) as the component of the waste stream generated by institutions and businesses including primary production and manufacturing industries, small and medium enterprises, retail and wholesale businesses, property and business services, the hospitality industry, health institutions and educational bodies. Waste in the C&I waste stream includes organic waste (e.g. paper and cardboard, metals, food organics, wood, biosolids), general waste (e.g. plastic), and e-waste (electrical and electronic equipment),

1.4.2 Defining Compostable Organics

For the purpose of this thesis, the compostable organics definition of the Recycled Organics Unit (2002) will be adopted. Compostable organics encompass all organic materials that can be separately collected for composting or biological treatment (e.g. anaerobic digestion). Compostable organics include: food and garden organics; wood and timber; biosolids, and agricultural organics (ROU, 2002 p.17).

1.4.3 Defining Food Organics

The food organics definition of the Recycled Organics Unit (2002) will be adopted. The term food organics covers all food residuals and is a synonym of the term 'food waste'. Food organics are generated from domestic or commercial and industrial sources and include:

- fruit and vegetable material;
- meat and poultry;
- fats and oils;
- seafood (including shellfish, excluding oyster shells);
- recalcitrants (large bones >15mm diameter, oyster shells, coconut shells);
- dairy (solid and liquid); and
- bread, pastries and flours (including rice and corn flours) (ROU, 2002 p23).

1.5 Chapter Outlines

This research project contains seven chapters. A brief outline of the contents of each chapter is provided below.

Chapter 2: Australian and Tasmanian Waste Management

This chapter examines the status of waste management in Australia and Tasmania and changes that have occurred over the last 20 years with a particular focus given to organic waste management.

Chapter 3: Food organics Recovery

Numerous problems with landfilling food organics are identified and the rational for food organics recovery and recycling is examined. A literature review on food organics is undertaken to examine the generation of food organics by different types of businesses in the C&I sector and report on the existing diversion and recovery options. The chapter also examines barriers that prevent food organics diversion and recovery in the C&I sector. It finally discusses European best practice for food organics diversion.

Chapter 4: Methodology

This chapter examines techniques for conducting an interview survey including sampling techniques, questionnaire designs and the methodology employed for the business survey conducted in the Hobart municipality as part of this study. It also report on difficulties that were encountered in the survey process and explains some of the changes in focus that took place during the study.

Chapter 5: Results

This chapter presents the results of the survey carried out in 23 businesses in Hobart.

Chapter 6: Discussion- Conclusion

This final chapter discusses the results obtained for this study. The first section of the chapter provides a discussion on the status and the need for change in the way compostable organics are managed in Australia. The specific barriers reported by businesses as preventing food organics diversion are discussed. The methods currently implemented by businesses to prevent and divert food organics are analysed and opportunities are discussed. The end of this chapter provides the conclusion to this research.

Chapter 2 Australian and Tasmanian Waste Management

2.1 Introduction

The aim of this chapter is to review waste management policies and practices at three levels of government – national, Tasmanian, local - in order to provide a context for the research project. The first part of the chapter provides an analysis of the Australian waste management context by first reviewing national policies relating to waste management and organic waste. This is followed by a discussion on the current status and impediments to Australian waste management. Tasmanian waste management policies and practices are then reviewed before providing a context for waste management in Hobart.

2.2 Waste Management in Australia

2.2.1 National Policy Context

Australian waste management is regulated at the national, State and Territory and local government levels. The Federal Government has responsibilities to nationally coordinate waste management policy through the Environment Protection and Heritage Council and in cooperation with the State and Territory Governments to ensure consistency and comprehensiveness across the nation. They also have the responsibility to ensure that Australia meets its international agreements relating to waste management, such as the Basel Convention (1989) on the Control of Transboundary Movement of Hazardous Wastes and their Disposal. Local government has the responsibility of domestic waste collection, disposal and resource recovery services. The non-domestic waste stream is generally dealt with by private waste management operators. Private waste management operators have also moved into the domestic market (Productivity Commission, 2006; DEWHA, 2009).

Australia has experienced a significant evolution in waste management policies and strategies over the last two decades following the rise in global environmental awareness. The National Strategy for Ecologically Sustainable Development adopted

in 1992 represented the first comprehensive domestic approach to waste in Australia. COAG "committed Australia to improving the efficiency with which resources are used; reducing the impact on the environment of waste disposal; and improving the management of hazardous wastes, avoiding their generation and addressing clean up issues" (EPHC, 2009a: p1). The 1992 National Strategy for Ecologically Sustainable Development provided guidance for all levels of government in Australia to introduce new waste minimisation and management policies and strategies supported by both environment protection legislation and waste minimisation legislation. The first major national waste minimisation strategies were the National Waste Minimisation and Recycling Strategy 1992 (NWMRS) and the National Kerbside Recycling Strategy (NKRS) 1992.

2.2.1.1 The National Waste Minimisation and Recycling Strategy and National Kerbside Recycling Strategy

The NWMRS proposed a 50% reduction target on the amount of waste per capita going to landfill by 2000 in reference to 1991 and a 20% reduction in putrescible waste to landfill by 1995 (CEPA, 1992 p.25). While the overall 50% reduction target was agreed by all jurisdictions only few adopted a 20% reduction target for putrescibles (LGAT, 2005). The NKRS was endorsed by the Australian and New Zealand Environment and Conservation Council (ANZECC) the same year as the NWRMS to advance some of the strategy recommendations. The NKRS proposed a range of voluntary recycling targets for materials such as paper, plastic container or glass (ANZECC, 1992).

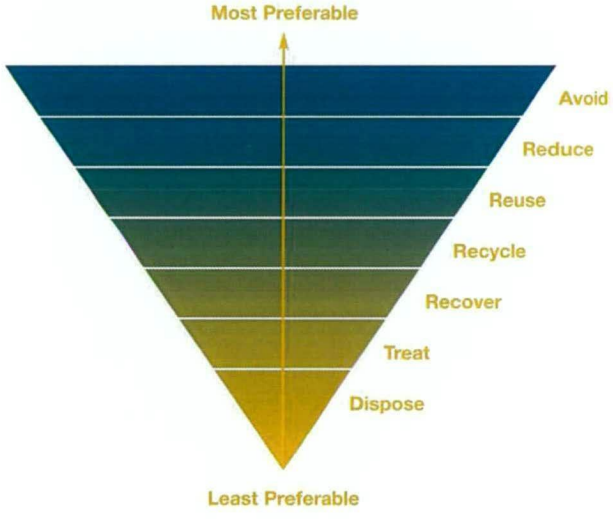
The goals of the NWMRS were to:

- encourage the ecologically sustainable non-wasteful use of resources;
- reduce potential hazards to human health and the environment posed by pollution and wastes; and
- maintain or improve environmental quality (CEPA, 1992 p.10).

The Strategy discussed different instruments such as Extended Producers Responsibility (EPR) and Product Stewardship to minimise waste during production and post production respectively. It integrated the polluter pays principle and user

pays principle. Central to the NWMRS was the introduction of a hierarchy of waste management priorities (CEPA, 1992). The waste hierarchy was first developed in the 1970s and since then is used as a guidance in waste policies in order to prioritise methods for waste treatment and disposal (Rasmussen and Vigsø, 2005). It prioritises a series of waste management options on a progressive scale of preferability in accordance to their environmental desirability, beginning with the avoidance of waste generation and ending with the disposal in landfill as the least desirable option (Rasmussen and Vigsø, 2005). Figure 2.1 is a representation of the waste hierarchy.

Figure 2.1: The Waste Management Hierarchy
Source: Envirocentre, 2009



2.2.1.2 The Australian Green and Organic Waste Management Strategy and the Organic Market Development Strategy

The *ANZECC Green and Organic Waste Management Strategy for Australia* was developed by ANZECC in 1996 to assist Australia to meet its 50% reduction in waste going to landfill (LGAT, 2005). The strategy also had a broader role in aiding the development of policies and practices to ensure that waste reduction takes place at source and provides direction in waste reduction, reuse and recycling. The strategy recognised that a 50% reduction target could not be achieved unless a significant improvement in the diversion of green and organic waste was made. Hence, the primary aim of the strategy was to reduce green and organic waste going to landfill

by 50% of 1990 levels by the year 2000 (ANZECC, 1996) To achieve this target, a number of principles were developed under the strategy including:

- a commitment to exclude disposal of garden waste to landfill;
- a commitment from all spheres of Government and industry to promote source separation;
- support for the development of consistent standards for all green products produced;
- a commitment to supporting the development of competitive and sustainable markets for products made from green and organic wastes;
- a commitment to allocating clear responsibilities to all parties involved in green waste management in each jurisdiction; and
- a commitment to developing clear environmental management guidelines for green/organic waste reprocessing sites (ANZECC, 1996 p7-8).

In order to support the *Green and Organic Waste Management Strategy for Australia,* the Department released the *Organics Market Development Strategy* in 1999. Under the strategy, an investigation of the status of the organic industry in Australia was conducted in order to review strategies in organic waste management and support the development of a competitive and sustainable market for recycled organics (LGAT, 2005).

Nationally however it is not evident that the reduction targets for general, green and organic waste set under the NWRMS and the *Green and Organic Waste Management Strategy for Australia* have been achieved (LGAT, 2005; Productivity Commission, 2006).

2.2.1.3 State and Territory Government Waste Minimisation Strategies

Waste and resource management strategies have been introduced by State and Territory governments to minimise waste, introduce landfill levies and provide subsidies to the recycling industry (Productivity Commission, 2006; DEWHA, 2009). Most of the strategies adopted by States and Territories were based on the waste hierarchy and most jurisdictions have set broad landfill diversion targets supported by specific targets for each of the solid waste streams. A range of policy instruments similar to those in the NWMRS were adopted by the State and Territory governments in order to meet these targets. These include market based instruments (polluter pays principle and user pay principle) and the principle of shared responsibility for waste reduction between industry and the community through extended producer responsibility and product stewardship (Productivity Commission, 2006). While most of the strategies acknowledge the necessity to drastically reduce the amount of organic waste entering landfill to reduce GHG emission of the waste sector, only few set clear reduction target for this type of waste. Table 2.1 lists the different waste management strategies and supporting legislation for each Australian State and Territory.

Table 2.1: Selected key legislation and waste minimisation strategies by State and Territory

STATE	*Waste minimisation strategies*	*Legislation*
New South Wales	➢ Waste Avoidance and resource Recovery Strategy 2007 The strategy provides a framework to reduce the quantity and environmental impact of wastes and use resources more efficiently. It also supports the development and implementation of organics recovery and recycling through the continued development of an organics market program. ➢ Waste Reduction and Purchasing Policy The Policy requires a reduction of waste across all states agencies and an increase in the purchasing of recycled products	➢ *Protection of the Environment Operation Act 1997* The Act regulates pollution and introduced a waste levy, along with exemption in order to encourage the separation at source of waste for recovery. ➢ *Waste Avoidance and resource Recovery Act 2001* The Act encourages the most efficient use of resources according to the waste hierarchy. It also introduced an Extended Producer Responsibility schemes.
Victoria	➢ Towards Zero Waste Strategy 2005	➢ *Environment Protection Act 1970*

	Under the Strategy targets were introduced with regard to waste and littering reduction and increased resource recovery. Specific targets and actions were also introduced to target both the MSW and C&I waste stream so as to deliver more sustainable use of resources by 2014. The strategy promotes the diversion and processing of MSW and C&I organic wastes from landfill (particularly food organics and green waste)	➢ *Environment Protection (Industrial Waste Resource) Regulations 2009* The regulation provides a regulatory framework promote the efficient use of resources and the management of waste according to the waste hierarchy for the industrial sector
Queensland	➢ The Environment Protection (Waste Management) Policy 2000 ➢ The Waste Management Strategy for Queensland 1996	➢ *Environmental Protection Act 1994* ➢ *Environment Protection (Waste Management) Regulation 2000*
Western Australia	➢ Statement of Strategic Direction for Waste management in Western Australia 2004 Outlines strategic framework and the fundamental principles on the new Strategic Direction for waste management. ➢ Towards Zero Waste 2020 Strategy The strategy provides a framework to achieve zero waste by 2020	➢ *Environmental Protection Act 1986* Provide the regulatory framework for waste management ➢ *Environmental Protection (Landfill Levy) Act 1998* Establishes a levy on metropolitan landfill waste. ➢ *Waste Avoidance and Resource Recovery Act 2007*
South Australia	➢ South Australia's Waste Strategy 2005 – 2010 Includes five strategic objectives aimed at reforming waste management. The strategy provides clear targets for the MSW, C&I and C&D waste streams ➢ Draft South Australia's Waste Strategy 2010 – 2015 Aims at maximising the values of resourced and avoid and reduce waste. The strategy identifies priorities for action, provides clear targets for the MSW, C&I and C&D waste streams and propose an EPR scheme in place by 2015. The strategy identifies food organics, cardboard and timber as key areas for future intervention. Propose the development of incentives for food organics collection and treatment.	➢ *Environmental Protection Act 1993* Deals with waste management through depot levies and waste facilities ➢ *Zero Waste SA Act 2004* ➢ Environment Protection (Waste to Resources) Policy 2010 Introduced a series of rolling bans on materials entering landfill and notably requires the diversion of vegetative matter aggregated for resource recovery and collected by a council
Tasmania	➢ The Tasmanian Solid Waste Management Policy 1994 ➢ The Tasmanian Waste and Resources Management Strategy	➢ *Litter Act 1973* ➢ *The Environmental Management and Pollution Control Act 1994*

	2009 Provides a framework for the coordinated management and delivery of priority waste prevention, recycling and resource recovery initiatives and services.	
ACT	➢ No Waste by 2010 Strategy Sets the vision for the ACT to become waste free by 2010 ➢ Waste pricing Strategy for the ACT	➢ *Environment Protection Act 1997* ➢ *Waste Minimisation Act 2001* ➢ *Litter Act 2004*
Northern Territory	➢ Litter abatement and Resource Recovery Strategy 2003	➢ *Waste Management and Pollution Control Act 1998*

Sources: adapted from Covington and Camenzuli (2005); Productivity Commission (2006); Department of environment Climate Change & Water (2009); Sustainability Victoria (2009); Department of Environment (2010); South Australia EPA (2010), DPIPWE (2010), Department of Territory and Municipal Services 2010, ZWSA (2010).

2.2.1.4 The National Waste Policy: Less Waste, More Resources

In 2009, The Department of Environment, Water, Heritage and the Arts (DEWHA) released *National Waste Policy: Less Waste, More Resources* which was adopted by all Australian environment ministers. The National Waste Policy responds to changes that took place in the waste management sector since the 1992 NWMRS. The purpose of this policy was to provide key directions for waste management and resource recovery in Australia over the next 10 years. The policy first seeks "to update and integrate Australia's waste policy and regulatory framework" so that approaches to waste management issues are dealt with in a more efficient and effective manner (The Allen Consulting Group, 2009 p.vi; EPHC, 2009b). The policy covers waste in the municipal, C&I and C&D waste streams. Hazardous wastes and substances, gaseous, liquid and solid wastes are also covered (EPHC, 2009b).

The aims of the policy are:

- to avoid the generation of waste, reduce the amount of waste for disposal, manage waste as a resource and ensure that waste treatment, disposal, recovery and re-use are undertaken in a safe, scientific and environmentally sound manner; and

- to contribute to the reduction of greenhouse gas emissions, energy conservation and production, water efficiency and the productivity of the land (EPHC, 2009b p.7).

The policy provides 16 priority strategies to be collectively implemented by the Commonwealth and States and Territory governments (EPHC, 2009b). The priority strategies are designed to:

- provide a coherent, comprehensive national framework for waste management, resource recovery and the avoidance of waste over the next decade;
- enable Australia to meet its international obligations in regard to the management of hazardous wastes and substances and persistent organic pollutants into the future and reduce the risk and legacy for future generations;
- address market impediments and streamline the regulatory frameworks so that national companies and small businesses can operate effectively and efficiently and manage products and materials responsibly during and at end of life;
- provide national leadership on waste and resource recovery where it is needed and facilitate collaboration between the states on national issues;
- contribute to climate change, sustainability, innovation and employment opportunities; and
- be high impact and cost effective by setting clear national directions and through collaborative, carefully targeted action that incrementally builds on the existing efforts of governments over a ten year period (EPHC, 2010 n.p.).

Under the "pursuing sustainability" key direction the policy outlines the need to: (1) "enhance biodegradable (organic) resource recovery and reduce greenhouse gas emissions from landfills," and (2) "avoid waste and increase recovery and re-use of wastes from the commercial and industrial and construction and demolition waste streams" (EPHC, 2009b p.13-14). Under the policy, State and Territory and local governments will be responsible to further extend current actions undertaken to divert biodegradable (organic) waste from landfill and establish regulation and licensee requirements for landfill to ensure that landfill gas is managed in a manner that prevents safety and health risks. Additionally, all State and Territory and local

governments, in collaboration with industry and businesses, will be responsible for improving waste minimisation and recovery in the C&I and C&D sectors.

2.2.2 Current Status of Australian Waste Management

2.2.2.1 National Waste Generation and Material Composition to Landfill

The predominant means of disposing waste in Australia is landfill disposal with some minor incineration (Productivity Commission, 2006). Since the release of the NWMRS, the amount and types of waste generated and the ways waste is managed have changed significantly. According to EPHC (2009a), the volumes of waste generated and waste disposed in landfill have increased over the last decade. There has been a 31 per cent increase in the amount of waste generated between 2002–03 and 2006-07. Over the 2006-07 financial year, 43,777,000 tonnes of waste were generated across the municipal solid waste, C&I and C&D streams (2.08 tonnes per capita). This increase in waste production is attributed to Australia's growth in population and per capita income (ABS, 2010).

Forty eight percent of waste generated in 2006-07 was disposed to landfill and the remaining 52% was recycled. Tables 2.2 and 2.3 present the amounts of waste landfilled and waste recycled by jurisdiction and stream.

Table 2.2: Amount of waste landfilled by jurisdiction and stream, 2006–07
Source: EPHC (2009b p.7)

State/territory	Landfill (tonnes)			
	MSW	C&I	C&D	Total
NSW	2,408,000	2,921,000	203,600	7,365,000
Vic	1,727,000	1,060,000	1,138,000	3,925,000
Qld	1,735,000	1,101,000	1,466,000	4,302,000
WA	1,015,000	585,000	1,939,000	3,539,000
SA	344,000	496,000	304,000	1,144,000
ACT	85,000	91,000	21,000	197,000
Tas	287,000	145,000	14,000	446,000
NT	44,000	57,000	51,000	151,000
Australia	7,645,000	6,456,000	6,968,000	21,069,000

Note 1: There are differences between jurisdictional definitions, classifications and methodologies for measuring waste data which may also cover different materials. Comparative use of these data may therefore be inappropriate and should only be done with caution.
Note 2: NT data are for Darwin City Council's MSW and recent data for the Territory indicate a total generation rate of 361 000 tonnes or 1679 kg per person.
Note 3: Figures for Victoria represent the amount of waste accepted at licensed Victorian landfills, excluding material used as cover. These figures from Victoria were calculated by taking the tonnes of material received at landfills (including cover material sourced off site) and reducing this by 15 per cent to allow for cover material. Likewise, cover fill is excluded from figures for Tasmania.

Table 2.3 Amount of recycling by jurisdiction and stream, 2006–07
Source: EPHC (2009b p.9)

State/territory	Recycled (tonnes)			
	MSW	C&I	C&D	Total
NSW	1,483,000	2,297,000	4,216,000	7,995,000
Vic	1,056,000	2,357,000	2,946,000	6,360,000
Qld	1,365,000	1,797,000	617,000	3,779,000
WA	408,000	891,000	409,000	1,708,000
SA	408,000	610,000	1,155,000	2,173,000
ACT	278,000	102,000	206,000	586,000
Tas	53,000	22,000	/	75,000
NT	30,000	/	/	30,000
Australia	5,082,000	8,076,000	9,549,000	22,707,000

Note 1: There are differences between jurisdictional definitions, classifications and methodologies for measuring waste data which may also cover different materials. Comparative use of these data may therefore be inappropriate and should only be done with caution.
Note 2: NT data are for Darwin City Council's MSW and the 30 000 recycling figure is the quantity of green waste generated in cubic metres. A revised figure of 13 000 tonnes for recycled municipal waste for the NT as a whole was provided in November 2009

Organic waste is the major component of both the MSW and C&I waste stream (material bolded in Table 2.4). Over the financial year 2006-07 approximately 20.06 million tonnes of organic waste was generated in Australia, 33% was recovered and the remainder sent to landfill. Organic waste represented 62 per cent (13.6 million tonnes) of all waste entering landfill most of which was from the municipal solid stream (7.1 million tonnes) and C&I sector (5 million tonnes), and the C&D sector (1.6 million tonnes).

Table 2.4 Composition of Australian waste to landfill by stream, 2006–07
Source EPHC (2009b p.6)

Material	Municipal solid waste %	C&I waste %	C&D waste %
Food	35	21.5	0
Paper and paper board	13	15.5	3
Garden and park	16.5	4	2
Wood and wood waste	1	12.5	6
Textiles	1.5	4	0
Sludge	0	1.5	0
Nappies	4	0	0
Rubber and Leather	1	3.5	0
Inert waste (including concrete, metal plastic and glass)	28	37.5	89
Note: Materials written in bold fall in the organic waste stream.			

Table 2.5: Organic waste generation in Australia
Source Warnken ISE (2007a p.6)

	Total Generated (million tonnes p.a.)	Total Recycled (million tonnes p.a.)	% Recycled	Total Landfilled (million tonnes p.a.)	% landfilled
Paper and cardboard	5	2.31	46	2.7	54
Garden organics	3.8	1.55	41	2.25	59
Food and other organics	3.2	0.3	10	2.89	90
Wood/timber	2.1	0.44	21	1.63	79
Total organics	**14.1**	**4.6**	**32**	**9.5**	**68**

The strong dependence of Australia on landfill for waste management may be due to the fact that most of the larger urban centres still have sufficient unused physical landfill capacity (EPHC, 2009a). In 2008 Australia counted a total of 665 landfills (WMAA, 2009). However, landfills are being consolidated and rationalised with the closure of smaller sites in favour of larger landfills which provide an overall improvement in environmental performance and economic viability. According to BDA (cited by The Allen Consulting Group, 2009) landfill fees in Australia range between $41 and $102 per tonne of waste disposed. However, disposal costs do not include waste externalities such as impact on the environment from landfill leachates.

2.2.2.2 Impediments to Australian Waste Management

Whilst Australia has a number of strategies and policies directly relating to waste management, there are a number of impediments in the sector. For instance, Australia does not have a national waste definition and a national waste classification system (Productivity Commission, 2006). This is due to the fact that the State and Territory governments regulate waste and this has resulted in differences between jurisdictions regarding definitions and classification of wastes (The Allen Consulting Group, 2009). These differences can lead to States and Territories reporting lower waste generation than others. As a way of illustration in Tasmania dirt is not classified as waste whereas it is in the other State and Territories (Hyder, 2009). Waste data are mainly collected and reported by landfill operators, local Councils or environmental protection agencies. Each has different data requirements, conversion systems and reporting according to different waste classification. Such differences result in a complex structure of waste reporting making the collection of waste data and the comparison between jurisdictions as very complicated (WMAA, 2009). There is a need to use standard definitions and waste classification across the nation in order to effectively inform decisions makers. Hazardous waste is, however, the most consistently classified type of waste due to the 2004 release of the National Environment Protection (Movement of Controlled Wastes between States and Territories) Measure (NEPC, 2004).

2.2.3 Waste Sector and Greenhouse Gas Emissions

According to the EPHC (2009a) the Australian total waste GHG emissions were 14.6 Mt of carbon dioxide equivalent (CO2-e) in 2007 which accounted 2.5% of the total GHG emissions that year. Around 80 per cent of waste sector emissions derive from solid waste, with the remainder from wastewater (around 20 per cent) and solvent and clinical waste incineration. GHG emissions from the waste sector are mainly due to the disposal of organic waste.. When decomposing in an anaerobic condition they generate landfill gas consisting of about 55 per cent of methane, a greenhouse gas with a global warming potential 20 times of carbon dioxide. Particular to the waste sector is the long term GHG emission legacy. Indeed, because solid waste degrades slowly and landfill gas is not spontaneously generated at disposal and the bulk of the GHG emissions in the waste sector is generated by the historical stock of landfilled biodegradable materials. With the challenge of climate change the waste management sector similarly to other sectors of the Australian economy is now required to examine its 'carbon liability' in terms of greenhouse gas emissions. As a signatory nation to the Kyoto Protocol, Australia has agreed to reduce GHG emissions to 108 per cent of 1990 levels. To achieve this, the Australian Labour Government has committed to introducing a Carbon Pollution Reduction Scheme (CPRS) to reduce GHG emissions. Under the proposed CPRS, large emitters of GHG would need to purchase a 'carbon pollution permit' for every tonne of GHG released into the atmosphere (Department of Climate Change, 2008). As a result this scheme would effectively 'put a price on carbon' for the first time in the Australian waste sector. The CPRS draft legislation initially proposed to impose a liability on landfill legacy emission. However, following intense lobbying from local governments and the waste management industry concerned about the equity of imposing a liability on legacy emissions and the cost it would impose on rate payers, legacy emissions from waste were excluded from the scheme. Under the Scheme, all landfills facilities with emissions above 25,000 tonnes of carbon dioxide equivalent (CO_2-e) will be covered. Additionally, to avoid the displacement of waste from sites covered by the scheme to uncovered ones, the CPRS establishes a Prescribed Distance Rule. This means landfills within a 'prescribed distance' of a landfill which meets the 25,000 tonnes CO_2-e threshold would have a lower participation threshold

of 10 kt CO_2-e per annum. This 'prescribed distance' is still to be determined through industry consultation and will be fixed for five years (Dorizas, 2009).Because the draft legislation failed to be ratified the CPRS has not taken affect. However, if the CPRS is passed through parliament, the need to buy permits for landfills over the 25,000 tonnes threshold will provide an incentive for better capture of GHG emissions and the establishment of alternative options to landfilling for the management of organic waste.

2.3 Tasmanian Waste Management

Up until the 1970s waste management in Tasmania was rudimentary. Similarly to many parts of Australia and other developed countries, solid waste was disposed in 'tips' or 'dumps' which consisted generally of trenches or gullies. Sewage waste, on the other hand, was released into rivers and seas (Glover, 1995). The introduction of the *Local Government Act 1962* placed the first obligation on councils to deal with wastes generated in their municipality, effectively making them responsible for refuse and disposal (LGA section 522, 523). In addition to the involvement of local governments, in 1974 State license regulations were established through the *Environment Protection (Waste Disposal Regulations)* under the *Environment Protection Act.* This conferred greater control of waste management to the Tasmanian Government. Other legislation that regulated waste management in Tasmania included the *Public Health Act 1962* and the *Groundwater Act 1985*. These Acts required that waste in disposal sites be regularly covered with soil and that leachates had to be trapped and treated. They also prohibited the burning of wastes and the dumping of hazardous wastes in landfill sites. According to Davis (1985), for much of the 20th century the Tasmanian public expressed little concern regarding poor waste management practices. Such attitudes may have been influenced by ignorance of the impacts of wastes on the environment coupled with a lack of relevant environmental information (Davis 1985). In addition, Tasmania has a highly decentralised and small population. As a result a large number of local municipal councils each of had their own landfill sites with minimal amounts of waste going into these landfill sites. This prevented serious environmental degradation from occurring and as a consequence, waste management remained largely unaddressed (Glover, 1995). However, in the late 1980s and early 1990s a world-wide shift in

focus from landfilling of waste to resource conservation took take place. In Australia, this shift was reflected in the release of the NWMRS and NKRS. These Strategies provided the Tasmanian Government with guidelines to develop the 1994 Solid Waste Management Policy.

2.3.1 Tasmanian Policy Context

2.3.1.1 Resource Management and Planning System

In 1974 the Department of Environment began conducting surveys of all waste disposal sites in Tasmania. Through the 1970s and the 1980s surveys revealed that 110 sites were in operation and most of which were poorly managed and consequently had a severe impact on the environment (DEP, 1992). The results of state-wide monitoring led to the development of the 1994 Tasmanian Solid Waste Management Policy (TSWMP). In the 1990s, the State Government also reviewed its environment and planning legislation. In January 1994, the Resource Management and Planning System (RMPS) was established following the introduction of a suite of new legislations. Central to the RMPS was the concept of sustainable use or development of Tasmania's natural and physical resources for which it provides the overall framework. However, Tasmania does not have legislation specific to waste minimisation. Primary legislation influencing waste management includes the *Land Use Planning and Approvals Act 1993* (LUPAA) and the *Environmental Management and Pollution Control Act 1994* (EMPCA).

LUPAA is the primary planning legislation and establishes planning assessment processes and a permit system to regulate land use and development to ensure that the use and development of land is done in an environmentally sound manner. To open a new disposal site, councils need to obtain a permit under section 51(2) of the Act. The issuing of a permit for a new disposal site depends on the types of waste to be received at the disposal site and its proposed level of activity. Landfills are classified under the *Landfill Sustainability Guide 2004* depending on the type of waste these sites receive. There are three categories of landfill in Tasmania: Category A: Solid Inert Landfill; Category B: Putrescible Landfill; and Category C: Secure Landfill. Table 2.6 provides a description if the different types of wastes that may be accepted at each category of landfill for disposal.

Table 2.6 Landfill Classification System

Waste type	Landfill Category		
	A (Solid Inert)	B (Putrescible)	C (Secure)
Solid inert material (includes clean fill)	✓	✓	✓
Potentially contaminated material			
Fill material	✓	✓	✓
Low level contaminated soil	×	?	✓
Contaminated soil	×	×	✓
Contaminated soil for remediation	×	×	×
Putrescible waste	×	✓	✓
Controlled waste	×	?	✓

Key: ✓ permitted
× not permitted
? may be accepted, subject to approval by the Regulatory Authority for the type of waste. Analytical testing may be required.

Source: DPIPWE, 2004

The *Environmental Management and Pollution Control Act 1994* is Tasmania's primary environment protection legislation. It aims at preventing the environmental damage from pollution. Under EMPCA, the Environment Protection Authority (EPA) has the power to issue 'Environmental Protection Notices' to ensure that no 'environmental harm' results from the management of waste disposal sites. The Act provides a set of objectives under Schedule 1, and some are specific to waste management in Tasmania:

> (a) to protect and enhance the quality of the Tasmanian environment; and
> (b) to prevent environmental degradation and adverse risks to human and ecosystem health by promoting pollution prevention, clean production technology, reuse and recycling of materials and waste minimization programmes; and
> (c) to regulate, reduce or eliminate the discharge of pollutants and hazardous substances to air, land or water consistent with maintaining environmental quality; and

> (d) to allocate the costs of environmental protection and restoration equitably and in a manner that encourages responsible use of, and reduces harm to, the environment, with polluters bearing the appropriate share of the costs that arise from their activities; and
> (e) to require persons engaging in polluting activities to make progressive environmental improvements, including reductions of pollution at source, as such improvements become practicable through technological and economic development; and
> (f) to provide for the monitoring and reporting of environmental quality on a regular basis; and
> (g) to control the generation, storage, collection, transportation, treatment and disposal of waste with a view to reducing, minimizing and, where practicable, eliminating harm to the environment; and
> (h) to adopt a precautionary approach when assessing environmental risk to ensure that all aspects of environmental quality, including ecosystem sustainability and integrity and beneficial uses of the environment, are considered in assessing, and making decisions in relation to, the environment; and
> (i) to facilitate the adoption and implementation of standards agreed upon by the State under inter-governmental arrangements for greater uniformity in environmental regulation; and
> (j) to promote public education about the protection, restoration and enhancement of the environment; and
> (k) to co-ordinate all activities as are necessary to protect, restore or improve the Tasmanian environment (Schedule 1 of EMPCA 1994).

Under EMPCA, when a landfill receives 100 tonnes or more waste per annum it is classified as a level 2 'waste depot'. This type of landfill is regulated by the Department of Primary Industries, Parks, Water and the Environment (DPIPWE) while smaller sites receiving less than 100 tonnes of waste per annum are regulated by local Councils (DPIPWE, 2010a). Landfill operators, either private or local Councils, also need to meet the requirements under the *Environmental Management and Pollution Control (Waste Management) Regulations 2000.*The regulation provides specific requirements for the disposal of controlled and general wastes. Disposal is to be done on land for which environmental approval has been obtained and waste should be disposed in a way to prevent environmental harm and health related risks. Challenges for landfill operators involve the prevention of groundwater contamination; the safe disposal of hazardous waste or the management of odour, vermin and visual impact management. The regulation fixes penalties for parties that do not meet the requirements.

2.3.1.2 The Tasmanian Solid Waste Management Policy (1994)

The waste management policy framework is based on the Tasmanian Waste Management Policy 1994 and the Tasmanian Hazardous Waste Management Strategy 1994 (DPIPWE, 2000). The Tasmanian Solid Waste Management Policy (TSWMP) is closely linked to the NWMRS (1992) to meet the targets set by the national strategy. The two main goals of the TSWMP (1994) were the promotion of waste minimisation and resource recovery, and the protection of the environment from effects arising from landfills (DELM, 1994). A number of guidelines were established under the policy to achieve these goals.

The TSWMP adopted a 50% reduction target in the amount of waste disposed to landfill by 2000, as set by the NWMRS, and provided a time frame for the State to meet this target. Two important aspects of the TSWMP (1994) were the promotion of the user pays principle and a state wide rationalisation of landfill sites. The user pays principle was introduced to discourage the dumping of waste and encourage recycling. This was undertaken by replacing the existing license fee with a system of waste disposal fees, calculated by material weight.

Landfills were rationalised to improve operational procedures and reduce the environmental impact of these facilities. In Tasmania, local Councils are the primary owner and manager of landfills. Historically, these facilities were primarily developed to meet the needs of urban and rural communities and were not suitably designed to cope with waste resulting from the industrial sector (SIA, 2008). In the 1990s, the EPA Division, in collaboration with local Councils, began to rationalise municipal disposal sites and started to incorporate recycling facilities (DPIPWE, 2010a). Large regional landfills were favoured over small local ones to: (1) improve landfill operations and construction in accordance best practice environmental management standards through 'economies of scale'; and (2) allow more efficient regulation by the authorities due to the smaller number of disposal sites (DPIPWE, 2010a). Additionally, larger regional landfills limit the potential for environmental harm. This rationalisation of landfills resulted in a significant reduction in the number of landfills from 99 (in 1994) to 17 (2010). An increase in the number of

waste transfer stations that were operated as satellite sites to major regional landfills was also achieved during this initiative.

Due to the high proportion of organic waste in the waste stream, the TSWMP (1994) called for a reduction in volume entering landfill. While the NWMRS set a separate target for a 20 per cent reduction in the amount of organic wastes entering landfill sites, that target for organic waste was subsumed in the TSWMP target for an overall 50 per cent reduction of *all* wastes being disposed to landfill (DELM, 1994). However, under the policy, local Councils were asked to encourage home composting through distribution of leaflets and advice and by providing compost bins for sale to residents, introduce chippers/shredders at refuse disposal sites and encourage the establishment of compost facilities for use by industry (DELM, 1994).

2.3.1.3 The Tasmanian Waste and Resource Management Strategy

While waste and resource management practices have been significantly improved with the release of the 1994 TSWMP problems still persist for the management of some waste streams. Additionally, Tasmania is not as advanced as other States and Territories in sustainably approaching waste and resource management. With both the State and local Governments committed to improving waste management and waste minimisation, the Department of Environment, Parks, Heritage and the Arts (DEPHA) developed the 2009 *Tasmanian Waste and Resource Management Strategy* (DEPHA, 2009). The Strategy targets primarily the solid waste stream and aims to improve the management of solid waste and resources. To achieve these aims it provides a set of objectives and strategic actions consistent with the National Waste Policy and to further develop solid waste management and resource recovery initiatives and programs in Tasmania (DEPHA, 2009). The objectives under the strategy are:

- improved partnerships, coordination and planning;
- waste avoidance and sustainable consumption;
- waste minimisation and resource recovery;
- improved regulation and management of residual wastes;

- improved data collection and management systems; and
- reduction of greenhouse gas emissions (DEPHA, 2009 p.8).

In the Strategy, organic waste is only mentioned once as a strategic action to reduce greenhouse gas emissions. Under this action, State and local Governments need to "increase the diversion of organic (green) waste from landfill and develop policies for alternative management of organic wastes" (DEPHA, 2009 p.16). Under the strategy a Waste Advisory Committee will be established to monitor whether the strategy is implemented successfully and facilitate collaboration between the different stakeholders in the waste management and resource recovery industry (DEPHA, 2009).

2.3.2 Current Status of Waste Management in Tasmania

2.3.2.1 Regional Waste Management Structures

Tasmania is divided into the North-west, the Northern and the Southern regions. Each of these regions is made up of numerous local Councils. In total 29 local Councils act as local government authorities, forming a third tier of government. Waste management in Tasmania is increasingly an area of core business for local Councils. Under the *Local Government Act 1993* Councils have the primary responsibility for the delivery of waste management services within their municipality while preventing any impact on environmental and public health. Waste management services provided by Councils include kerbside recycling, green waste collection, public education for waste reduction and recycling, recycling centres, litter management, and management of transfer stations and landfills. In order to better coordinate the provision of services, local Councils have formed three regional authorities: Northern Tasmania Development; Cradle Coast Authority; and Southern Tasmanian Councils Authority. Additionally, the 12 southern councils established the Southern Waste Strategy Authority (SWSA) in 2001. This was done in order to facilitate integrated regional waste management planning in Southern Tasmania and led to the development of the Southern Waste Management Authority five years Strategy 2006-2001 in 2005. The strategy encourages "sustainable resource recovery from all waste streams in Southern Tasmania and minimum environmental impact from waste management activities" (SWSA, 2005 p.5). The SWSA also aims to raise

public awareness about resource recovery, improve monitoring of waste management performance monitoring and coordinate waste management policy in the Southern Tasmania region (SWSA, 2005). Table 2.5 provides a brief account of the three regions and their waste disposal infrastructure.

Table 2.7: Overview of the three Tasmanian regions and their waste disposal infrastructure
Source: adapted from SIA 2008

Region	Number of councils	Number of landfills	Regional Landfills	Waste Transfer Stations	Material recovery facilities	Composting Facilities
North Region	8	9	1	24	2	1
North Western Region	9	5	/	16	2	1
Southern Region	12	5	1	33	1	1

In 2005, the SWSA released the *Southern Waste Strategy Authority: Five Year Strategy 2006-2011.* The strategy provides broad policy framework and strategic direction to complement regional waste management planning initiatives. The strategy identifies the C&I waste stream as the main target for future resource recovery given the fact that 90 per cent of Southern Tasmania have access to kerbside recycling. While in the strategy organic waste seen as a critical issue, there are no clear objectives and strategic action for the removal of organic waste in landfill.

2.3.2.2 Tasmania Waste Data Reporting and Solid Waste Classification

Whilst resource recovery is supported in the waste management sector there are also gaps in the way waste data is reported and classified. Waste data are collected and reported on a consistent basis by both the State and Local government in order to:

- facilitate waste management strategic planning, budgeting and cost control for all levels of government;
- facilitate the identification of priority areas and opportunities for resource recovery; and
- measure progress that is made in resource recovery (DPIPWE, 2010b n.p.).

While waste data are collected by Councils, there is currently no state-wide database on waste in Tasmania. Two Environment Protection Notices were issued in 2006 by the Department of Tourism, Arts and the Environment requiring landfill operators to report reporting the total weight of waste disposed during each financial year in accordance with the Tasmanian Solid Waste Classification System (Figure 2.2). As well Councils record waste data from their Waste Transfer Station, however, there is no mandatory requirement for them to undertake that requirement.

Figure 2.2: Tasmanian Solid Waste Classification
Source: DPIPWE, 2010c

Tasmanian Solid Waste Classification System (Based on the Australian Waste Database)				
Processing Route	Primary Source	Secondary Source	Transport Mode	Material Composition
1 Recycling 2 Composting 3 Incineration 4 Landfill 5 On-site	A Municipal B Commercial & industrial C Construction & Demolition	1 Domestic Waste 2 Other Domestic 3 Other Council X Waste Processing Facility 0 Unknown X Waste Processing Facility 0 Unknown 2 Other Domestic 3 Other Council X Waste Processing Facility	0 WEIGHBRIGE 1 LIGHT VEHICLES Boot Load < 1m³ 1 - 2 m³ 2 3 m³ > 3m³ 2 TRUCKS GVM 3t - 7t GVM 7t - 12t GVM >12t single axle GVM >12t dual axle Dual Axle trailers 3 SKIP/BIN Up to 4 m³ 4 - 8 m³ 8 - 12m³ 12-15m³ 15 - 20m³ 20 - 25m³ 25-30m³ > 30m³ 4 COMPACTOR UP TO 7m³ 7 - 15m³ (Half Full) 7 - 15m³ (Full) >15m³ (Half Full) > 15m³ (Full)	0 Mixed 1 Paper/Cardboard 2 Food/Kitchen 3 Green Organics 4.1 Wood 4.2 Trees > 150mm diameter 4.3 Sawdust 5.1 Tyres - Car 5.2 Tyres 4WD 5.3 Tyres - Trucks 5.4 Tyres - Other 6 Glasses 7 Plastic 8.1 Ferrous - other 8.2 Ferrous - cars 9.1 Controlled Waste - Other 9.2 Sewage sludge 9.4 Putrescible/Organic 9.5 Asbestos 9.6 Clinical & Pharmaceutical 9.7 Low level contaminated soil 9.8 Contaminated soil 10 Clean fill - mixed 10.1 Bricks, concrete, rubble 10.6 Non - ferrous - other 10.8 Clean Excavated Material

The Tasmanian Solid Waste Classification System was developed by the SWSA using the National waste classification model. It provides a reporting system to waste managers and allows the waste management industry to measure the amount and type of material received and processed (Clarke, 2006). The classification is meant to provide consistency of waste measurement and reporting, based on consistent data gathering, to assist local Councils in making decisions about future infrastructure investments.

However, Tasmanian waste datasets have significant gaps and inconsistencies. For instance, in the 2007-2008 reporting year, 482,252 tonnes of solid waste were generated across the MSW, C&I and C&D streams. According to DEPHA (2009), only 11% (51,880 tonnes) of the total waste generated that year was recycled. The total quantity of solid waste disposed to landfill was 419,772 tonnes and Tasmania also exported 10,600 tonnes of controlled waste to other states for treatment and/or disposal. This 'apparent' very low recycling level in Tasmania, when compared to the average level of 46% waste recycling and recovery nationwide (except for the Northern Territory), is not reflective of the actual commitment to recycling and resource recovery of both local and State government (Hyder, 2009; DEPHA, 2009). This significant difference in recycling level is due to the fact that Tasmania does not have complete datasets for waste generation and recycling for the C&I and C&D waste streams. Given that fact, there are no data for the amount of organic waste generated and recycled in the State. Data for recycled material only includes material recycled through the kerbside. There are many reasons for the gaps and inconsistencies in waste data. Inconsistencies may be due to the fact that landfill operators reporting the data are not sufficiently trained and may report waste in the wrong category. Hyder (2009) notes that with Tasmanian waste reporting, "it appears that the data for the C&D sector is underreported, possibly due to the use of a default reporting code that favours the C&I stream." Hyder (2009) also states that dirt is not classified as waste in Tasmania which may lead to lower waste generation than other states and territories. There is also a clear lack of monitoring for some of the waste streams. For instance, data on organic waste generation and recycling levels through composting is inexistent (Clarke, pers. comm. 2010). The nomenclature for organic waste as either wet (food) or dry (green waste) is also very broad given the variety of waste types found in this waste stream (see Section 1.4). Food organics comprises a whole range of different waste types and with the current nomenclature it is impossible to assess the contribution of a given type of food organics against another. This situation is an impediment for the development of alternative food organics management.

2.4 Waste Management in Hobart

Local Councils continue to play an important role in waste management and ultimately reducing the organic fraction going to landfill. The Hobart City Council (HCC) provides both a domestic refuse collection and kerbside recycling for residences and commercial businesses. A green waste collection service is also offered twice a year. The waste service provided by HCC to commercial premises is limited to a 240L bin for refuse and a 240L bin for recyclables. Businesses generally have their waste and recyclables removed by private waste management operators such as Veolia. Disposal of waste as landfill remains the main method used at the South Hobart McRobies WMC. The WMC has been operating for 35 years and has a remaining life expectancy of 7 years (Holmes, pers. comm. 2010). In 1990, HCC was the first council in Southern Tasmania to introduce a disposal fee for its landfill site, hoping that, as a result of this user pay policy, the public and businesses would increase their recycling activity (Bakker et al., 1993). A Green waste mulching and composting facility currently operates at the WMC. The facility receives diverted organic waste from landfill and turns it into mulch, compost and soil conditioners made to the Australian Standard AS 44545 (Hobart City Council, 2009). The Green waste mulching and composting facility primarily receives green waste (35,000 m3per annum) either collected via the green waste collection service offered by HCC or directly brought by residents and businesses. The green waste is mulched and stock piled for a period of three months to mature before being arranged into windrows. The windrows are then fed with food organics essentially from fish farms and the Cascade brewery. The composting facility at the McRobies WMC receives almost no food organics from the MSW, C&I and C&D waste streams. In Hobart, the C&I sector contribute greatly to the volume of waste entering landfill. Parsons and Kriwoken (2009) examined the recycling practices for three types of organic waste - cardboard, paper and food waste- in small to medium sized enterprise (SME) in Hobart. While food waste was the major component of the organic fraction of waste ending up in landfill (EPHC, 2009a) their study revealed that food waste was the least recycled type of waste with only 4.3% of food waste recycled amongst the SMEs. Most food organics generated in Hobart currently ends up in landfill.

Significant change is currently taking place in Hobart with the establishment in 2010 of two projects aiming at diverting food organics from landfill. In order to further reduce greenhouse gas emission from its McRobies Landfill – measures currently undertaken include Landfill Gas Collection System and Green Waste Composting – the HCC proposed the establishment of a Food Waste Collection and Composting Trial. The project also aimed at continuing diversion of waste from landfill and assessing the viability of a food waste collection service across a wider base. The trial started in June 2010 for a period of six and involved fives businesses (café/restaurant and general store) and one household which were provided with bins and biodegradable liners. Under the trial, the material collected was limited to fruit and vegetables waste. Collection was free of charge and provided twice a week. The collected material was sent to the McRobies organics facility and to a community garden where it was composted. When this thesis was submitted the trial was still ongoing.

In late 2010, the Hobartian Company Eenee Designs will start providing a food and garden organic waste collection service in the greater Hobart area. The service will be available to both businesses and households which will have to purchase a 240L aerated wheelie bin, equipped with a gravity lock. Collection of the material will be subcontracted to Veolia and will take place once fortnightly for households and on a more frequent basis for businesses not yet determined. Under the service the collected material will be delivered at the Soil First composting facility near Oatland.

2.5 Chapter Summary

This chapter has provided an overview of Australian, Tasmanian and local Council waste management. Both federal and State and Territory governments have acknowledged the need to reduce waste, and policies have been introduced on minimal management of waste to integrated waste and resources management using a variety of practices to handle waste including source reduction, recycling, and landfilling. Recovery and processing organic waste has the largest impact on reduction of landfill GHG emissions and volume disposed to landfill. The National Waste Minimisation and Recycling Strategy 1992 was the first to incorporate specific reduction target for the amount of organic waste entering landfill. National

and State and Territory waste management policies and strategies also set targets or directions to reduce organic waste disposal and increase their recovery. However, while recycling levels of inert waste have significantly increased, organic wastes still account for 62% of all waste entering landfill. With the challenge of climate change and the future introduction of the CPRS there is a real need for stronger action in the recovery or organic waste and food organics in particular. The next chapter will provide a literature review on food organics generation and management in the C&I sector and examine the barriers faced by businesses for the recovery of food organics, Australia and Tasmania. The chapter will analyse the existing options to reduce the amount of organic waste disposed of in landfill and recycle organic waste into value-added products.

Chapter 3 Food Organics Recovery

3.1 Introduction

The vast majority of organic waste, and more particularly food organic materials, generated in Australia are sent to landfill sites. The Waste Enquiry (2000) conducted in NSW showed that only 3.1% of food organics produced by the C&I sector is recycled. However, there are numerous alternatives to disposal that can improve environmental and resource conservation outcomes. The low recovery of food organics is due to a number of obstacles encountered by businesses such as lack of incentive for source separation, or problems with collection, transportation, and storage (Farrell, 1998). This chapter will first provide an overview of the environmental impacts of organic waste and food organics disposal and the environmental benefits and drivers for food organics recycling. A number of different alternatives to landfilling are available to businesses in the C&I sector. These include donation to charity, donation to farmers for animal feeding, anaerobic digestion and aerobic composting. These options are presented and analysed in terms of their individual advantages and weakness. The chapter examines the potential barriers that prevent the diversion of food organics in the C&I sector before finally reporting on European "best practice' examples in food organics diversion.

3.2 Rational for Diverting Food Organics from Landfill

3.2.1 Impacts of Food Organics Disposal

Although the recycling of organic waste has grown in recent years —especially for green waste, paper and cardboard —a substantial amount of organic material still goes to landfill almost half of it food organics. On average, in Australia over 60 per cent of all waste entering landfill is organic (EPHC, 2009b). According to the principle of the Waste Hierarchy, the disposal of food organics in landfill is the least desirable option as a range of alternatives offering improved environmental and resource conservation outcomes such as composting or anaerobic digestion (see section 3.3) (ROU, 2007a). The disposal of organic waste and food organics in landfill is a misuse of resources and can also have significant impacts on the environment and public health. When decomposing in anaerobic conditions organic

wastes generate a number of gases. Some gases are malodorous, but others, notably methane, a greenhouse gas with a global warming potential 20 times that of carbon dioxide, represents a much more serious problem (EPHC, 2009a). Food organics represent the dominant component of the organic waste stream and the second largest source of methane in landfills (US EPA, 1997; Environment, Planning & Resource Recovery Consulting, 2005). This is due to the very high moisture and nutrient content of food organics. The decomposition of food organics in anaerobic conditions also produces acids which through contact with other rubbish items generate a toxic mix known as leachate (Clean Up Australia Limited, undated). The largest sources of leachate in the landfill are food and garden organics (ROU, 2007a). The collection of landfill leachate at the bottom of landfills can result in the contamination of surface water and groundwater which in turn may have a significant impact for communities that derive potable water from underground water storage (Assmuth and Strandberg, 1993). Food organics in landfill also attract vermin and other disease vectors which can have serious implications for public health. Finally, the value of other recyclable materials can be reduced when mixed with food organics (Environment, Planning & Resource Recovery Consulting, 2005; ROU, 2007a).

3.2.2 Drivers for Recovering Food Organics and Benefits

There are, however, numerous drivers for the recovery of food organics. Increased community concern about the impacts of waste disposal on the environment has resulted in strong opposition to locating new landfill sites in urban areas or on the urban fringe. In addition to the need to conserve scarce landfill space for non-recyclable and/or non-compostable materials, such concerns have brought intense pressure on governments to seek alternatives to landfill disposal. Through the introduction of policies and incentives governments have encouraged organic waste avoidance, reuse and recycling. Diversion from landfill and reprocessing of food organics help diminishing increasing pressures on landfill sites and is also associated with a number of environmental benefits by utilising materials that have been considered '*waste*' as a resource (ROU, 2007b).

The proposed Carbon Pollution Reduction Scheme and various State Government taxes and levies – that are being introduced to reflect the full extent of waste disposal externalities – also provide strong incentives to local governments and communities to avoid the cost and GHG emission of organic materials disposal by implementing alternative diversion options. Additionally, the various sources of food organics, if separated and handled properly, have the potential to reduce disposal costs and produce valuable end-products. However, the recovery of food organics is low and this type of waste remains a significant challenge in waste management because of its contribution to landfill GHG emissions and the collection issues it poses (WME, 2009).

Finally, the disposal of organic waste in landfills has significantly impacted the balance of carbon and nutrient cycles. This has affected the health of natural ecosystems but also had severe consequences on our agricultural production systems (Environment, Planning & Resource Recovery Consulting, 2005). Over the last 50 years, the organic carbon content of Australian agricultural soils has been depleted from 3% to less than 1% due to modern farming practices (Jones, 2007). Loss of soil carbon has a critical impact on agricultural productivity, landscape function and water quality, which in turn, have significant economic and environmental implications (Jones, 2007). Organic waste, including food organics, can be composted into fertilisers and soil conditioners. Compost is mainly produced by garden waste, however food organics is high in nitrogen and when added to compost speeds up the decomposition process and increases the nutrient content of the finished product. This benefits agricultural production systems through replenishing organic carbon and enhancing plant health. By increasing soil organic matter, the addition of recycled organics to soil improves soil structure that prevents surface sealing (WRAP, 2008; Agassi *et al.,* 1990 cited by ROU, 2006). This in turn, improves water infiltration and the water holding capacity of soil enabling a 25% water saving (WRAP, 2008 and Albaladejo *et al.,* 2000). Given the current and projected reductions in annual average rainfall especially in the eastern parts of Australia and southern Western Australia as a result of climate change (DCCEE, 2009), the application of recycled organics reduce environmental impact associated with land use and increase the resilience of agricultural production systems to climate change by better retaining water in soil (Jones, 2007).

To ensure a sustainable diversion and recovery of food organics from landfill into compost and mulch for soil application it is crucial that are appropriate and sustainable markets for these product. If markets are not properly developed and product supply exceeds demand, compost products are generally stockpiled and may eventually have to be disposed. The quality of the final product is also critical when it comes to sustaining a market for recycled organics. Products of poor or inconsistent quality can undermine the confidence of users and therefore impact on market uptake. Statutory authorities at Commonwealth, State and Local Government level play a key role in facilitating the development of market for recycled organics by introducing a number of initiatives to address the management and minimisation of organic waste. There is however no strong initiative in Australia to promote the recovery or organic waste and food organics in the MSW and C&I waste stream (Environment, Planning & Resource Recovery Consulting, 2005).

3.3 Food Organics in the Commercial and Industrial Sector

Many different types of businesses generate food organics as part of their activity including: food manufacturer and processors; retail stores; institutions or restaurants. Food organics can be categorised as either 'pre-consumer' (e.g., food preparation waste) or 'post-consumer' (e.g., leftover food or plate scrapings) (US EPA, 2010 n.p.). The following section first reports on the generation of food organics of different types of businesses within the C&I sector. The different options for the diversion of food organics from businesses includes: (1) avoidance through cleaner production; (2) treatment through on-site processing systems; and (3) off-site management of excess food organics (Environment, Planning & Resource Recovery Consulting, 2005). These options are presented in the second part of this section. The last part of this section outlines some of the barriers that prevent source separation of food organics and food organics diversion within the C&I sector.

3.3.1 Generation of Food Organics in the Commercial and Industrial Sector

The main metropolitan food organics generating businesses in the C&I sector, as targeted in this thesis, can be grouped in five industry sectors: Food Manufacturing and Processing, Food Retailing; Accommodation, Cafes and Restaurants, Education

and Health Institutions. Today we do not have a good understanding of the volumes of food organics that are available for recovery in the C&I waste stream. This is due to the lack of studies on the different sources, types and quantities of food organics generated in the C&I sector in Australia. Additionally, businesses often remove all or part of their food organics in ways that avoid solid waste management (Environment, Planning & Resource Recovery Consulting, 2005). According to Environment, Planning & Resource Recovery Consulting (2005 p.50), "direct soil injection on farms; direct animal feeding and rendering; and in-sink disposal into the sewerage system are the main hidden flows of food organics from the C&I sector".

Nationally, food organics accounted for 21.5% of the mixed C&I waste stream sent to landfill in 2009 (EPHC, 2009a). According to a C&I waste survey conducted by the DECCW (2009) in Sydney, the contribution of food organics to the mixed C&I waste stream sent to landfill has increased significantly from 4% in 2003 to 14.6% in 2008. This rise is due to the significant advances made in terms of recycling and reusing of inert material while the same cannot be said for food organics. Additionally, this needs to be seen in the light of more general increases in food consumption taking place in Australia, as in other developed counties (Morgan, 2009). In order to minimise and recover food organics in the C&I sector it is important to know what industries are the main generators of food organics.

Two major studies in the field of food organics survey are those of Maunsell Pty Ltd and Ratio Consultants (1998) and Nolan-ITU (2000a). These studies examined the waste stream of different business sectors and the quantity and types of food organics generated. Such data are pivotal in order to understand which businesses generate the bulk of food organics that are disposed in landfill and develop appropriate waste minimisation and recovery strategies for food organics in each business sector. Both studies used ANZSIC categories for the sampling of businesses. Maunsell Pty Ltd and Ratio Consultants (1998) assessed food organics generation in Victoria in only two ANZSIC categories: Retail Trade and Accommodation and Food Services. Nolan-ITU (2000a) audited food organics generation of different industry groupings in Southern Sydney, namely Food Retailing; Accommodation, Cafes and Restaurants; Education and Health

Institutions; Food Manufacturing and Processing, and Remaining Businesses (e.g. corporate offices, miscellaneous retailing).

The research conducted by Maunsell Pty Ltd and Ratio Consultants (1998) involved a sample of 25 businesses in each ANZSIC category. Businesses selected in Retail Trade were limited to Supermarket and Grocery Stores and those selected in the Accommodation and Food Services category were limited to Cafes and Restaurants. The survey results revealed that the bulk of waste generated by Supermarkets and Grocery Stores and Cafes and Restaurants was organic waste. Supermarkets and Grocery Stores are a much larger source of food organics than Cafes and Restaurants with larger sized supermarkets having a much higher rate of organic waste production than the smaller sized stores (<20 employees) (Maunsell Pty Ltd and Ratio Consultants, 1998). Vegetable/fruit and meat were the two major food organics generated by Supermarkets and Grocery Stores representing 34% and 10% of all waste respectively. While 68% of meat waste was recovered, only 2.8% of vegetable and fruit waste was recycled. Several of the businesses surveyed expressed the desire to recycle organics and some were trialing organics recycling (Maunsell Pty Ltd and Ratio Consultants, 1998).

The waste survey conducted in Cafes and Restaurants targeted ordinary restaurants that have: staffing levels less than 20, 5-star or high quality restaurants which prepare fresh food on the premises, fast food restaurants that had large staff numbers, and family restaurants that used pre-prepared food (Maunsell Pty Ltd and Ratio Consultants, 1998). The survey revealed that except for fast food and family restaurants, food organics generation was consistent across businesses. The fast food restaurants produced the lowest level of food organics per employee while 5 star or high quality restaurants produced the highest. Vegetable/fruit and meat accounted for 47% and 16% of the total waste disposed by Cafés and Restaurants. Unlike for retail shops, none of the food organics generated was recycled (Maunsell Pty Ltd and Ratio Consultants, 1998).

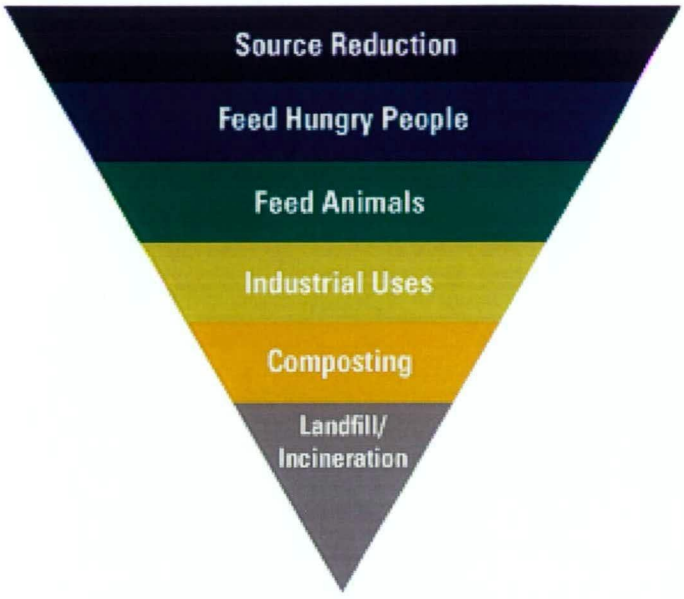
The research conducted by Nolan-ITU (2000a) showed that quantity and composition of food organics generated in the C&I sector differ significantly across different industry groups. For instance, the research showed that food organics

generated by processors and manufacturers are relatively homogeneous and have a low level of contamination. Food Manufacturers and Processors are not significant contributors to food organics going to landfill (Nolan-ITU, 2000a). Food manufacturers only generate pre-consumer food organics, which gives them a better ability to control food organics in comparison to restaurants. Restaurants on the other hand generate both pre-consumer food organics in the kitchen and post-consumer food organics from plates scraps that are generally mixed with other waste materials when disposed. The food organics audit revealed that the Food Retailing sector and the Accommodation, Cafes and Restaurants sector are the two industry groupings with the largest food organics generation. They respectively produced 38% of all food organics generated by the five industry groupings

3.3.2 Diversion and Recovery Options for Commercial and Industrial Food Organics

Diversion and recovery of food organics generated within the C&I sector are at the early stage in Australia. Quantities of recovered food organics are known to be small in most states but difficult to assess because of limited data due to "hidden material" through the supply chain (Environment, Planning & Resource Recovery Consulting; 2005). The three types of diversion options include: (1) avoidance through cleaner production; (2) treatment through on- site processing system; and (3) off-site management of excess food organics (Nola-ITU, 2000b, Environment, Planning & Resource Recovery Consulting; 2005). There are numbers of strategies that can be implemented to divert food organics from landfill, most of them requiring food organics to be separated at source. These options can be prioritised in terms or desirability according to the food waste recovery hierarchy, developed by the US EPA (Figure 3.1).

Figure 3.1: Food waste recovery hierarchy
Source: US EPA, 2010



The food waste hierarchy prioritises activities to manage food organics from the most to the least desirable. The most desirable option is the avoidance at source through cleaner production. When edible, food organics can be recovered for human consumption through food banks and food rescue programs. If not suitable for human consumption food organics can be recovered into animal feed. For food organics that are not suitable for either human or animal consumption, the most desirable recovery option involves the use of Alternative Waste Technologies (AWTs). AWTs involve biological treatment of food organic material such as anaerobic digestion or aerobic composting. AWTs can be used either on-site or off-site for the management and recovery of food organics (Nolan-ITU, 2000b; ROU, 2007a). The advantages of recovering food organics via AWTs instead of landfilling include a reduction in landfill leachate and landfill gas generation and the production of energy or compost (Warken ISE, 2007b; ROU, 2007a; SCECA, 2008). Diversion and recovery options of food organics have the potential to reduce disposal costs, and this can constitute an incentive for businesses to separate food organics for recovery (ROU, 2007a).

A range of factors influence the choice of a food organics diversion option that may suit a business, in particular the amount generated. The following sections present the different options for the diversion and recovery of food organics available to businesses in the C&I sector following the food waste hierarchy.

3.3.2.1 Avoidance through Cleaner Production

Cleaner production involves the implementation of measures and practices within a company to minimise the use of resources, minimise the generation of waste and emissions while maximising production capacity (Fresner, 1998). In recent years, local, state and national agencies have developed guidelines and case studies for food organics generating businesses to implement alternative measures and procedures to limit the generation of food organics and their disposal in landfill (Nolan-ITU, 2000c). Examples of guidelines are listed below:

- *Waste Reduction Assessment Guide for the Food Processing Industry* (UNSW; 1998);
- *Guidelines for Waste Minimisation in Food Service Outlets* (EcoRecycle Victoria; 1998);
- *Environmental Information for Retail Food Businesses* (NSW EPA; 1998);
- *Food Sense – A Guide to Reducing Waste in the Hospitality Industry,* (NSW EPA; 1998);
- *Waste Wise Catering - Small Changes Big Difference* (Sustainability Victoria, 2005).

Food organics and more particularly *pre-consumer* food organics represent a loss of revenue for businesses in the food industry but also increase the cost of waste disposal. The implementation of cleaner production measures to reduce the generation of food organics not only reduces cost, it also provides benefits to the environment and improves the corporate image of businesses that can lead to further economic benefits (Sustainability Victoria, 2005).

Measures that can be implemented to reduce the generation of food organics depends on what type is generated by the business. Nolan-ITU (2000c) identified and documented different options specifically related to food organics minimisation through cleaner production measures for different business types. For food

manufacturing and processing businesses, the main cleaner production measure involves improving production scheduling in order to minimise food organics at all stages of production. For other food organics generating businesses three main areas can be targeted to reduce food organics generation: (1) product purchasing – buying material in bulk or in concentrated form, as well as purchasing pre-prepared foods when adequate, (2) product handling and storage – ensuring good rotation of perishable stock and good storage and handling of fresh produces to minimise the risk of spoilage, optimise pricing and discount products approaching their "used by date" to increase clearance rate before spoiling, and (3) food preparation and storage – making sure quantities ordered match the requirement of the business, monitor the quantity of food left on plates and review menu planning practices and meal portion size, limit over trimming and reuse unused food (Nolan-ITU, 2000c; Sustainability Victoria, 2005). Cleaner production measures to avoid the generation of food organics are already implemented to varying degrees in a large number of businesses. When food organics cannot be avoided through cleaner production measures the next option to recover food organics is on-site or off-site food organics management systems and food donation to charity. The different options for food organics recovery will be described later in the chapter.

3.3.2.2 Source Separation of Food Organics

Resource recovery of waste has significantly increased over the last two decades in order to reduce dependency on landfill and the associated environmental impacts. Separation at source involves physical sorting at the point of generation of specific materials or components of the waste stream for alternative management and has increasingly become the preferred strategy worldwide as an integral part of resource recovery system (ROU, 2007a).

Source separation is pivotal to the recovery of food organics and to maximise the environmental and economic potential of food materials. Source separation ensures that food materials have a low level of contamination –including "physical inorganic materials (metals, glass), non biodegradable organic materials (plastics), chemical compounds and/or biological agents" (ROU, 2009a p.6). This in turn maximises the

value and potential recovery options for processed organic material as compost or for energy recovery (Environment, Planning & Resource Recovery Consulting, 2005).

The separation at source of inert waste, such as metal, plastic and glass, through kerbside recycling has been largely successful in the C&I sector, largely as a result to the introduction of legal instruments and waste management strategies in Australia that have established clear recovery targets for these types of waste. However, while similar recovery targets were included in waste management strategies for organic waste (see chapter 2) the separation at source of organic wastes remains limited with food organics the least recovered (SCECA, 2008). Apart from some isolated operations, food organics in both the MSW and C&I waste streams are not collected and processed on a large scale in Australia (Biala and Rutherford, 1999). In the C&I sector, food organics separated at source and collected consist of pre-consumer material from commercial kitchens, food retailers or food manufacturers (SA EPA, 2002). Barriers to source separation and collection of food organics for recovery in the C&I sector are detailed further in section 3.3.

3.3.2.3 Donation of Edible Unused Food to Charity

C&I food organics that are still suitable for human consumption, generally consisting of pre-consumer food organics, can be diverted by services referred to as foodbanks. Donating excess food or unsellable food that is still suitable for human consumption to foodbanks helps provide a social service to the community and is a waste avoidance option reducing the disposal cost of usable products for businesses. Additionally, all donations are tax deductible to an amount equivalent to the value of the material donated. Australian businesses can voluntarily donate surplus food and unspoiled food to organisations such as Secondbites, Foodbank Australia or Fareshare. Foodbanks collect both irregular and regular donations of fresh, frozen, canned and packet foods fit for human consumption. Donated food is then redistributed to local charities that prepare it for people in need. One of the main obstacles to the growth of food donor programs is the concern that donors can potentially be liable if a problem occurs, such as contamination. To overcome this problem, food banks have lobbied State Governments to pass a law commonly known as the Good Samaritan Act that limits the potential civil liability of a donor if

food is donated in good condition and in good faith. Since similar Acts were introduced in most states donations have significantly increased nationally (Godinho, 2009). The Good Samaritan Act was passed in Tasmania in 2008. While both the community and businesses benefit from food surplus to be donated, the existing constraints – food organics need to be suitable for human consumption, and the need to collect, transport and distribute food organics in limited time – make the ability of diverting C&I food organics from landfill to human consumption limited (ROU, 2007b). Distribution to charity is however best suited for retail stores, wholesalers and manufacturers as these types of businesses have better control over their food organics that consists mainly of pre-consumer material. Donations from businesses in the food service sector tend to be less common and in smaller volumes than for businesses in other sectors as pre-consumer waste, that is, kitchen waste, tend to be minimised and most food organics generated by such businesses consists of post-consumer waste not suitable for human consumption.

3.3.2.4 Food Organics Processing – Food Organics as Animal Feed and Rendering

Using food organics as animal feed was practiced in most countries at some stage and has been common in the food processing sector. Livestock have the ability to eat plant materials and foodstuffs that humans cannot. Therefore source separated food organics can be processed into or directly fed to animals, depending on the food requirements of the species (Westendorf and Zirkle, 1997; ROU, 2007a). Food organics from restaurants and grocery stores were long used by pig farmers until concerns regarding hygiene standards and the risk of animal disease were raised (Nolan-ITU, 1997). To avoid pathogen transfer it is advised that all food organics for animal feed be pasteurised or sterilised through pre-treatment such as heating. Sophisticated processes for the preparation of food organics into animal feed are generally preferred (ROU, 2007a). Meat and other animal materials also pose a serious risk of introducing diseases such as bovine spongiform encephalopathy. Food organics for animal feed is limited mainly to vegetable and fruit material for direct feeding. Good source separation is pivotal to ensuring that material is uncontaminated. In Tasmania it is illegal to feed swill (containing or having been in contact with meat, bone or dairy material) to pigs, or to supply swill to a pig owner.

Vegetable and fruit organics that have been properly separated without meat or dairy contamination can be directly fed to livestock (DPIPWE Animal Health and Welfare Branch, pers. comm. 2010). Given the need for only high quality, non-meat food for animal feed, the opportunity for C&I food organics to be diverted from landfill by feeding it to animals is limited (ROU, 2007b). In most case, food scraps from restaurants are unsuitable for animal feed because of the high potential of contamination with meat or dairy products. Businesses with better control on their food organics, such as fruit and vegetable wholesalers, food retailers or food manufacturing and processing businesses, are better positioned to be able to divert food organics for animal feed.

3.3.2.5 Biological Treatments for Food Organics

The biological treatment of food organics involves using microbial activity to decompose organic matter. There are several biological treatment options suitable for food organics sourced from the commercial and industrial sector. The technologies available include utilising on site or centralised processing systems (ROU, 2007b). The treatment of food organics at the source of generation or on-site processing generally consists of 'in-vessel' processing system particularly suited for use in the C&I sector but also involves open aerobic composting or vermicomposting. There are a number of benefits to onsite processing. These include: savings in disposal costs for businesses, reduction of GHG emissions from the reduced transport of food organics, and the production of soil amendments that can be sold (Rynk, 2000; ROU, 2007b). Centralised biological treatment for food organics involves the implementation of a collection program for source-separated food organics from participating businesses by one or more waste contractors. Collected material is then delivered to a centralised enclosed facility for subsequent processing. Centralised collection and processing of commercially-sourced food organics is limited in Australia. The following sections report on the different options available to businesses in the C&I sector to manage food organics.

3.3.2.5.1 Anaerobic Digestion

Anaerobic digestion (AD) involves the composting of organic waste by microbial activity in the absence of oxygen. Such conditions lead to the generation of a biogas made up of around 60 per cent methane. Because the process is completely contained, the biogas produced can be captured and used for electricity, heat generation or as vehicle fuel (Warnken ISE, 2007b). In addition to biogas, anaerobic digestion also produces 'digestate', a mix of solid and liquid residue that is usually composted aerobically to produce soil conditioner products. The more putrescible the feedstock the more biogas will be produced in a shorter time (Friends of the Earth, 2007). As food organics are readily biodegradable in comparison to other organic solid wastes, they only require a short anaerobic digestion time. As a result, food organics can be recycled in smaller-sized digesters, than are required for treating mixed organic wastes, resulting in lower capital costs for new digesters (US EPA and EBMUD, undated). Source separated food organics are an excellent feedstock to increase the generation of biogas at AD facilities and ensure that digestate is uncontaminated for the production of soil conditioners. An example of this type of biological treatment is found in East Bay Municipal Utility District, California, USA where collected food organics from 2,300 restaurants and grocery stores is sent as feed stock to an anaerobic digester. It receives 100 tons of food organics per day, 5 days a week that generates sufficient electricity to power up to 1,400 homes for one year (Cardno and Shuster, 2009; US EPA and EBMUD, undated).

3.3.2.5.2 Aerobic Composting

Composting is gaining increased attention for treating food organics (Cekmecelioglu et al., 2005). Composting includes three different options: windrow composting, vermi-composting and in vessel composting. The composting process involves the decomposition of organic matter by colonies of bacteria in the presence of water and oxygen for a period not less than six weeks and up to six months. The heat generated as a result of the bacterial action in the process kills harmful pathogens and the compost at the end of the process is generally considered microbiologically stable if it has been subject to temperatures > 55°C over a period of at least three consecutive days (Campbell, undated).

i. Windrow composting

Windrow composting is undertaken as a centralised processing of organic wastes rather than used onsite because it requires relatively large space to achieve the required economies of scale and may not be suitable as an on-site system for most of businesses in the C&I sector (ROU, 2007a). Windrow composting involves the least technology of the three aerobic composting options and has lower establishment costs but has higher labour requirements and higher running costs (ROU, 2007a). Indeed, windrows need to be manually or mechanically turned in order to aerate the compost and avoid anaerobic areas to form which can result in methane emissions. Temperature moisture and carbon-to-nitrogen ration also need to be frequently checked to ensure ideal conditions for bacterial activities and aerobic conditions to be maintained (ROU, 2007a). Most material composted through windrow composting consists of green waste. Green waste is needed as a bulking agent and the addition of food organics increases the volume and quality of the end product because of the high moisture and nutrient content (US EPA, 2010). However, given the putrescible nature of food organics, windrows are often odorous and need to be placed on bunded concrete or asphalt pads to ensure leachate control (ROU, 2007a). The composting process using windrows can take up to six months depending on the technology available to aerate and adjust temperature and moisture of windrows. Given the specific requirements of windrow composting, this technology is only suitable as an onsite processing system to the largest types of food organics generating businesses.

ii. In-vessel composting

In-vessel composting is a system that uses enclosed containers and an aeration system to break down the organic matter under the composting process. The major advantage of on-site in-vessel composting over windrow composting is that the temperature and oxygen parameters that effect on the rate of composting can be controlled and optimised to ensure pasteurisation of the final compost and enable the production of compost in a shorter time (3–6 weeks) (ROU,2001). The in-vessel systems also allow for better leachate control than windrow composting. In-vessel composting systems range in their scale of application from onsite systems for small

scale composting systems to system designed for centralised application. On-site in vessel composting system are more space efficient and less labour demanding than on-site windrow composting. The continuous flow systems are particularly suitable for food organic management in businesses such as schools, restaurants, cafeterias and supermarkets (Rynk, 2000; ROU, 2007a). Similarly, to windrow composting, a bulking agent such as garden waste is necessary to maintain aerobic conditions. In-vessel composting requires higher establishment costs.

iii. Vermicomposting

Vermicomposting of food organics involves the use of specific worm species and micro-organism to decompose organic materials under mesophilic (20-45°C) temperatures (ROU; 2007c). In Australia, vermicomposting is mostly used for the processing of biosolids. Vermiculture systems process a much narrower range of food organics than other aerobic composting systems. According to ROU (2007e) fruits and vegetable are the only food organics suitable for vermicomposting and need to be mixed with shredded cardboard that acts as a carbon source and bulking agent (ROU, 2007c). Because vermicomposting is much less effective in excluding insect pests than in-vessel composting system, high levels of management are required to control the composting process but also to sustain worm population (ROU, 2007b). Process time is in the order of four months or longer with the final product having a higher nutrient content than compost produced with windrow composting. Processing time can be reduced to three months if food organics are shredded beforehand. Given the significant labour requirement for management and potential health issues related to vermicomposting, the potential use of this technology within the C&I sector to recover food organics is limited.

3.3.3 Selection of Appropriate Food Organics Diversion Option

In order to select the most suitable food organics diversion option, businesses need to understand the nature, origin and quantity of food organics generated at their premise as well as the waste system regarding the number and size of containers, frequency of collection and cost of garbage removal. To assess the type and quantity of food organics generated businesses should provide their operational staff with extra bins labelled "food waste only" and make sure that, for a couple of weeks, all food organics are separated in order to assess the volume generated. The different types of food organics collected (e.g. cooked/uncooked, meat, vegetable/fruit) and the proportion of each type and the overall volume separated should be recorded on a spreadsheet on a daily basis. At this stage there is also an opportunity to assess staff commitment to separating food organics and the contamination rate of the separated material and provide extra staff education if necessary (ROU, 2009b). Once businesses know the different types and where their food organics originate, they can investigate and assess the implementation of cleaner production measures to avoid their generation. For food organics that cannot be avoided through cleaner production measures businesses should then determine which of the diversion options mentioned earlier in this chapter are the most suitable to them. A pre-selection of potential food organics diversion paths can be undertaken based on the types and quantity of food organics generated. Businesses would then have to consider the costs and benefits of the implementation of the short listed options. Costs to be considered include: major equipment cost for food organics diversion (e.g. on-site processing system); additional equipment cost (e.g. bins, biodegradable bags); site preparation; system maintenance; staff training and labour; and space. In terms of benefit, potential reduced garbage cost is the only benefit that can be easily quantified in dollar terms. However, benefits arising from the diversion of food organics also include: the production of nutrient rich compost, reduced environmental impact and higher social benefit, improved corporate image and increased marketing benefits, and increased employee awareness and satisfaction. Once the different costs and benefits have been identified, managers need to assess

the advantages of implementing alternative food organics diversion options by considering both tangible and intangible whole-of-system costs and benefits.

3.4 Barriers to Food Organics Diversion and Recovery in the C&I Sector

The avoidance and recovery of food organics is limited in the C&I sector. For many businesses, preventing food organics from entering the garbage stream is not a high priority due to the range of barriers they encounter, most importantly the lack of economic incentive and lack of management capacity to separate food organics at source (Biala and Rutherford, 1999; Environment, Planning & Resource Recovery Consulting, 2005; Parsons and Kriwoken, 2009). The following section presents the different barriers encountered in attempting to divert food organics from landfill in the C&I sector.

3.4.1 Increase in Waste Disposal Cost

Recycling – via the local authority or private waste contractor –would generally be implemented by businesses if proved to be either cost-neutral or cost-effective. If businesses have to pay more than they are already paying for their waste collection service in order to divert and recover food organics they will not usually consider it as a viable option (Thomas *et al,* 2007). What will eventually determine if a business undertakes a food organics diversion program is whether the benefits outweigh the costs (ROU, 2007a). Unless businesses operate on-site food organics management, diverting food organics to a centralised organic waste recycling facility requires a separate collection and transportation system that operates in parallel with the business' existing waste management system – which can result in increased waste disposal costs. In Hobart, while the McRobies organic waste recycling facility charges lower disposal fees than the landfill, the cost of a food organics collection service throughout the Council would still be high. This is due to the fact that the establishment of source separate collection systems for food organics – either by the Hobart City Council or a private waste collection operator – requires the provision of new bins and a separate truck for collection. Many businesses in the C&I sector have

fixed waste collection contracts with a monthly charge for their waste disposal, or are charged based on the volume of their container and regardless of the fullness of the containers at the time of collection (Environment, Planning & Resource Recovery Consulting, 2005). This means that, unless the waste collection contractor recommends downsizing the garbage bin capacity, the reduction in garbage disposal due to the separation of food organics would not result in a reduction in the cost of garbage removal. Instead, additional cost for the collection of food organics would incur (Phillips, 2003). It is likely that in some cases waste collection contractors may not recommend a reduction in garbage bin capacity as this would result in loss in revenue for the contractor. As a result of a potential increase in waste disposal cost, the willingness of businesses to participate in a separate food organics collection service is low.

3.4.2 Absence of Services

Most businesses in the C&I sector have their waste collected by private commercial waste collectors. The high competition amongst commercial waste collectors to provide waste removal services to businesses in metropolitan centres is one of the main barriers that prevent the introduction of source separation (Environment, Planning & Resource Recovery Consulting, 2005). As mentioned above, the introduction of a separate collection service for food organics requires the provision of new bins, staff education to introduce the new system and running a separate truck for collection usually increases the service cost to the customer. This constitutes a risk of losing customers as waste collectors compete essentially on the cost of the service delivered. The introduction of a source separate collection service to commercial precincts is also dependent on whether the provision of such service is economically viable. The economic viability of food organics source separate collection service is greatly influenced by the quantity of food organics that can be collected per unit area within a region (Nolan-ITU, 1997; Environment, Planning & Resource Recovery Consulting, 2005). To make the separate collection economically viable waste collection contractors need to be able to collect sufficient quantities of food organics from their customers within a limited geographic area. The introduction of a regular food organics collection service requires the involvement of

the larger commercial food organics generators to ensure the economic viability of the service.

Another obstacle to the introduction of source separate food organics collection is the very high density of food organics (Nolan-ITU, 1997). Waste collection providers generally operate compaction trucks to collect waste, however, for the collection of food organics compaction is not recommended. Because of their high density, compacted food organics may result in truck loads exceeding the legal road limit and compaction may also create a problem with leachate management (Nolan-ITU, 1997). As a result of these potential difficulties, waste collection companies tend to be reluctant to introduce separate food organics collection. At the time this thesis was written there was no food organics collection service operating in Hobart. Except for the food waste collection trial currently undertaken by the Hobart City Council, no research has been conducted to assess the economic viability of introducing a food organics collection service (Holmes, 2010 pers. comm.; Brennan, 2010, pers. comm.). This situation reflects the reluctance of private contractors to establish a separate food organics collection service in the Hobart City Council municipal area.

3.4.3 Lack of Information

According to a waste survey on the Food Service and Retail Industry in a local municipality conducted by the South Sydney Council (1997) food organics are not readily perceived as a resource by businesses and are generally disposed of in landfill (South Sydney Council, cited by Nolan-ITU, 2000b). This misperception of food organics as simply a waste instead of a resource can be a serious impediment to food organics recovery. A study on barriers inhibiting recycling in SMEs in Hobart conducted by Parsons and Kriwoken (2009 p.5) showed that lack of information on the local recycling services was acknowledged by businesses as a critical barrier to recycling. Businesses generally lack information and advice on how and what food organics to recycle, as well as information about the different options – food donation, onsite processing, centralised processing – available to them to recover food organics (Thomas *et al,* 2007). In some cases businesses also ignore the legislation/legal requirements relating to food organics management. For instance,

some businesses are reluctant to donate food to food banks because of the fear that poisoning or death can result from the consumption of donated food with the business being liable. According to Mather *et al.* (2010) this perception is widespread and because businesses are not aware of the Good Samaritan Act which removes potential civil liability from a food donor when the material is donated in good condition and good faith.

3.4.4 Inadequate Storage Space

Diverting food organics for human consumption, animal feed or biological treatment requires businesses to separate food organics and store the material in separate containers before collection. Food donation also requires refrigerating edible surplus food for regular pick-up by charitable organisations. In order to divert and recover food organics, businesses require adequate storage space. Lack of space for storing materials has been identified as a common issue hindering recycling practices across a large range of businesses (Thomas *et* al, 2007; Parsons and Kriwoken, 2009). For businesses willing to divert food organics from landfill, the space available in the waste storage area restricts the size of containers that can be used for food organics separation (Nolan-ITU, 1997). The system for separating food organics at the source aims at maximising the capture rate of food organics while minimising labour and space requirements to avoid interfering with the business activity and ensure business participation. Businesses lacking storage space are therefore unlikely to participate in food organics recovery programs.

3.4.5 Time Restriction and Staffing Issues

Small businesses in the food industry have a limited number of staff. Source separation of food organics for recovery requires the separation of food organics while ensuring that contamination does not occur for the material to be reprocessed. When introducing a new food organics collection system, managers need to provide in-house training and support to ensure that the sorted material is uncontaminated and suitable for reprocessing. Food organics are highly putrescible and can generate odorous leachate, therefore bin hygiene is an issue and containers in which food organics are collected require regular cleaning. The 'cost' in terms of time for sorting food organics material, cleaning containers and providing staff education can be seen

as a burden by understaffed businesses if they cannot see any immediate financial benefits. The high staff turnover in food retailing businesses, accommodation, cafes and restaurants (Nolan-ITU, 2000b) also requires managers to provide a comprehensive and ongoing education program to their staff to encourage the correct practice for food organics separation. Because waste disposal and recycling is usually a minor overall business priority the time required to provide such education to staff can be seen as a burden by business managers.

3.4.6 Lack of Incentive to Separate Food Organics from Other Wastes

There is at present a lack of financial incentive for businesses to separate food organics for recovery. Most organisations only implement a food organics separation scheme if there is a cost benefit or at least no extra cost involved (Nolan-ITU, 2000b). Given the additional labour and space required to sort, transport and store food materials, and the general paucity of financial savings on garbage collection bills, businesses do not generally receive financial reward from participating in food organics separation schemes. This is one of the greatest inhibiting factors to the source separation of food organics. Some businesses also believe that they should be financially rewarded for their effort to separate material that will be used as a resource by other businesses in their production process rather than paying to have it removed. This situation results in a lack of will from businesses to separate food organics for recovery.

The barriers identified above are central reasons for the reluctance on the part of Australian businesses in the C&I sector to embrace food organics recovery. Especially important is a perceived lack of financial incentive to engage food organics diversion. In order to address these problems, many European countries have introduced legislations that require businesses to establish separate collection systems for food organics (European Environment Agency, 2002). The following part of this chapter explores some relevant European legislative frameworks and practices in relation to food organics diversion and recovery in order to identify some best practice examples.

3.5 Best Practice in Europe

The recovery of food organics is most advanced in Europe (Environment, Planning & Resource Recovery Consulting; 2005). The European waste management sector is almost totally regulated by EU Directives. The Directives were introduced to harmonise waste management strategies and practices and national regulations amongst EU members. In 1999 the European Landfill Directive was introduced as a means to regulate and manage a number of issues related to landfill and notably requires the biological treatment of biodegradable wastes – "any waste that is capable of undergoing anaerobic or aerobic decomposition, such as food and garden waste, paper and cardboard, or sewage sludge" (European Environment Agency, 2009 p.14). The Directive sought to reduce methane emissions, minimise the greenhouse impacts of landfills, and prevent adverse effects of landfill waste on the environment. The EU Landfill Directive encouraged the establishment of AWTs to treat biodegradable waste and set targets for a progressive reduction of the amount of biodegradable waste in landfill in the period to 2016. According to the Directive, "member States must reduce the amount of biodegradable municipal waste going to landfill to 35% of 1995 levels by 2016" (European Environment Agency, 2009 p.12). There is, however, no over-riding goal as to reduce the amount of waste going to landfill nor does the Directive stipulate how the targets should be reached. Each European country is free to choose its own approach to meet the target set by the Directive (European Environment Agency, 2009). The revised European Waste Framework Directive, passed in November 2008, is the second key policy that has effect on food organics recovery by requiring EU member States to take measures to separately collect and reprocess bio-waste. This only includes garden/park waste and food and kitchen waste from households and businesses such as restaurants, caterers and retail premises as well as comparable waste from food processing plants.

Specifically, Article 22 of the Waste Management Directive states:

> Member States shall take measures, as appropriate, and in accordance with Articles 4 [the waste hierarchy] and 13 [protection of the environment], to encourage:
> (a) the separate collection of bio-waste with a view to the composting and digestion of bio-waste;
> (b) the treatment of bio-waste in a way that fulfils a high level of environmental protection;
> (c) the use of environmentally safe materials produced from bio-waste.

> The Commission shall carry out an assessment on the management of bio-waste with a view to submitting a proposal if appropriate. The assessment shall examine the opportunity of setting minimum requirements for bio-waste management and quality criteria for compost and digestate from bio-waste, in order to guarantee a high level of protection for human health and the environment. (Directive 2008/98/EC)

Source separation of biodegradable material and the provision of widespread separate collection facilities are the key to achieving high landfill diversion rates and recovery. The different approaches that are taken to encourage the separate collection of biodegradable waste in Europe include a number of different mechanisms: legal obligations that require source separation and separate collection; fiscal instruments such as landfill tax to more accurately reflect the total cost of landfilling; a ban on landfilling of biodegradable waste; and educational campaigns to increase awareness and participation (European Environment Agency, 2002). EU member States commonly implement a combination of instruments to increase the source separation and recovery of biodegradable material. Each country has also established achievable and reasonable targets for source separation and separate collection to ensure the high quality of the recovered material while making sure that viable markets exist for the final compost product.

A landfill tax was introduced in most European countries to promote diversion from landfill via any other option. The tax played a key role in the transition phase to landfill bans and contributed to the compliance and enforcement regimes for these bans across Europe. Municipalities and companies could decide to continue landfilling or restricted waste as long as they acquitted the tax. However, as member States increased their waste tax rate over time, compliance with the landfill bans became a cheaper option. Funding obtained from the landfill tax is generally used to develop alternative waste treatment infrastructure and support environmental projects. In the Spanish region of Catalonia, for instance, revenues from the landfill tax are used to help the development of schemes for separation of bio-wastes at source (European Environment Agency, 2009).

Germany and Norway have both banned the landfilling of biodegradable waste. Since 1 July 2009 Norway introduced a landfill ban prohibiting the landfilling of degradable waste with a total organic carbon > 10 % or organic matter > 20 %. The

strategy on biodegradable waste adopted by Germany focused on recycling paper and bio-waste. It has led to the introduction of a landfill ban for waste with organic content > 3 %. As a result of these bans, very high recycling rates of biodegradable waste have been achieved and Germany has already met the Landfill Directive 2016 target (European Environment Agency, 2009). Denmark introduced a legislation to require businesses generating more than 100 kg of food organics per week to establish a separate collection system for the material to be recovered (European Environment Agency, 2002). Ireland introduced the Waste Management (Food Waste) Regulations 2009 in order to achieve the targets set under the European Landfill Directive and to promote the segregation and recovery of food organics generated in the C&I sector. From 1 July 2010, the Regulations oblige businesses considered as the major sources of food organics (i.e. pubs, nursing homes, restaurants, canteens, hotels, supermarkets) to separate food organics in a special bin and make the segregated material available for separate collection. The regulation also enables businesses to treat the separated material onsite when the capacity exists.

While there has been significant improvement in terms of biodegradable waste diversion in Europe since the introduction of the European Landfill Directive, the directive does not prescribe specific treatment options for the diverted waste. The lack of consistency in the investments and operational behaviour for the treatment of bio-wastes, with member States often inclined to choose the seemingly easiest and cheapest option without regard to actual environmental benefits and costs, has triggered criticisms and discussions on the need for a Bio-waste Directive. Such a Directive was proposed as early as 1999 to provide a legal requirement for separate collection and reach agreement on compost quality criteria for final products (composts and digestates) with a view to fostering an internal market. In July 2010 the European Parliament finally agreed to draft a specific EU legislation to introduce compulsory recycling of bio-waste, including garden waste and food organics from restaurants and food processing units.

3.6 Chapter summary

The market for recycled organics in Australia is in its early stages and while government initiatives and policies have led to an increase in organic waste source separation and recovery, most food organics generated in Australia still end up in landfill. This chapter first reviewed the different impacts of landfilling food organics and the current drivers for the separate collection and recovery of these materials. Trends in food organics generation were reported for different types of businesses followed by a presentation of the different diversion paths available to the C&I sector. The chapter then detailed some of the barriers that inhibit the diversion and recovery of food organics in the C&I sector. The final part of the chapter presented some best practice examples from Europe where directives for biodegradable waste and bio-wastes diversion have facilitated the shift from landfilling food organics to recovery. The following chapter will outline the methodology of the survey and questionnaire component of this study, with the aim of examining the quantity of food organics generated by a sample of businesses in the Hobart City Council and the perceived barriers to the recovery of food organics.

Chapter 4 Methodology

4.1 Introduction

This chapter presents the methodology employed in a food organics waste survey conducted amongst the following businesses within the six ANZSIC divisions in the Hobart City Council: (1) Manufacturing; (2) Wholesale Trade; (3) Retail Trade; (4) Accommodation and Food Services; (5) Education and Training and (6) Health Care and Social Assistance. The aims of the survey were to assess the volumes and types of food organics generated, determine the barriers and opportunities to the diversion of food organics from landfill in the C&I sector in Hobart, assess the current measures undertaken by businesses to avoid and recover food organics, and to determine the willingness of business to recover food organics. The focus of the chapter is on the design and administration of the survey and methodology used to sample these businesses.

The chapter first addresses the survey approach and questionnaire design including the development of the questions and the questionnaire format and layout. The sampling technique that was employed for the survey is then discussed taking into consideration the problems that were encountered in the sample selection. The method used to administer the questionnaire will also be discussed. In June 2010, the researcher undertook a two week professional placement at the HCC in parallel to the thesis and participated in the establishment of a food waste collection trial. The outcomes of the placement and how it informed the research are discussed. Finally, the last section provides the methods used to analyse the data collected during the survey.

This research project involved the participation of human research subjects during interviews and therefore ethical clearance was obtained from the Tasmanian Social Sciences Human Research Ethics Committee (HREC) (University of Tasmania, 2007). As the project aim was to survey and obtain data regarding the generation and management of food organics in businesses, the study presented minimal risk to participants. Before undertaking the administration of the survey in the field a minimal risk application form, containing Information Sheets and Consent Forms

(Appendix A and Appendix B), was submitted to the Committee. Subsequently, University of Tasmania Social Sciences HREC Ethics Approval H11171 was granted for this research project.

4.2 Approach

Survey instruments, commonly consisting of questionnaires, are either self-administered – that is completed by someone with or without assistance – or administered by an interviewer, either face-to-face or via the telephone interview. Survey research involves taking a sample of a population and administering a questionnaire to that sample. Survey questionnaires have a wide variety of applications and can be "used to describe, compare, or explain individual and societal knowledge, feelings, values, preference and behaviour" (Fink, 2006 p.1; Neuman, 2004; de Vaus, 2002). Surveys are generally classified as either quantitative or qualitative (Neuman, 2004; de Vaus, 2002).

This study aims at surveying businesses in food-related industries in Hobart to determine the barriers and opportunities to the diversion of food organics from landfill. The survey aimed to elicit responses from participants as representatives of a particular business. As such both a quantitative and a qualitative approach were assessed as being appropriate. According to Nardi (2006), the advantages of a quantitative approach are that it provides for standardised questions, facilitates generalisations, and is ideal when seeking information on opinions and attitudes. There are also practical advantages to a quantitative approach as it is often less time intensive. Disadvantages to quantitative survey method include the fact that the use of closed-ended questions may be viewed as unimaginative and restrictive, and if the survey questionnaire is self administered without assistance, the respondent can misinterpret questions without opportunity for clarification that may impact on the response rate and the quality of the data collected (Nardi, 2006; de Vaus, 2002).

4.3 Survey Design

4.3.1 Survey Questionnaire

Surveys work by asking participants questions in order to obtain information, therefore good wording of questions and questionnaire design are essential to ensure that information is reliable and able to meet the research objectives. Neuman (2004) and de Vaus (2002) present clear guidelines for the design of survey questionnaires and how to avoid major problems that may affect answers and in turn impact on the quality of the information collected. It is important for a questionnaire to have an organised structure that allows for a logical flow of questions. The questionnaire should also be constructed in a way that minimises participant discomfort. This can be undertaken by sequencing questions from easy, general and concrete at the beginning to more specific, difficult and abstract questions by the end (Neuman, 2004; de Vaus, 2002). While there is no absolute length for a questionnaire (number of pages or administration time), it should be kept relatively short so that it can be administered easily and does not dissuade participation. My questionnaire was developed with these issues in mind. The formulation of questions and topics for investigation emerged from the literature review in relation to food organics recovery.

4.3.2 Survey Questions

Open or closed questions are generally used in survey questionnaires. There is an extensive discussion on the benefits and limitations of both types of format in the literature (Fink, 2006; Nardi, 2006; Neuman, 2004; de Vaus, 2002). Open-ended questions enable participants to freely formulat answers in their own words without limitations to particular response categories. This allows participants to express their opinion in full and favours the collection of detailed answers that were unanticipated. The role of the interviewer is to record the answers. However, open-ended questions can be intimidating for some respondents, because they imply that a respondent should be able to answer in a relatively detailed manner. The use of prompts by the interviewer to obtain an answer from hesitant respondents may unintentionally shape and therefore bias the information obtained (Neuman, 2004). Open-ended questions generally require time, thought and effort to answer. Finally, answers obtained with

open-ended questions are difficult to compare and analyse statistically as they are highly variable and difficult to generalise.

Closed-ended or forced choice questions ask questions and propose a fixed list of answers from which respondents have to select one or more of the answers. This type of question is easier and quicker for the respondent to answer. Answers are also easier to compare and analyse statistically than with open ended questions (Neuman, 2004; de Vaus, 2002). Closed-ended questions can also be easier for people to answer who might be intimidated by the discursive nature of open-ended questions. There are, however, some disadvantages. According to de Vaus (2002) one of the major problems is that on some issues they can create false opinion either by not providing a sufficient range of possible answers from which the respondents will not have the possibility to provide their own answer and opinion. Closed-ended question can also suggest ideas or 'acceptable answers' to the respondent which he or she would not have otherwise had.

Given the nature of the data and the limited availability of businesses to answer this type of survey, it was decided that the use of closed-ended questions was the most suitable. Some questions allowed the respondent to choose options such as 'other' and 'don't know' if the respondent had a different answer than those provided in the questionnaire or did not know how to answer the question. Because of the commercial confidentiality of some information collected, an option for participants to 'refuse' to answer a question was also included. Where it was appropriate, room was allocated for some open-ended responses, in particular to obtain detailed opinions from businesses managers on the main barrier they identify to separate and recover food organics.

Questions were worded according to suggestions by de Vaus (2002 p.164) for good question design: short as possible in length, understandable and not beyond the respondent's capabilities; without any jargon or abbreviations and not worded in a way that would lead the respondent to choose one answer over another as this could provide unreliable data.

4.3.3 Questionnaire Format, Lay-out and Content

The two main factors that were considered in designing the questionnaire for this survey were to ensure that: (1) the survey could be administered as quickly and as accurately as possible to avoid interfering with the activity of the business; and (2) the questionnaire was designed with a logical flow by sequencing the questions from general to specific (de Vaus, 2002). The questionnaire was divided into five sections each with a specific topic. The five sections refer to: (1) Profile of the business; (2) Food organics characterisation; (3) Waste management system; (4) Food organics minimisation and recovery measures; and (5) Willingness to recover food organics. This sequence was thought to flow smoothly with the specificity of the questions gradually increasing as the survey progressed.

4.3.3.1 Questionnaire Section 1

The first section of the questionnaire recorded general information about the business. The information included the number of days per week and hours per day that the business operated, how variable the business activity was over a year and if the business was closed for any length of time. These questions were asked as they may explain differences in food organics generation for similar businesses. Additionally, knowing the variability in business activity is also useful as it may affect the generation of food organics throughout the year. Respondents were also asked to indicate the number of employees (both full and part-time and casual) and provide an estimated level of staff turnover over a year. The number of employees recorded was limited to employees having direct contact with food. For instance in supermarkets the number of staff recorded only included employees working in the fresh product section, delicatessen or at the backroom, cash register operators were not counted. High staff turnover in commercial businesses is responsible for variable success in food organics source separation in the Retail Trade and Accommodation and Food Services sectors (Environment, Planning & Resource Recovery Consulting, 2005).

4.3.3.2 Questionnaire Section 2

The second section records information about the different types of food organics generated by the business and the origin of the material. Respondents were asked to provide an estimate of the proportion of the total food organics generated each type of food organics represents. The different types of food organics proposed were derived from ROU's (2002) definition of food organics (see section 1.4 Definitions). Businesses were also asked whether they knew where did their food organics originate from and in the affirmative to provide what proportion of the overall food organics originate from each source. A better understanding of the different types of food organics and their origin will help the businesses to identify pathways to minimise and/or recover the material.

4.3.3.3 Questionnaire Section 3

The third section was concerned with the waste management practices and existing waste collection systems of businesses. In this section the interviewee was first asked to provide information on the waste storage area. This was intended to assess the accessibility to the area and the possibility to have an additional container for food organics only if it were to participate in a separate food organics collection service. The interviewee was then asked whether food organics was mixed with or separated from other garbage when disposed. Information on separated food organics is collected later in the fourth section of the questionnaire.

The third section also gathered information about the type, number and volume of the different containers used for the disposal of waste in the business, the frequency of waste collection, the fullness of containers when collected and what proportion of the container did food organics represent when collected. These questions were asked to obtain an estimate of the volume of food organics that were disposed by each business.

In the last part of this section, participants were asked to provide the name of their waste collection operator, on what basis the business charged for garbage removal and whether collection fees depend or not on the volume of garbage collected. These questions were asked to assess whether the separation of food organics could

generate savings on waste collection charges that would provide a financial incentive to participate in separate food organics collection service.

4.3.3.4 Questionnaire Section 4

Questions in the fourth section centred on measures undertaken by businesses to avoid the generation and recover food organics. For measures undertaken to recover food organics – such as donation to charity, donation for animal feed, donation to composting facility – respondents were asked to provide the volume of food organics donated per week, whether it is collected or delivered and the frequency of collection/delivery per week. The section additionally asked respondents to provide what motivated the business to avoid the generation and recover food organics. Finally, respondents were asked to provide the main difficulty/barrier to participating in a source separated food organics collection. They were asked to identify and score potential barriers from a list that was synthesised from a literature review on barriers encountered by businesses during food organics collection trials.

4.3.3.5 Questionnaire Section 5

The last section assessed the willingness to recover food organics by using alternative pathways to the disposal in landfill including donation to food charity or participating in a separate food organics collection service for composting. The last section of the questionnaire also assessed businesses' readiness to pay for the provision of a separate food organics collection service. Businesses willing to pay for such service were asked how much they would be ready to pay on top of their current garbage removal charge.

4.3.4 Pretesting the Questionnaire

Once a questionnaire has been developed, it is preferable to pre-test the questionnaire before administration to ensure research objectives are met (de Vaus, 2002). The questionnaire was first pretested informally with the thesis supervisor, Dr Lorne Kriwoken, at the University of Tasmania during initial construction. The purpose of this informal pretesting was to check the clarity and adequacy of the

questions and proposed answers, and assess the efficiency of the questionnaire layout. The suggestions were considered in detail and used to improve the different sections of the questionnaire.

According to de Vaus (2002), pretesting should occur on a group of businesses representative of the intended actual sample. Due to time constraints, the researcher was only able to pre-test the survey questionnaire on a single business. Factors taken into account during pretesting included questions that were misinterpreted by the respondents and questions that the interviewer found difficult to read. Subsequently, modifications were made to improve the clarity of questions and avoid potential misinterpretation and ambiguity. The questionnaire was designed to take around 20-30 minutes to complete.

4.4 Method of Sampling

Survey research is a means to gather and obtain data about a particular population. According to de Vaus (2002), maximum data accuracy can be ensured by surveying the entire population. This situation is ideal and due to various time and monetary constraints may only be practical for small communities. Such an undertaking is almost impossible for large populations (Nardi, 2006). Therefore, researchers generally select a group of people – the survey sample – which exhibits relevant characteristics, attitudes and is expected to provide responses reflective of the wider population (Neuman, 2004; de Vaus, 2002). If the selected sample is representative of the wider population, the statistical analysis of the data obtained from that sample can be generalised and used to draw conclusions for the wider population (Nardi, 2006). The sample selection must be carefully designed to avoid an over or under-representation of segments of the population that can bias the collected information hence limiting the extent to which it can be used to draw conclusions about the wider population (Neuman, 2004; de Vaus, 2002).

According to de Vaus (2002), probability sampling is the best way to ensure that a sample is representative of the population and is generally used in quantitative research. An appropriate approach to obtain a sample that represents the population first involves clearly defining the population, then obtaining an unbiased sample frame from which the sample can be selected using probability sampling methods (de

Vaus, 2002). There are a number of probability sampling methods that can be generally classified as simple random sampling, systematic sampling, stratified sampling and multistage sampling.

Non probability sampling is commonly used in qualitative research (Neuman, 2004). Unlike quantitative research, qualitative research pays less attention to the representativeness of a sample. Instead, qualitative researchers seek appropriate case studies that will provide a better understanding of a specific context (Neuman, 2004). Non probability sampling methodologies include haphazard sampling, quota sampling, purposive sampling, snowball sampling, deviant case sampling and sequential sampling (Neuman, 2004).

The research conducted in this thesis first intended to use a stratified sampling method to ensure the representativeness of the results across the HCC municipality. However, it proved impossible to obtain an accurate survey population from which to draw the survey sample. It was therefore decided to change the focus of the research. Instead of aiming to be representative of the whole HCC area the research focused on being informative and provided a snapshot case study of the volumes and types of food organics generated by different types of businesses. This would also make available indicative information on the opportunities and perceived barriers for the diversion of food organics. To meet these circumstances and the exploratory objectives of the research, a novel sampling strategy was developed. In the language of social science research it is called a 'hybrid quota and purposive non-probabilistic sampling methodology', which will be explained below. The following sections describe the varied methodological problems that were faced and discuss the alternatives that were adopted.

4.4.1 Sampling Technique

This study focused on businesses in food-related industries within six Australian and New Zealand Standard Industrial Classification (ANZSIC) divisions including:

- (1) Manufacturing;
- (2) Wholesale Trade;
- (3) Retail Trade;
- (4) Accommodation and Food Services;
- (5) Education and Training; and
- (6) Health Care and Social Assistance.

These were purposively selected as the businesses within each division were considered amongst the largest food organics generators in urban environments (Nolan-ITU, 2000a). Additionally, the introduction of a regular food organics collection service, such as the one proposed by the HCC Waste Engineering Unit, requires the involvement of large commercial food organics generators to ensure the economic viability of the service. As such, by focusing on these six divisions, the study aimed to provide background information on volumes and types of food organics generated by large commercial food organics generators in the HCC. This information could then be used to assess the feasibility of introducing a separate food organics collection service in the HCC.

The ANZSIC divisions are widely utilised to group businesses into categories that are used as a stratifying variable to create a stratified sample in studies of a similar nature. The ANZSIC divisions are widely utilised to group businesses into categories that are used as a stratifying variable to create a stratified sample in studies of a similar nature. Parsons and Kriwoken (2009) used the ANZSIC codes in a study undertaken on maximising recycling participation amongst SME in Hobart. In the study the ANZSIC codes were used to divide SMEs into 19 categories subdivided into 163 strata specific to the function and waste production of the businesses to allow for stratified sampling of the population. Nolan-ITU (2000b) also adopted the ANZSIC codes to categorise businesses and use the stratified sampling technique in a Market Research Survey on Food Organics Generators. Other researches that used

the ANZSIC codes include Maunsell Pty Ltd and Ratio Consultants (1998) and Nolan-ITU, (1997).

ANZSIC is an industrial classification that groups together businesses with similar production activities. The classification was jointly developed in 1993 by the Australian Bureau of Statistics (ABS) and Statistics New Zealand (Statistics NZ). This was undertaken to facilitate the comparison of industry statistics between the two countries and with the rest of the world (Trewin, 2006). Prior to this there were separate industry classifications: the Australian Standard Industrial Classification (ASIC) and New Zealand Standard Industrial Classification (NZSIC). A review of ANZSIC 1993 began in 2000 and led to the current 2006 edition of ANZSIC. ANZSIC is a hierarchical classification consisting of four levels. The hierarchical structure includes 19 Divisions, 86 Subdivisions, 214 Groups, and 506 Classes. Individual businesses are assigned to an industry division based on their predominant activity (Trewin, 2006) (Figure 4.1).

Figure 4.1: Hierarchical structure of the ANZSIC
Source: Trewin, 2006

Level Example
Division F Wholesale Trade
Subdivision 36 Grocery, Liquor and Tobacco Product Wholesaling
Group 360 Grocery, Liquor and Tobacco Product Wholesaling
Class 3605 Fruit and Vegetable Wholesaling

The original intention was to obtain a list of all businesses within the HCC municipality with their assigned ANZSIC codes. That list was expected to provide the survey population from which the survey sample was to be derived using the stratified sampling technique with the ANZSIC code assigned to each business utilised as the stratifying variable. The stratified sampling technique involves choosing a stratifying variable and dividing the sampling frame into strata according to the stratifying variable. The stratified sample then allows the correct proportion of each strata to be systematically selected to ensure representativeness (Neuman, 2004; de Vaus, 2002).

To obtain a list of all businesses in the HCC area the researcher contacted a number of different regulators, consultants, and academics that could supply such a list including: Hobart City Council, Tasmanian Chamber of Commerce and Industry (TCCI), a marketing consulting company Enterprise Marketing and Research Services, and academics from the Australian Innovation Centre, University of Tasmania. Due to concerns over commercial in-confidence they would not supply a list of businesses for the purposes of this research. Veolia, the largest private waste collection operator that provides waste collection service to businesses in the HCC municipality, was asked if a list of client businesses could be accessed. It was thought that by contacting the different private waste operators and obtaining client business lists from them, a list of all businesses in the HCC could be reassembled. Veolia, however, also argued that a list of client businesses could not be provided to the researcher due to commercial in-confidence considerations.

In the absence of a list of all businesses in the HCC it was not possible to pursue the aim of undertaking a representative survey, using stratified sampling, of the businesses. Given that very little research in the field of food organics has been conducted, it was agreed that the project could be profitably modified and developed as an exploratory and explanatory study based on contextualised case studies. Therefore, instead of aiming to be representative of the whole HCC, the project was modified into an information-gathering study. Such a study would obtain data on the volumes and types of food organics generated by different types of businesses in food related industries and provide indicative information on the perceived barriers and opportunities for food organics diversion from landfill. To meet the exploratory research objectives a mixed quantitative and qualitative survey method was adopted.

The HCC and Andrew Grant from Food Recyclers, a South Australian company, were then consulted to discuss this alternative approach. From these conversations it was decided that the research should continue with the strategy of focusing on the ANZSIC divisions but instead of surveying all business types the selection of businesses to be surveyed would be refined to provide informative data on the main food organics generators in the HCC municipality. A total of eight ANZSIC classes or business types were purposively selected across the six ANZSIC divisions. It was then decided that a quota of five businesses per class would be selected for inclusion

in the survey so that the research would provide a larger spectrum of responses on food organics handling practices from businesses of the same type. Table 4.1 provides the different ANZSIC classes and a description of the business types that were included in the sample. It was agreed with the HCC that a larger quota of 10 businesses for the ANZSIC class of supermarkets and grocery stores would be selected (5 supermarkets - 5 grocery stores) as they are the larger food organics generators (Nolan-ITU, 2000a).

This sampling approach was developed in conjunction with a review of relevant social science methodology literature. The novel approach adopted could be termed a hybrid quota and purposive non-probabilistic sampling technique. The quota sampling technique involves the identification of relevant business categories and the selection of a fixed number of businesses to survey in each category (Neuman, 2004). Purposive sampling is generally used in exploratory or field research and involves the purposive selection of different types of cases that will provide informative data to the researcher. The purpose of selecting different types of cases is to gain a better and deeper understanding of the different types rather than providing a generalisation of the larger population (Neuman, 2004). While this technique does not ensure representativeness of the results, it can provide critical information that can be used with other sources of information to identify broad and indicative trends.

4.4.2 Sample Selection

The Electronic Yellow Pages were used as a sampling frame to select businesses. While the Yellow Pages exclude businesses that choose not to advertise in this manner this was not considered to be a problem in this exploratory research since it does not seek to draw a representative sample. Table 4.1 provides the different search words that were used to select businesses from the Electronic Yellow Pages.

Table 4.1: Industry Classification and Number of Businesses Included in the Survey Sample

ANZSIC DIVISIONS	ANZSIC CLASSES	DESCRIPTION OF SELECTED BUSINESS TYPES	SEARCH WORD USED IN THE ELECTRONIC YELLOW PAGE	NUMBER OF BUSINESSES INCLUDED IN THE SAMPLE
Manufacturing	C1140	Fruit and Vegetable Processing	Food Products--Manufacturers & Processors	1
Wholesale Trade	F3605	Fruit and Vegetable Wholesaling	Fruit & Vegetables—Wholesale	5
Retail Trade	G4110	Supermarket and Grocery Stores	Supermarkets & grocery stores	10
Accommodation and Food Services	H4400	Hotels	hotels-accommodation	5
	H4511	Restaurants	Restaurants	5
Education and Training	P	Education and Training (School Canteen)	School; Education	5
Health Care and Social Assistance	Q8401	Hospitals (public and private, excludes Psychiatric Hospitals)	Hospital—public; Hospital—private	3
	Q8601	Aged Care Residential Services	Aged care nursing homes	2
			TOTAL	36

Less than five businesses were included in the sample for the ANZSIC classes of Hospital, Aged Care Residential Services and Fruit and Vegetable Processing. This is due to the fact that it was not possible to find five businesses in the HCC area for the ANZSIC classes of Hospitals and Fruit and Vegetable Processing. For convenience Hospital and Aged Care Residential Services were considered as a single ANZSIC class (Nolan-ITU, 2000a) and five businesses were included in the sample.

Businesses were contacted by telephone to inform them about the nature of the survey and provide an opportunity to participate. Businesses were contacted between 9-11am and 2-4pm and were asked whether they would be willing to participate in a food wastage survey. To address concerns over confidentiality all businesses were informed that the information gathered would remain confidential and that no business name would be identified. To provide an incentive for participation the researcher also proposed to each business the conduct of a cost-benefit analysis for the participation in a separate food organics based on the waste volumes and cost of waste collection data collected during the survey. If businesses agreed to participate

in the survey, the business manager/owner, or in some cases the chef in charge of the kitchen, were asked to provide the researcher with an appointment to make sure that the interview would not interfere with their activity and that the respondent would have adequate time to answer the survey. The researcher continued calling businesses until the quota of businesses for each ANZSIC class was reached. A significant proportion of the businesses contacted refused to participate in the survey with only 20 interviews granted out of the 126 businesses contacted.

Given the difficulties faced to obtain sufficient businesses to participate and since some businesses respond more readily to a survey conducted by a government agency than by a university (National Academy of Science, cited by Groves *et al.*, 2004) it was decided that asking the HCC for assistance was an appropriate option to increase the number of businesses participating in the survey. The HCC Waste Engineering Unit agreed to write a letter of support to assist in obtaining businesses to participate in the survey. The support letter is provided in Appendix C. Instead of contacting businesses over the phone to obtain survey participants the researcher then approached businesses with the letter of support from the Hobart City Council however no additional survey participants could be obtained.

Contacts with the Eenee design company, currently establishing a separate food organics collection service in Hobart, enabled the obtaining of three additional survey participants (a hospital, an aged care nursing home and a restaurant) however the quota of 36 businesses to be surveyed could not be met.

Table 4.2: Proportion of business contacted that granted interview

ANZSIC codes and description	Quota of businesses to be surveyed	Number of businesses contacted	Number of interviews granted	Participation Rate
C1140 Fruit and Vegetable Processing	1	1	1	100%
F3605 Fruit and Vegetable Wholesaling	5	5	1	20%
H4400 Accommodation (Hotels)	5	40	3	8%
H4511 Restaurants	5	25	5	20%
P Education and Training	5	15	3	20%
Q8401 Hospitals (Except Psychiatric Hospitals) Q8601 Aged Care Residential Services	5	5	2	40%
G4110 Supermarket and Grocery Stores	10	35	8	23%
TOTALS	**36**	**126**	**23**	**18%**

4.5 Survey Administration

4.5.1 Administration Method

The three main methods used to administer survey questionnaires consist of face-to-face interviews, telephone interviews and mail-based questionnaires (Neuman, 2004). There is, however, no established best method as each has strengths and weaknesses. Instead, the choice of the method depends on several factors including: the nature of the survey (type of questions, length), the nature and size of the sample, time and cost constraints and the importance of response rates (de Vaus, 2002). According to Nardi (2006), Neuman (2004) and de Vaus (2002) the effectiveness of the method employed to administer a survey is often measured by response rates.

The survey was administered as a face-to-face interview. This was preferred over other methods due to the fact that it has the highest response rate and is more adapted to conducting surveys with long questionnaires (Neuman, 2004, de Vaus, 2002). Additionally, while more costly and time consuming, face-to-face interviews allow the interviewer to visually observe the arrangement of waste storage areas, measure the volume of containers and assess the way businesses handle food organics. This

survey administration method was previously used for research in the field (Parsons and Kriwoken, (2009), Nolan-ITU (2000b), Maunsell Pty Ltd and Ratio Consultants, (1998); Nolan-ITU, (1997)) and was strongly recommended by HCC and Andrew Grant.

4.5.2 Conduct of the Survey

The survey interviews were conducted in July and August 2010. This period was considered to be the most suitable as business activity during winter was the lowest and they were most likely to have time to participate. All interviews were recorded on a Dictaphone with the agreement of the interviewees for future reference and the use of quotes regarding perceived barriers.

4.6 Food Waste Collection Trial in the Hobart City Council

In parallel to the thesis, the researcher spent two weeks within the Waste Engineering Unit at HCC participating in a food waste collection trial previously mentioned in section 2.4. This was undertaken as part of the Master of Applied Science unit *KGA513: Professional Placement* that requires students to undertake a placement of at least 80 hours in an organisation. During the placement, the researcher positioned himself as a '*participant-as-observer*' (Gold, 1958 cited by Hay, 2000). In order to obtain detailed and accurate information, participant observation requires extended period of time (Hay, 2000). While this is largely accepted for the observation of individuals or communities, the length of the placement (two weeks) was deemed to be sufficient to inform the research, allow familiarisation with the activities and practices of the Waste Engineering Unit through involvement and observation, and gain an understanding on how to operate a separate food organics collection service and deal with businesses. During the placement, the researcher was asked to survey the businesses involved in the trial in order to assess the motivation behind their participation. The researcher also participated in the onsite collection of the separated food material to first assess the satisfaction of business with the service and equipment provided and to assess the contamination level of the collected material.

Overall, the professional placement provided the researcher with a better understanding of the different aspects of providing a food organics collection service and the difficulties encountered when working with businesses.

4.7 Data Analysis

Following the completion of each interview results were entered electronically into the Excel software package and analysed using the statistical functions. In a similar manner to Nolan-ITU (2000b), four broad groups of businesses were used to examine the results of the survey. These groups were established assuming that businesses within each had similar characteristics in relation to food organics generation (Nolan-ITU, 2000a). Table 4.3 describes the composition of each group.

Table 4.3: Businesses grouped according to their waste characteristics
Adapted from Nolan-ITU (2000b)

Group	ANZSIC Group Divisions Description	ANZSIC Classes and Description	Waste Characteristics	Degree of Source Separation Required for Food Organics	Number of Businesses Included in the Sample
1	Manufacturing and Wholesale Trade	C1140 Fruit and Vegetable Processing F3605 Fruit and Vegetable Wholesaling	Food manufacturer/ processor and wholesalers have a good control of their waste streams since they generate only few types of materials	Low	2
2	Accommodation and Food Services	H4400 Hotel H4511 Restaurants	Food organics produced in these organisation consists of both pre and post-consumer food organics that are disposed with other materials	High	8
3	Education and Health Institution	P Education and Training Q84 Hospitals Q8601 Aged Care Residential Services	These organisations use large kitchen and generate high volume of food organics. Once the food has left the kitchen it is generally taken to bedrooms for hospital/aged care nursing home or to playground for schools Increased scope for on-site management of food organics than other groups	Medium	5
4	Food Retailing	G4110 Supermarket and Grocery Stores	Food retailers generate waste streams including both perishable foods and non perishable foods	Medium	8
				TOTAL	**23**

4.8 Chapter Summary

This chapter examined various techniques in survey research and presented the methodology that was employed to administer a questionnaire to businesses in food-related industries in Hobart in order to assess volumes and types of food organics generated and the perceived barriers to the diversion of food organics from landfill. The chapter considered questionnaire design and administration, sample selection and data analysis. Methodological problems were faced during the research that led to a change in focus from the research aiming to be representative of the whole HCC area to the research being developed as an informative study. The different methodological problems encountered were reported and the change in focus for the research was explained. The following chapter presents the results of the survey.

Chapter 5 Results

5.1 Introduction

This research aimed to examine perceived barriers and opportunities for food organics minimisation, recovery and reprocessing. This was undertaken by surveying 23 businesses purposively selected across 6 ANZSIC divisions in the Hobart City Council municipality. Particular attention was paid to the different barriers perceived by businesses and their willingness to participate in a separate food organics collection program. The results from the survey are presented in this chapter in the same order as set out in the questionnaire. The results are expressed primarily through the use of tables and graphs generated using the Excel software. The survey results were analysed and interpreted both as a total for all four business groups and where appropriate for each individual group (i.e. Accommodation and Food Services, Manufacturing and Wholesale Trade; Food Retailing and Education and Health Institution). This allowed the identification of specific trends within business groups and separate types of businesses. The chapter first presents the profiles of businesses within each business group followed by food organics characterisation and generation, waste management systems, food organics minimisation measures and willingness to recover food organics.

5.2 Business Profile

5.2.1 Seasonal Variation in the Level of Activity

Businesses were asked to provide general information about when they were open and the variability in business activity throughout the year. This allows an assessment of temporal differences in business activity that are likely to affect the generation of food organics.

5.2.1.1 Accommodation and Food Services

Businesses in the Accommodation and Food Services group were generally open an average of 14 hours per day 7 days per week. Two restaurants located within the University of Tasmania were open 9 hours per day 5 days per week. Most businesses reported moderate variability in business activity (i.e. between 10% and 50%) indicating summer as the highest season and winter the lowest. None of the hotels closed down during the year. Restaurants closed down for an average period of 18 days. The two restaurants at the University of Tasmania closed for 3 weeks and 8 weeks. All the other restaurants closed for 2 days per year. Figure 5.1 displays the seasonal variation of business activity for the Accommodation and Food Services business group.

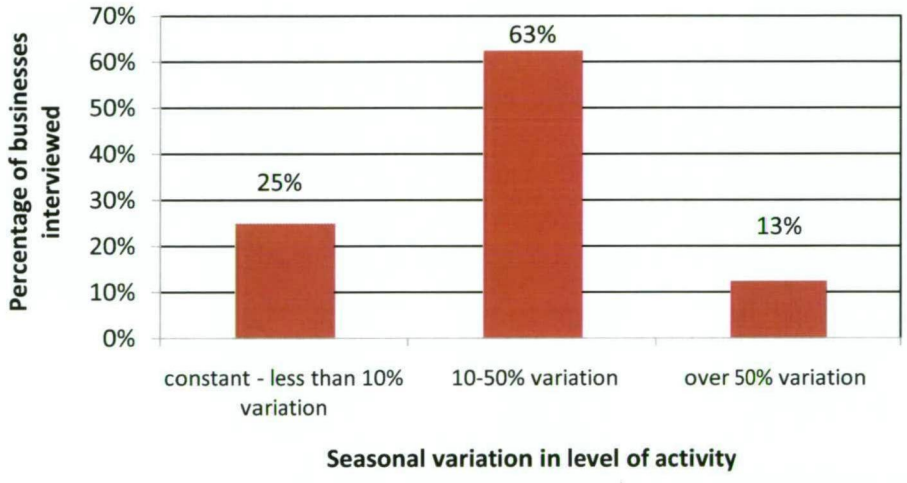


Figure 5.1: Seasonal variation of business activity in the Accommodation and Food Services group

5.2.1.2 Vegetable Processing and Fruit and Vegetable Wholesale Trade

Two businesses indicated they were open 12 hours per day, 7 days per week. Variation in business activity throughout the year was reported to be moderate (25%) with activity the highest in summer and the lowest in winter. The two businesses closed down 2 days per year.

5.2.1.3 Food Retailing

Businesses were biased towards the larger sized supermarkets and grocery stores because the two largest supermarket chains agreed to participate in the survey. Every business operated 7 days a week with the larger sized supermarkets open 17 hours a day. Other businesses were open on average 13 hours a day. Sixty three of the businesses described their activity as constant, with less than 10% variation over the year with activity peaks for Christmas and Easter. The remaining 37% businesses indicated low to moderate variation in activity, on average 20%, with higher activity in summer and lower activity in winter. All businesses within the group closed down 2 days per year. Food organics generation remains relatively constant for the food retailing business group. Figure 5.2 displays the seasonal variation of business activity for the Food Retailing.

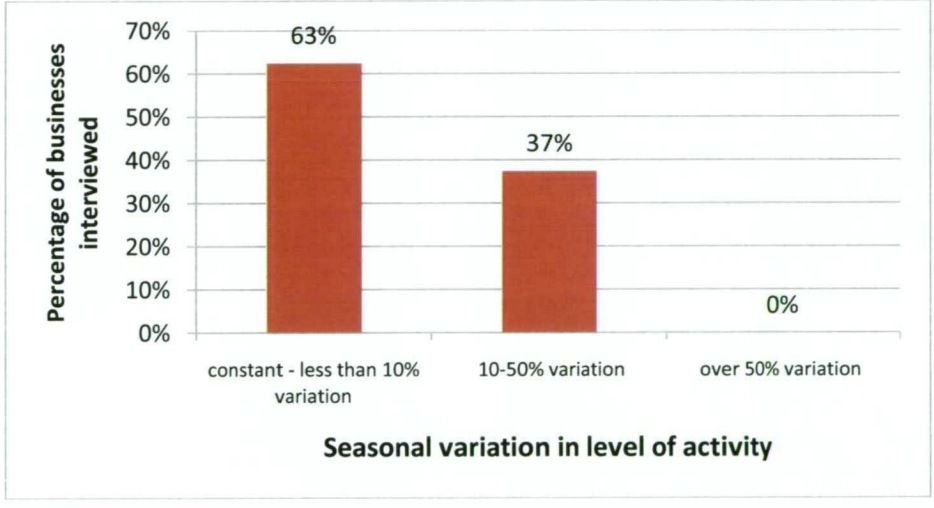


Figure 5.2: Seasonal variation of business activity for businesses in the Food Retailing group

5.2.1.4 Education and Health Institutions

The school canteens were open on average 7 hours per day, 5 days per week. Catering services within health institutions operated 7 day per week, 14 hours per day. Discounting the 15 weeks per year school vacation period, the level of catering activity from all the Education and Health Institutions catering services was reported as constant throughout the year. Figure 5.3 displays the seasonal variation of activity for businesses for Education and Health Institutions.

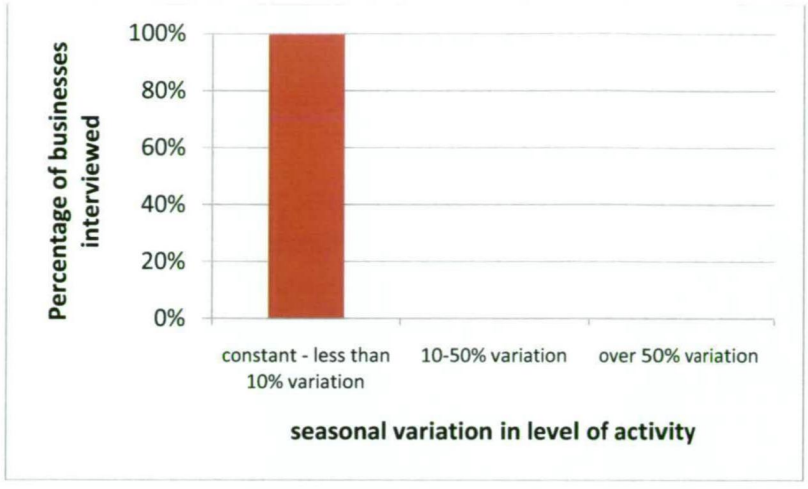


Figure 5.3: Seasonal variation of business activity for catering services in the Education and Health Institutions group

5.2.2 Staff Numbers and Turnover

Businesses were asked to provide an estimate of staff turnover over a year. High staff turnover in commercial businesses impacts the rate of success in food organics source separation.

5.2.2.1 Accommodation and Food Services

There was considerable variation in the number of employees; one restaurant employed two staff, while an inner-city hotel employed 100 staff. The average number of employees was 18. Forty-two per cent of employees were engaged on a casual basis, compared to 30% full time and 20% part time. Despite this, businesses reported moderate staff turnover with 75% of participants indicating that less than one in four staff would be replaced every year. Figure 5.4 displays the estimated level of staff turnover in the Accommodation and Food Services business group.

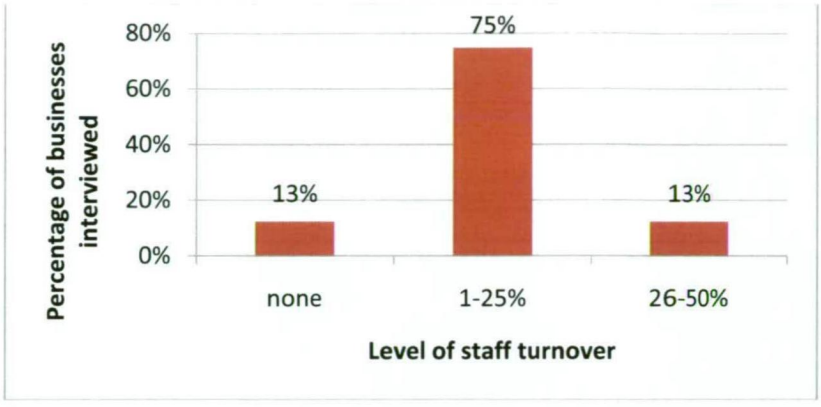


Figure 5.4: Level of staff turnover over a year for businesses in Accommodation and Food Services group

5.2.2.2 Vegetable Processing and Fruit and Vegetable Wholesale Trade

Businesses employed an average of 18 staff. Over 50% of the staff was engaged on a casual basis, compared to 38% full time and 12% part time. Business owners estimated yearly staff turnover at around 10%.

5.2.2.3 Food Retailing

The number of employees per business varied significantly depending on the nature of the business. There was an average of 31 employees per business. Thirty-two per cent of employees in this group were engaged on a casual basis compared to 32% part time and 36% full time. Despite this, staff turnover was relatively low with 75% of the businesses indicating a yearly staff rotation of about 10%. Figure 5.5 displays the estimated level of staff turnover for the Food Retailing business group.

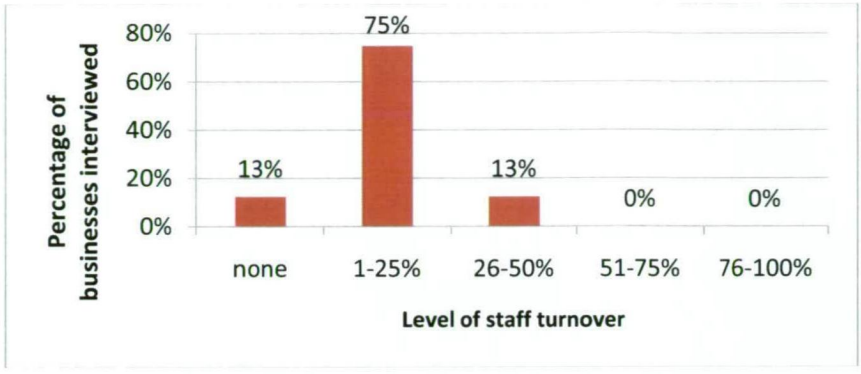


Figure 5.5: Level of staff turnover over a year for businesses in the Food Retailing group

5.2.2.4 Education and Health Institutions

Health institutions employed a higher number of staff in the catering services than schools. School canteens had an average of 2 employees compared to 85 for health institutions with a peak of 152 catering service employees reported for the hospital. The reason is that health institutions serve up to 4 meals per day while school canteens mostly offer one meal per day. For the group as a whole, 54% of staff working in catering services are employed full time and the remaining 46% are engaged on a part time basis. Staff turnover was low. Sixty per cent of the institutions reported no staff turnover and only the two health institution food service businesses indicated that one in ten staff would have to be replaced each year. Figure 5.6 displays the estimated level of staff turnover in the Education and Health Institutions business group

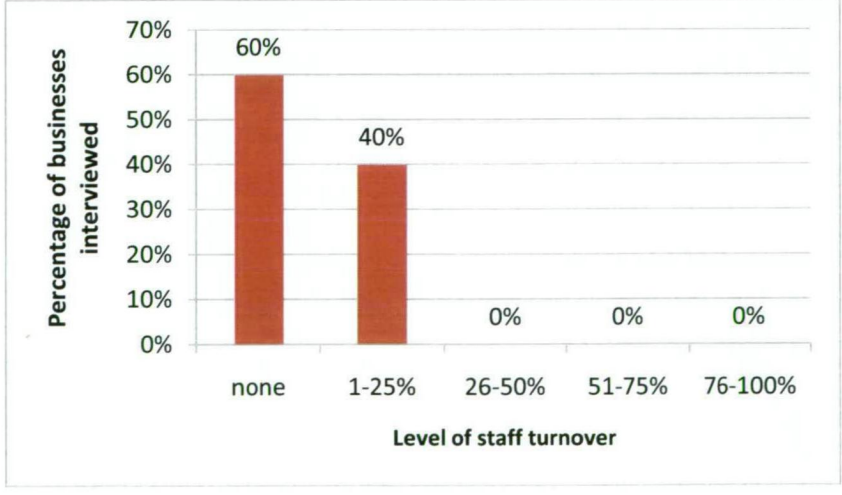


Figure 5.6: Level of staff turnover over a year for Businesses in Education and Health Institutions

5.2.3 Summary Business Profile

The survey results for the profile of businesses are summarised in Table 5.1 to facilitate comparisons between the four business groups.

Table 5.1: Profile of businesses surveyed

	Accommodation, and Food Services (Restaurants and Hotels)	**Manufacturing and Wholesaling** (Fruit and vegetables processing and wholesaling)	**Food Retailing** (Supermarkets and grocery stores)	**Education and Health Institutions** (School Canteens, Hospitals and Aged care nursing homes)
Employee number	Highly variable depending on the business type and size. 50% of businesses employed less than 20 staff.	Businesses employed an average of 18 staff.	Variable. Large chain supermarkets employed 55 staff compared to an average of 18 for smaller grocery stores.	Highly variable depending on the institution type and size. The number of catering service staff are higher in health institutions compared to schools.
Staff turnover	High	Low	Moderate	Low
Proportion of casual staff	High	High	High	Low
Seasonal variability in business activity	Moderate. 10-50% variability in business activity. Higher business activity in summer and lower in winter.	Relatively constant	Relatively constant. Higher business activity in summer and lower in winter Peaks in activity over Christmas and Easter.	Constant. (Not considering the 15 weeks school holiday period).

5.3 Food Organics Characterisation

In order to identify pathways to minimise and/or recover food organics an understanding of the origin and types of food organics generated by the businesses is required. Participants were asked to indicate the different types and proportions of food organics generated. The origin of food organics was sought. Fruit and Vegetables food organics represented the main type of food organics generated across the four business groups. However, the source of food organics varies significantly between business groups as well as between business types within the same group.

5.3.1 Types of Food Organics Generated

Fruit and vegetables are the main food organics generated by businesses representing on average 66% of the overall food organics generated across all businesses (Figure 5.7).

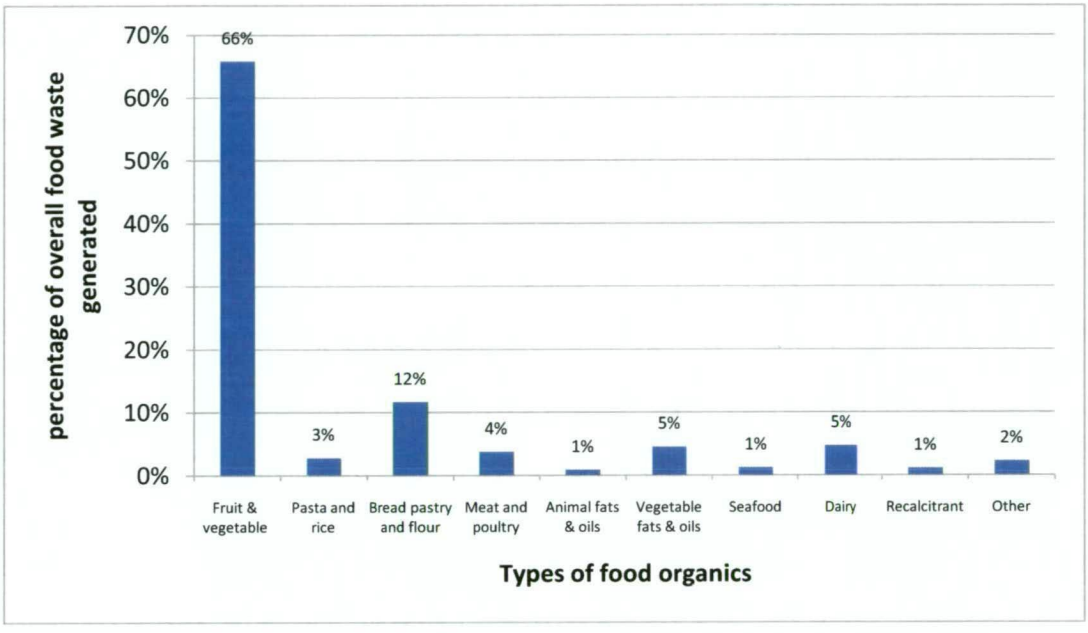


Figure 5.7: Type and proportion of food organics generated across all businesses

Fruit and vegetables make up 100% of food organics generated by fruit and vegetables processors and wholesalers. The proportion of fruit and vegetables was the lowest for Supermarkets, representing 45% of food organics generated. Bread and pastry is the second largest food organics produced representing 12% of all food organics generated across businesses. Hotels generated the largest proportion of bread and pastry waste accounting for 23% of all food organics generated. Breakfast is often served as a buffet which and this generates higher bread wastage. Figures 5.7.1 to 5.7.3 display the types and proportion of food organics generated for each business group and business type within each group.

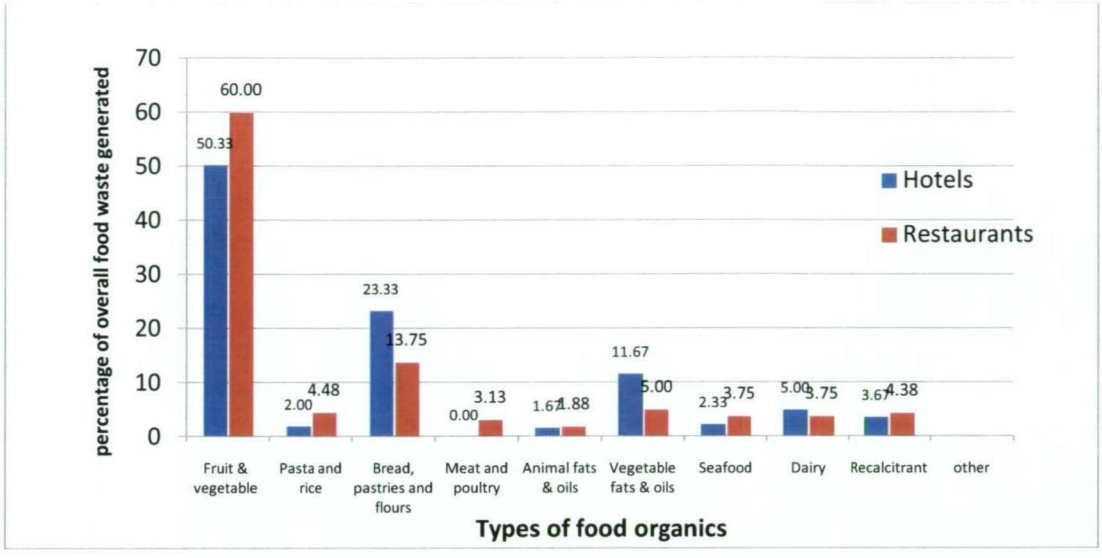


Figure 5.7.1: Types and proportion of food organics generated by businesses in the Accommodation and Food Services business group

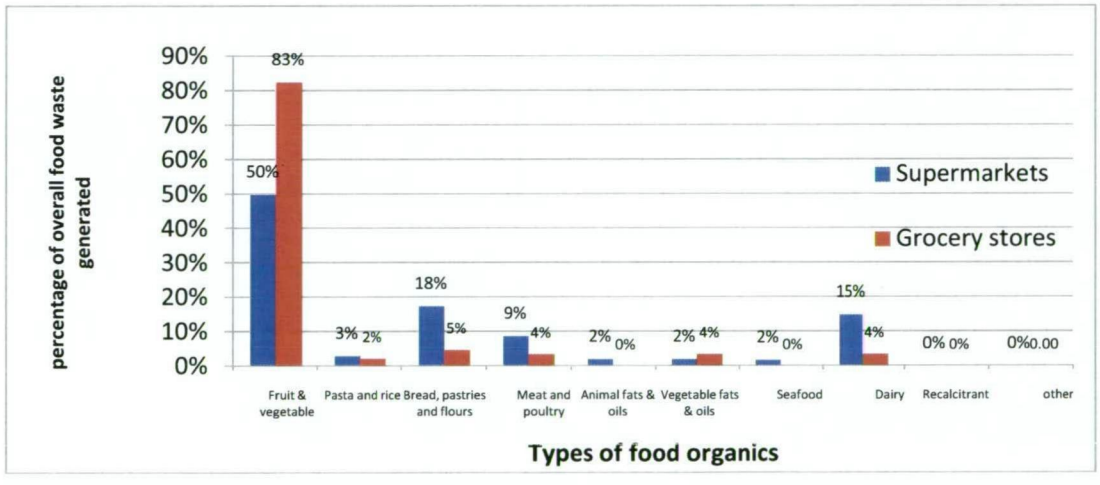


Figure 5.7.2: Types and proportion of food organics generated by businesses in the Food Retailing business group

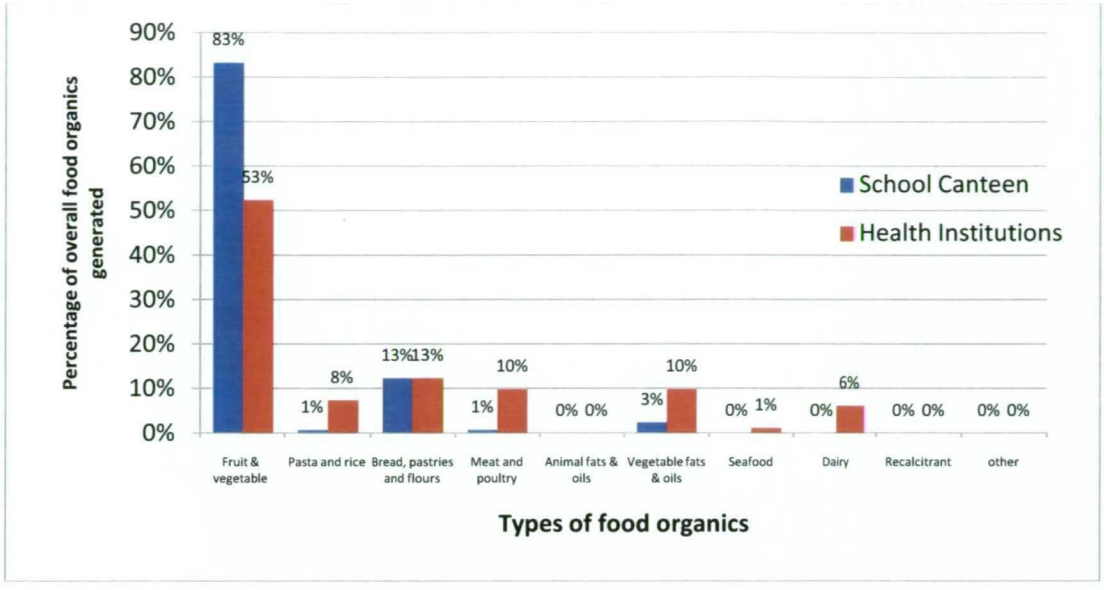


Figure 5.7.3: Types and proportion of food organics generated by businesses in the Education and Health Institutions business group

5.3.2 Origin of Food Organics

When asked about the origin of their food organics, all businesses responded that they *did* know the source of the food material. However, businesses experienced difficulties when asked to specify the different sources of food organics and what proportion of their overall food organics originated from each source. The main source of food organics differed significantly across the four business groups as well as businesses types within each group.

In Accommodation and Food Services Hotels reported that most food organics (52%) were generated in their kitchens during food preparation. Restaurants reported that 58% of food organics consisted of food scraps from the plates of customers. Hotels often operate high quality restaurants and prepare large amounts of fresh food on site. Additionally, one of the chefs indicated that the more expensive the menu, the fewer food scraps return to the kitchen. Figure 5.8 displays the origin of food organics for Accommodation and Food Services.

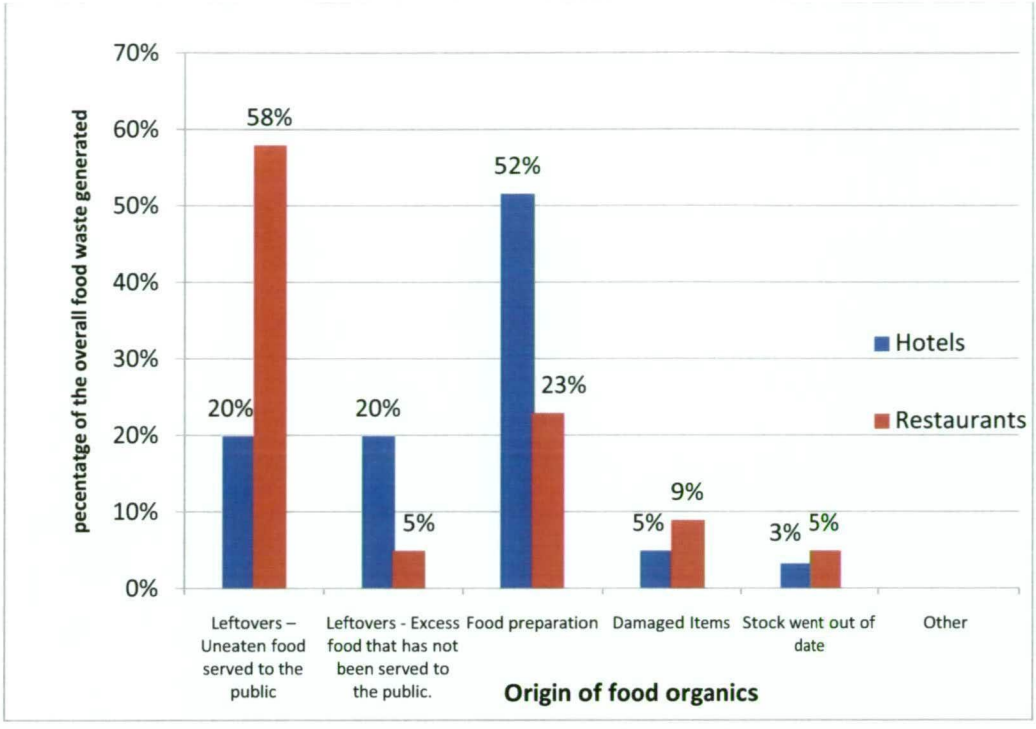


Figure 5.8: Source and proportion of food organics generated by source in Accommodation and Food Services

Food organics generated in Manufacturing and Wholesaling originate from food preparation or damaged products. The Fruit and Vegetables Processor generated 100% of its food organics during food preparation. Comparatively, all food organics generated by the Fruit and Vegetables Wholesaler consisted of damaged products.

In Food Retailing, 45% of the food organics generated by Grocery Stores originated from food preparation, compared with 10% for supermarkets. Supermarkets indicated that damaged items represent the largest source of food organics waste and account for one third of all the food organics generated. Figure 5.9 displays the origin of food organics for Food Retailing.

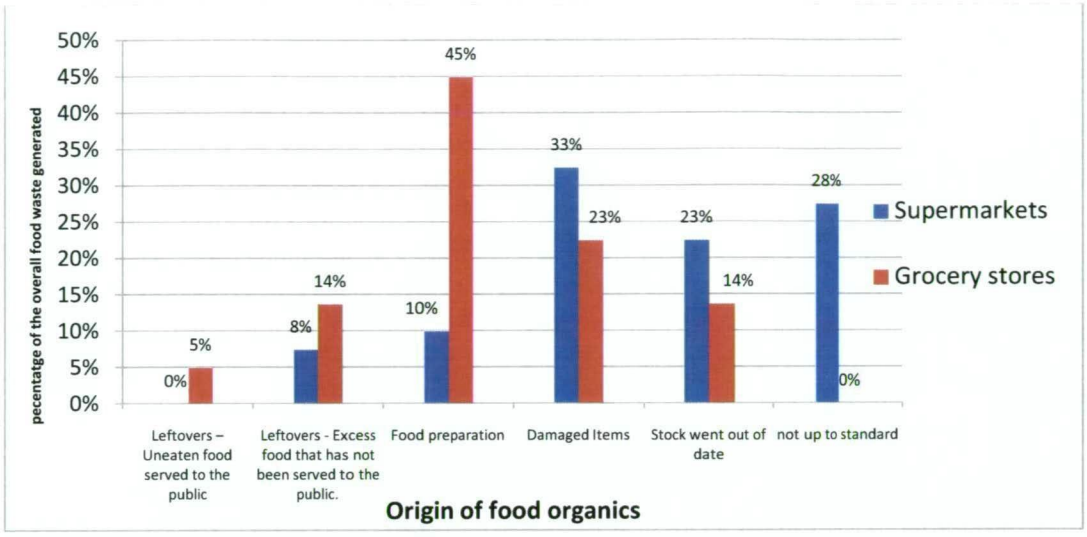


Figure 5.9: Source and proportion of food organics generated by source in Food Retailing

In Education and Health Institutions the main source of food organics for Health institutions is food scraps from patients (70%). In School Canteens the majority of food organics is generated during food preparation (65%). Figure 5.10 displays the origin of food organics for Education and Health Institutions.

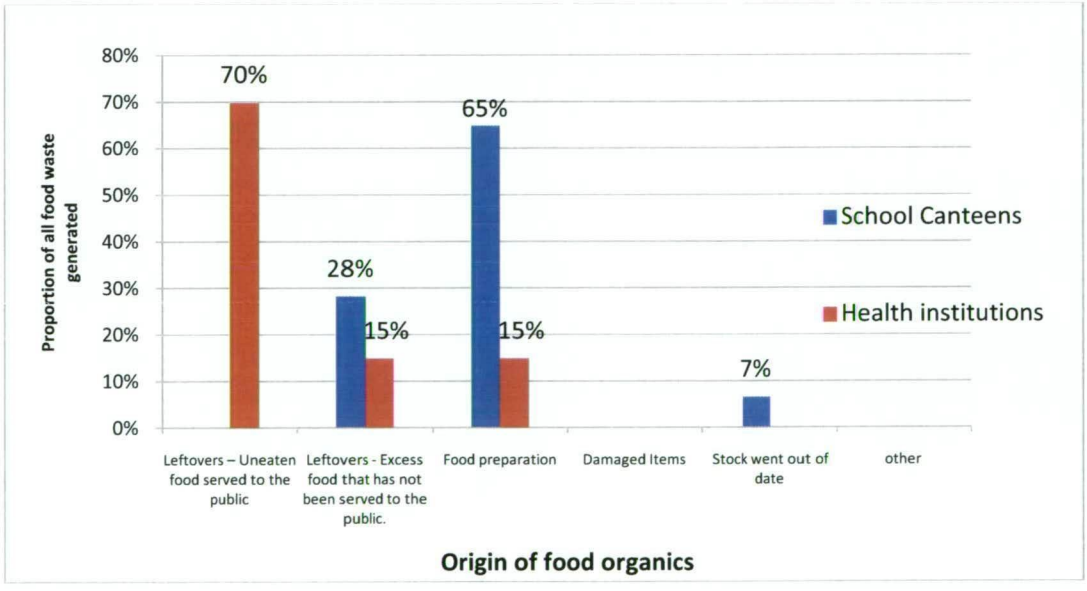


Figure 5.10: Source and proportion of food organics generated by source in Education and Health Institutions

5.4 Waste Management System

5.4.1 Storage Space

A lack of appropriate storage space can represent a significant barrier for businesses assessing whether or not to participate in a separate food organics collection service. This is largely due to the need for separate containers to segregate this material. However, 91% (21 out of 23) of the businesses indicated that their waste storage area was suitable, in terms of size and access, and that they had more waste storage space available for an additional container. Of these 21 businesses, 57% indicated that additional space for a food organics container was available outdoors, and the other 43% had indoor space available. All businesses with additional waste storage space agreed that they could store an additional 240L wheelie bin for food organics separation. Two businesses – a school canteen and a restaurant –indicated they could not easily accommodate an additional waste storage bin. These respondents highlighted issues associated with inadequate size and restricted access with their existing waste storage area.

5.4.2 Storage Containers, Collection Frequency and Volume of Food Organics Generated

In order to assess the volume of food organics generated, businesses were first asked whether their food organics were mixed with other garbage prior to disposal. Three businesses – the hospital and the two businesses in Manufacturing and Wholesaling – reported that all food organics generated were disposed separately from garbage. The hospital indicated that food organics generated onsite was disposed directly to the sewer after it was macerated.. Food organics generated by Manufacturer and Wholesaler were all donated for animal feed. Alternative methods used by businesses for the disposal of food organics and volumes of diverted food organics are further described in chapter 5.5.

Apart from these three businesses, 20 others responded that food organics generated were mixed with other garbage prior to disposal. Businesses were questioned on the type and quantity of containers used to dispose of food organics with garbage. Mobile garbage bins (240L) were the most commonly used waste

storage container and were mainly used at grocery stores and restaurants. Metal skip bins were also widely used across businesses to dispose of food organics that were mixed with garbage, especially in Hotels, Supermarkets and Health Institutions. Figure 5.11 displays the different types of container used by all businesses.

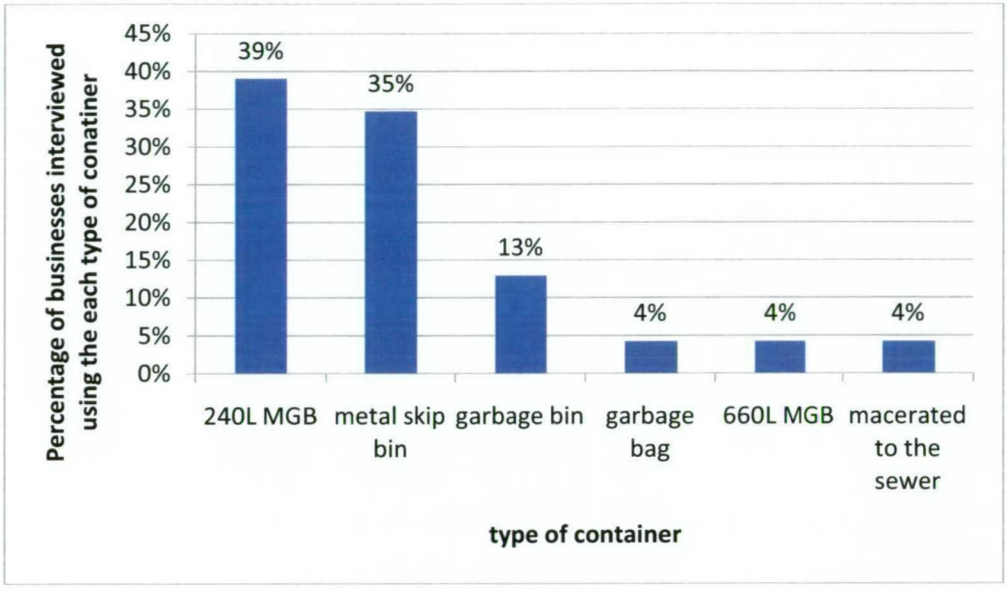


Figure 5.11: Different types of containers used by businesses and proportion of businesses using them

The average volume of container available for garbage disposal was estimated at 2.28m³ across all businesses. Collection frequency also varied between business groups. On average businesses had garbage collected 3.4 times per week. Daily garbage collection was the highest for Supermarkets and Restaurant. Hotels had the lowest garbage collection frequency with two weekly pick- ups.

A total volume of 82.63m³ of food organics was generated weekly across all businesses, 69% of that was directed to landfill and the remaining 31% recovered. Businesses within the Manufacturing and wholesaling sector reported the highest food organics recovery rate with all the material generated being recovered. Almost 31% of food organics generated by food retailing businesses were recovered. The Accommodation and Food Services and Education and Health Institutions business groups reported the lowest food organics recovery rate with 0.07% and 0.23% respectively. Table 5.2 and Figure 5.12 show the volumes of food organics generated and the food organics disposal methods employed across all businesses and for each business group.

Table 5.2: Weekly volumes of food organics produced across the four business groups

Business group	Weekly volume of food organics generated		Weekly volume of food organics disposed to landfill			Weekly volume of food organics recovered		
	Volume (m^3)	Proportion of overall food organics generated	Volume (m^3)	% of the food organics from the business group disposed to landfill	% of the overall food organics disposed to landfill	Volume (m^3)	% of the food organics from business group recovered	% of the overall food organics recovered
Accommodation and food service	7.24	8.77%	7.24	99.93%	12.68%	0.005	0.07%	0.02%
Manufacturing and Wholesaling	14.01	16.96%	0	0.00%	0.00%	14.01	100.00%	54.92%
Education and Health Institutions	24.25	29.35%	24.19	99.77%	42.36%	0.055	0.23%	0.22%
Food Retailing	37.12	44.92%	25.68	69.18%	44.96%	11.44	30.82%	44.85%
Total	**82.63**		**57.12**		**69.13%**	**25.51**		**30.87%**

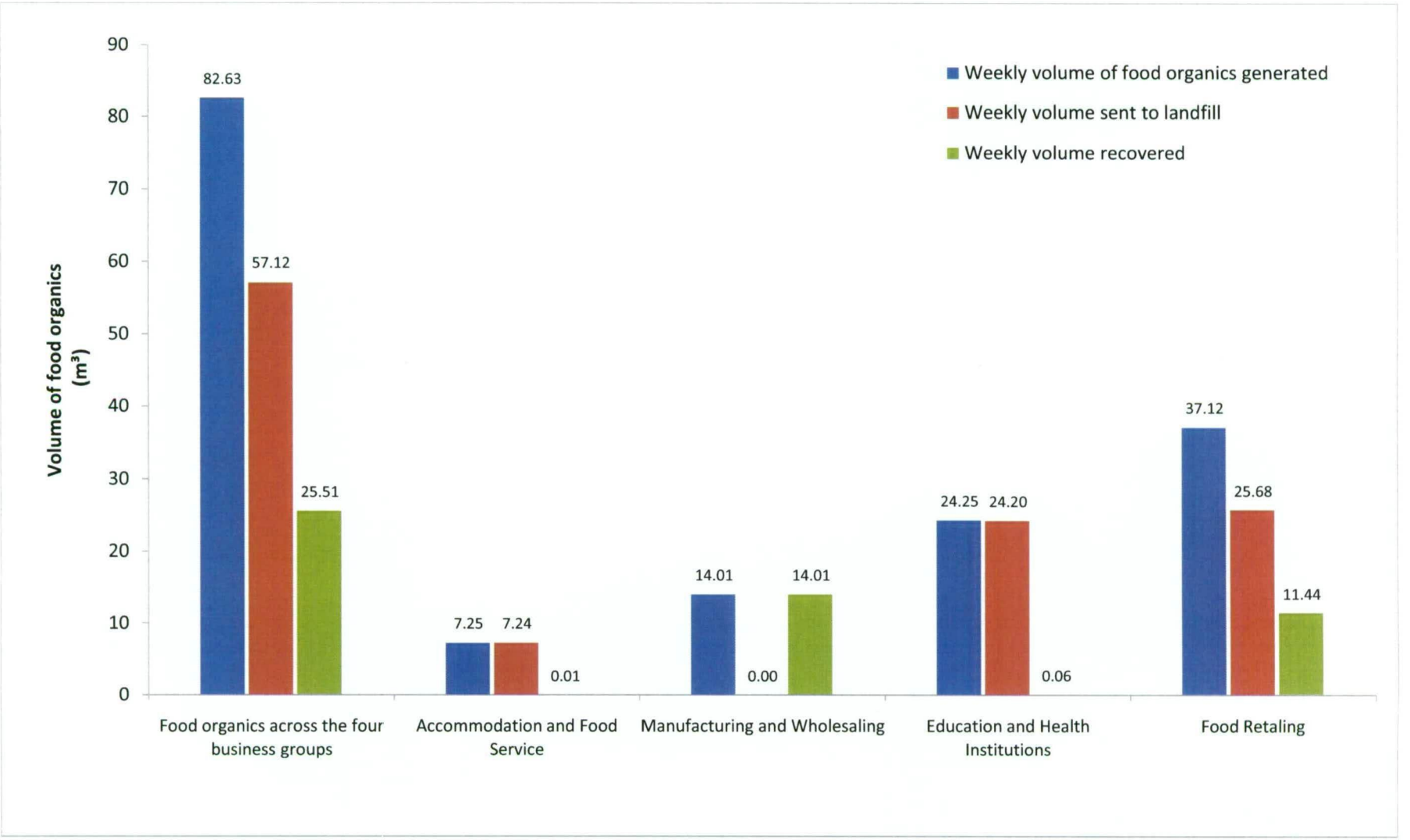


Figure 5.12: Weekly volume of food organics disposed to landfill and recovered for each business group

Eighty seven per cent of businesses indicated the use of a private company for garbage removal and the remaining 13% had garbage collected by the Hobart City Council waste management service. Businesses were charged either by individual collection (55%) or on a fixed monthly fee (41%) for garbage collection. All businesses reported they were charged regardless of the volume of garbage generated.

5.5 Food Organics Minimisation Measures

The management of food organics was assessed for the four business groups by examining the implementation of cleaner production measures to avoid food organics generation. This also included determining whether businesses participated in any form of onsite food organics management or source-separated food organics collection service. Measures to avoid the generation of food organics were clearly the most widely implemented. All businesses undertook cleaner production measures while participation in food organics recovery and reprocessing was reported by under half of the survey participants.

5.5.1 Cleaner Production Measures Implemented for Food Organics Avoidance

For many businesses that generate food organic waste the implementation of cleaner production measures can minimise the amount of wastes generated. It can also provide benefits for the environment, the profile and marketing of the business, and for the profit of the business. To assess the implementation of cleaner production measures, participants were provided with a list of measures adapted from Nolan-ITU (2000c) and asked to indicate which they have implemented. Measures included the reuse of leftovers, matching food supply with demand, buying material in bulk or concentrated forms, purchasing pre-prepared food, ensuring good stock rotation, and discounting damaged items or products as they reach their use by date.

All participants reported the implementation of measures to avoid the generation of food organics. The most common measure undertaken, and implemented by all businesses, involved ensuring good stock rotation of food products. The second most common cleaner production measure, implemented by 86% of businesses, involved the matching of food supply and procurement with projected demand. Figure 5.13 displays the measures implemented across the businesses.

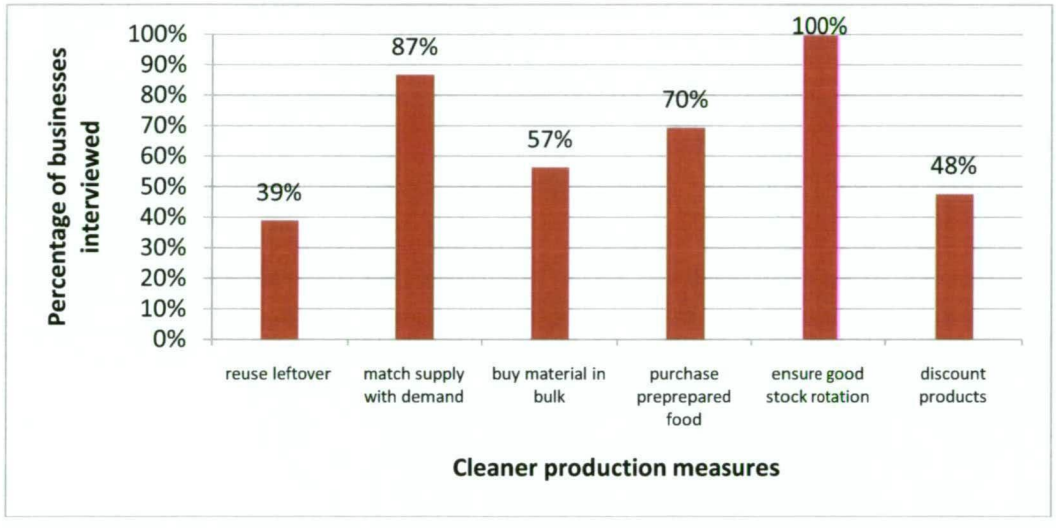


Figure 5.13: Cleaner production measures undertaken by businesses to avoid food organics generation

All measures reported were not, however, applicable to all four business groups. The reuse of leftovers was mainly implemented in the Accommodation and Food Services group with all businesses indicating that they reused unserved food and food trimmings for the preparation of new meals. Discounting of unsold products or products approaching their use by date was implemented by all businesses in the Food Retailing group and School Canteens. Figures 5.13.1 to 5.13.3 display the cleaner production measures implemented for each business group.

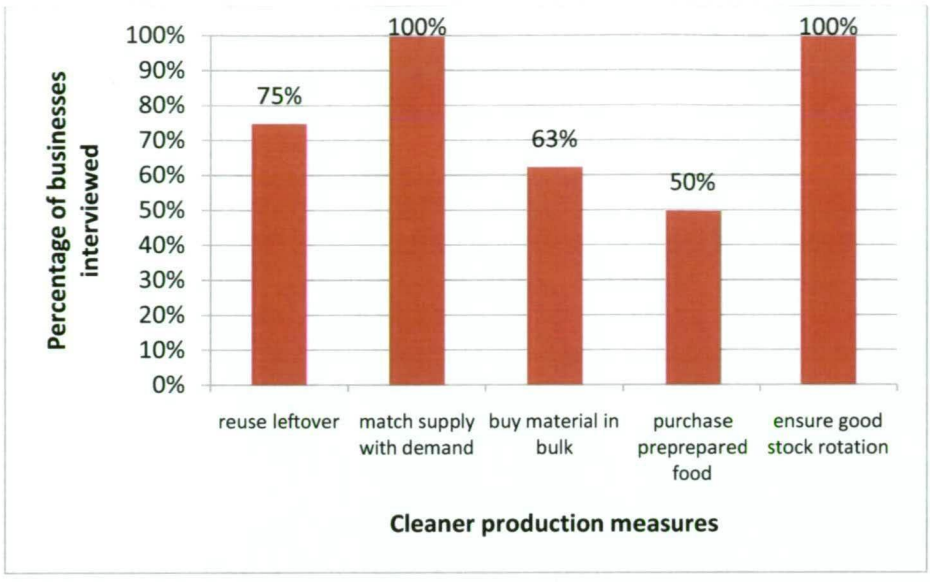


Figure 5.13.1: Cleaner production measures undertaken the Accommodation and Food Services business group to avoid food organics generation

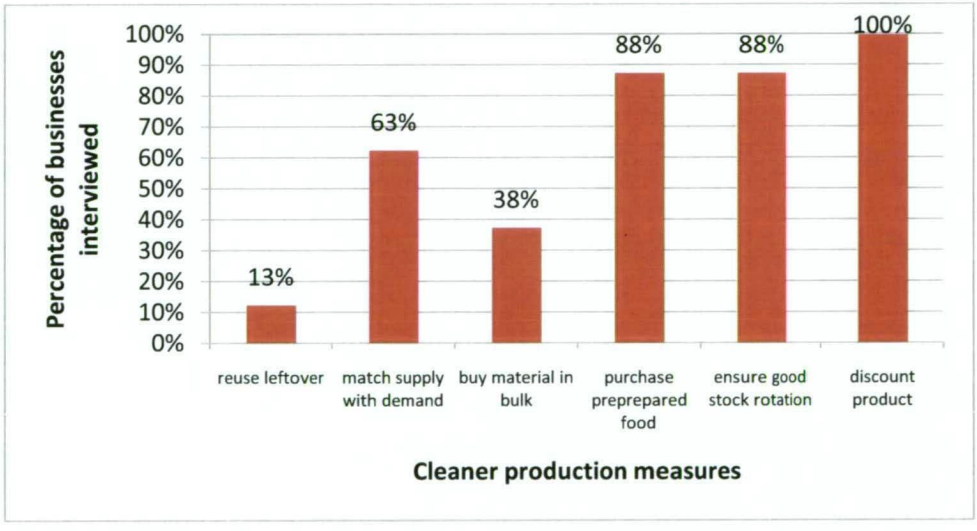


Figure 5.13.2: Cleaner production measures undertaken by the Food Retailing business group to avoid food organics generation

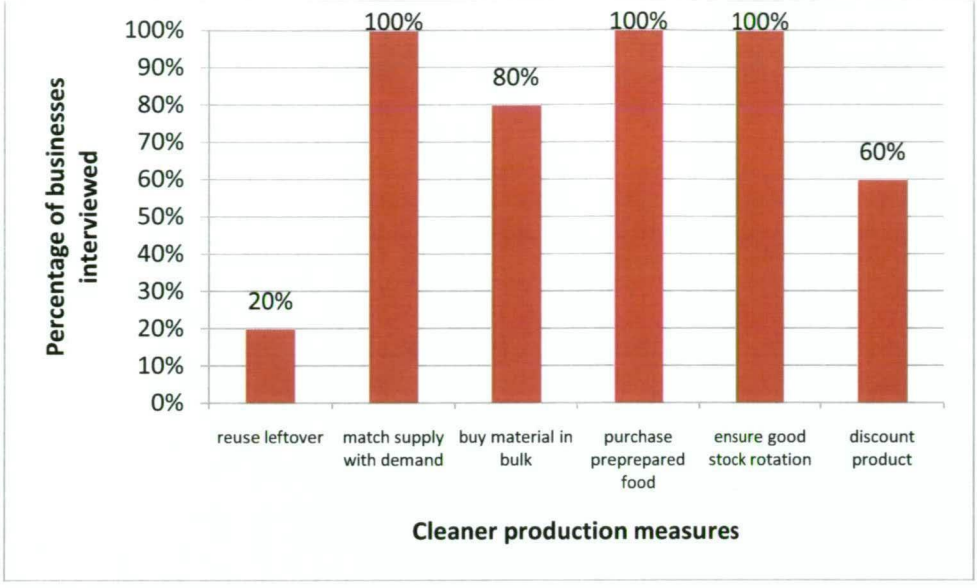


Figure 5.13.3: Cleaner production measures undertaken by the Education and Health Institution business group to avoid food organics generation

5.5.2 Measures for the Recovery and Reprocessing of Food Organics

Businesses were provided with a list of measures for the recovery and reprocessing of food organics and were asked to indicate which measures they implemented. Measures included donation to food banks, donation to animal feed producers, donation for animal feed, onsite composting, separation of food organics for home composting and provision of food organics to a composting facility.

Compared to cleaner production measures, only 48% reported the implementation of measures for the recovery and reprocessing of food organics. The two main measures implemented across all four business groups included the donation of food organics for animal feed and to charity. The total volume of food organics diverted from landfill through the implementation of these measures was estimated to be 25.51m^3 per week across the four business groups. Ninety-eight per cent was donated for animal feed and 2% was donated to charity. Figure 5.14 displays the recovery and reprocessing measures implemented across the four business groups.

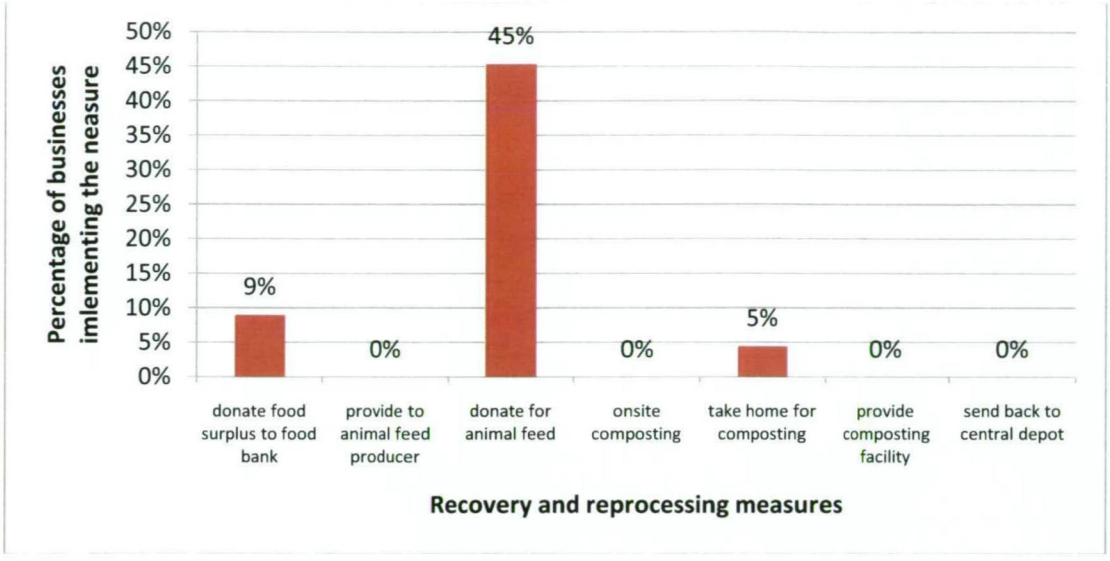


Figure 5.14: Food organics recovery and reprocessing measures implemented across the four business groups

5.5.2.1 Donation for Animal Feed

Ninety per cent of the businesses that recover and recycle food organics reported donating food organics for animal feed. The vast majority of food organics separated for animal feed was sent to pig farms. Donation as animal feed for pig farms was mainly undertaken by the Manufacturing and Wholesaling (100%) and Food Retailing (75%) business groups. Two of the school canteens reported the donation of minimal volumes of food organics backyard chickens. Fruit and Vegetable Manufacturers and Wholesalers donated all of their food organics for animal feed. The material donated to farmers was limited to fruit and vegetables food organics since the feeding of swill to pigs is illegal in Tasmania. One supermarket reported the donation of mixed fruit and vegetables and bakery products to pig farms. Those businesses donating animal feed reported they had been contacted by pig farmers trying to source animal feed and agreed for food organics to be collected free of charge. Large chain supermarkets indicated that they had contracts with farmers to cover the donation of food organics, while for other businesses their arrangements with farmers were more informal.

Manufacturers, Wholesalers and the large supermarkets used cardboard tri-wall bins ranging in size from 0.8-1.2m^3 to separate food organics for animal feed.

Smaller grocery stores used 80L garbage bins. Businesses indicated that on average farmers collected the material 3 times per week. The total volume of food organics donated for animal feed on a weekly basis was estimated at 25m^3 of which 56% came from Manufacturers and Wholesaler, 43.7% from Supermarkets and Grocery stores and 0.3% from School Canteens.

5.5.2.2 Donation to Charity Organisation

Only two businesses reported donating surplus food organics to charitable organisations. A large chain supermarket reported donating 480L per week, while a fruit and vegetable wholesaler donated 10L per week. Donated material from the supermarket included bread, fresh produce and damaged shelves items that were still suitable for consumption, while the wholesaler only donated fruit and vegetable material. Surplus food was donated to charitable organisations including Second Bites from the supermarket and the Tasmanian Cancer Council from the wholesaler.

5.5.3 Motivation behind Implementing Food Organics Minimisation and Diversion Measures

Participants were asked to identify the factors that encourage minimisation and recovery of food organics. The reasons included the avoidance of lost revenue, reduction in the volume of garbage disposed, reduction in waste disposal costs, benefits to the environment, head office corporate policy and helping communities in need. The overarching reason – reported by all survey participants – for why businesses had implemented food organics minimisation and recovery and reprocessing measures was related to the avoidance of lost revenue. Seventy per cent of businesses also reported the environmental benefit of minimising and recycling food organics as a motivator. Sixty five per cent indicated that waste minimisation was part of their head office corporate policy and as such food organics was to be minimised. Figure 5.15 lists the percentage of the businesses that responded in the affirmative for each of the motivational factors.

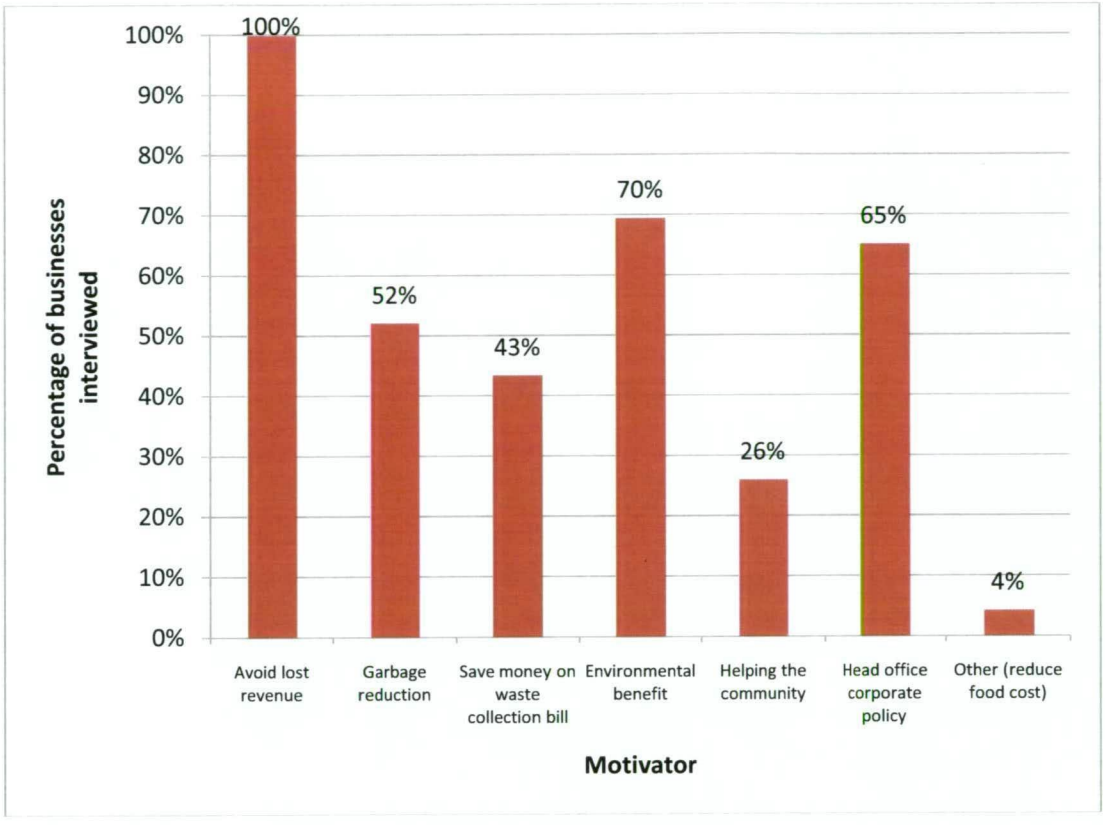


Figure 5.15: Motivator for businesses across the four business groups to implement food organics avoidance and recovery and reprocessing measures

Factors that motivate businesses to minimise and recover food organics were examined for each group separately. Figures 5.15.1 to 5.15.3 display the results for each business group.

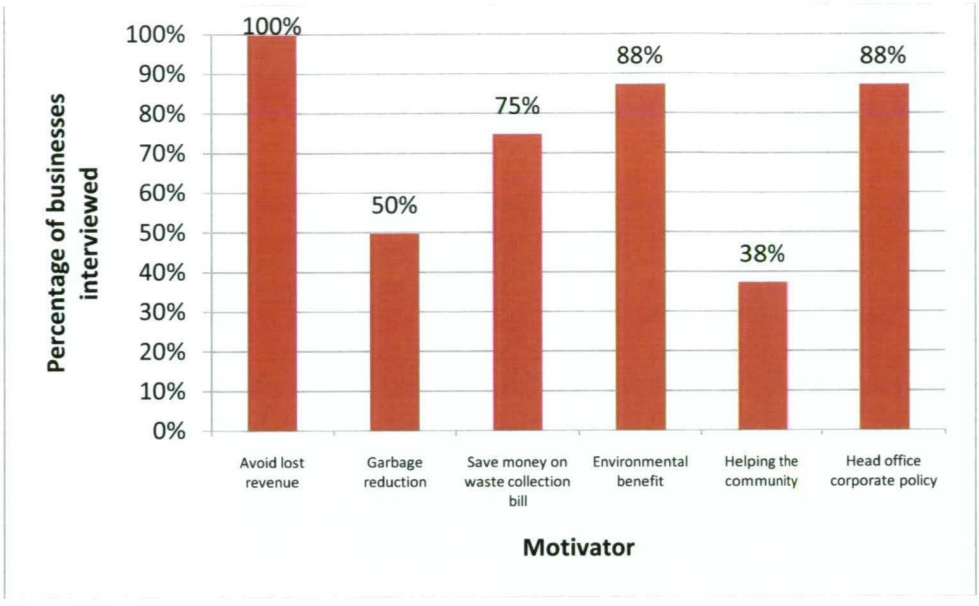


Figure 5.15.1: Motivator for businesses in the Food Retailing group to implement food organics avoidance and recovery and reprocessing measures

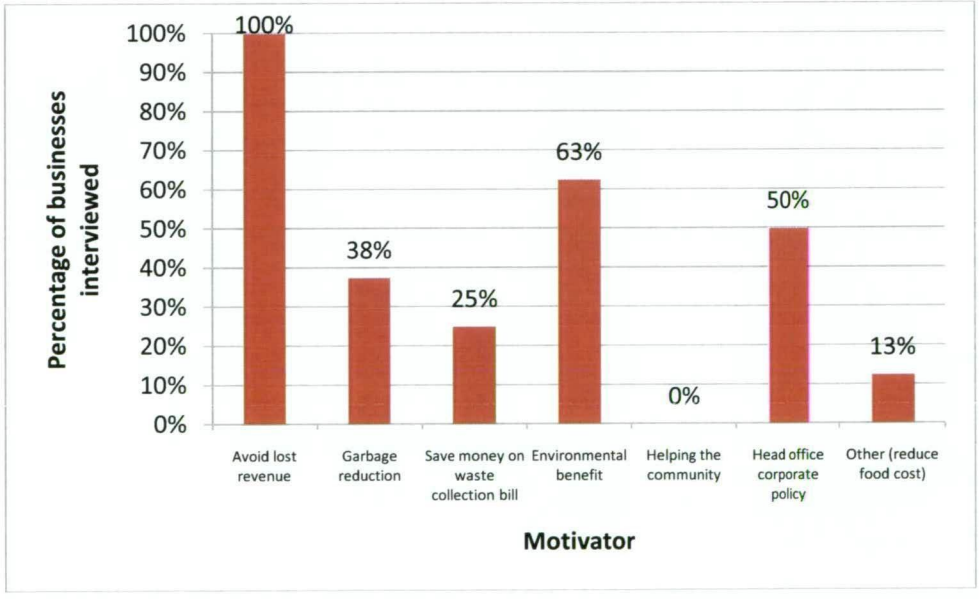


Figure 5.15.2: Motivator for businesses in the Accommodation and Food Services business group to implement food organics avoidance and recovery and reprocessing measures

5.5.4 Perceived Barriers and Difficulties to Food Organics Source Separation

In order to assess the perceived barriers or difficulties to food organics separation for recovery and reprocessing, businesses were provided with a list of barriers. This list was synthesised from a literature review on barriers encountered by businesses during food organics collection trials. Businesses were asked to score each perceived barrier from the list, depending on whether it presented no difficulty (1) or a significant difficulty (5). The barriers included the non availability of a food collection service, lack of information on available services, the cost of a food organics collection service, lack of financial incentive, lack of support from staff, lack of staff time to sort the material, staff education on contaminants, lack of space in food preparation area, lack of storage space in waste storage area, poor collection vehicle access, and health and safety concerns.

The three most significant barriers to participating in a food organics collection service include: the perceived additional cost; the absence of a food organics collection service in Hobart; and the lack of financial incentives. Businesses also reported the frequency of food organics collection as an additional potential barrier to undertake food organics separation. Figure 5.16 shows the weight attributed to each barrier across the four business groups.

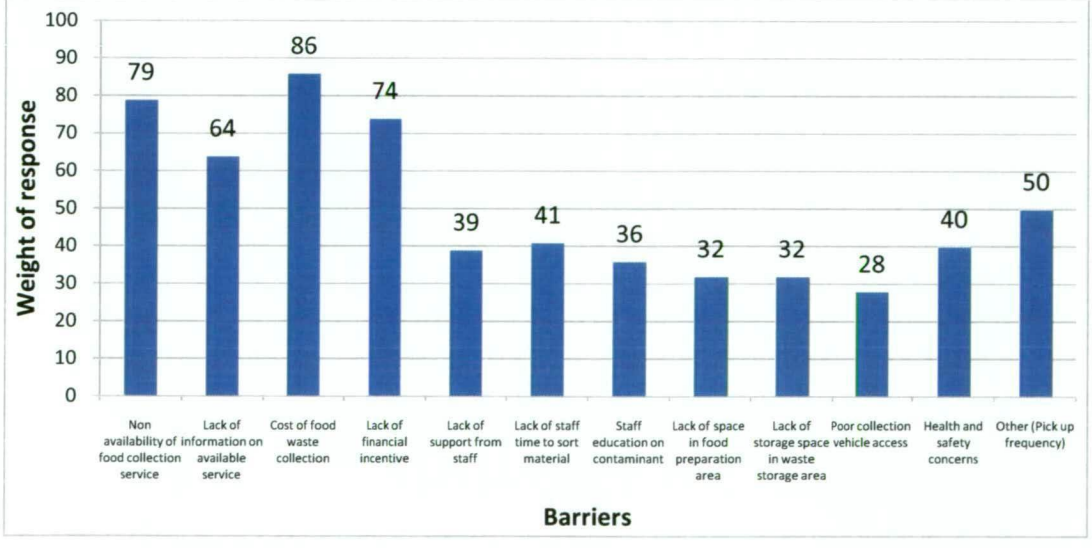


Figure 5.16: Perceived barriers to food organics source separation across all businesses

The four business groups differed in their emphasis to these perceived barriers. For supermarkets and grocery stores, the pick-up frequency of the segregated food organics material was reported as the main perceived barrier. These businesses generate large amounts of material for which timely removal is necessary due to potential health and safety issues. Businesses within the Manufacturers and Wholesalers group were the only one indicating that the cost of food organics collection was not perceived as a barrier. Figures 5.16.1 to 5.16.4 display the weight attributed to each barrier for each business group.

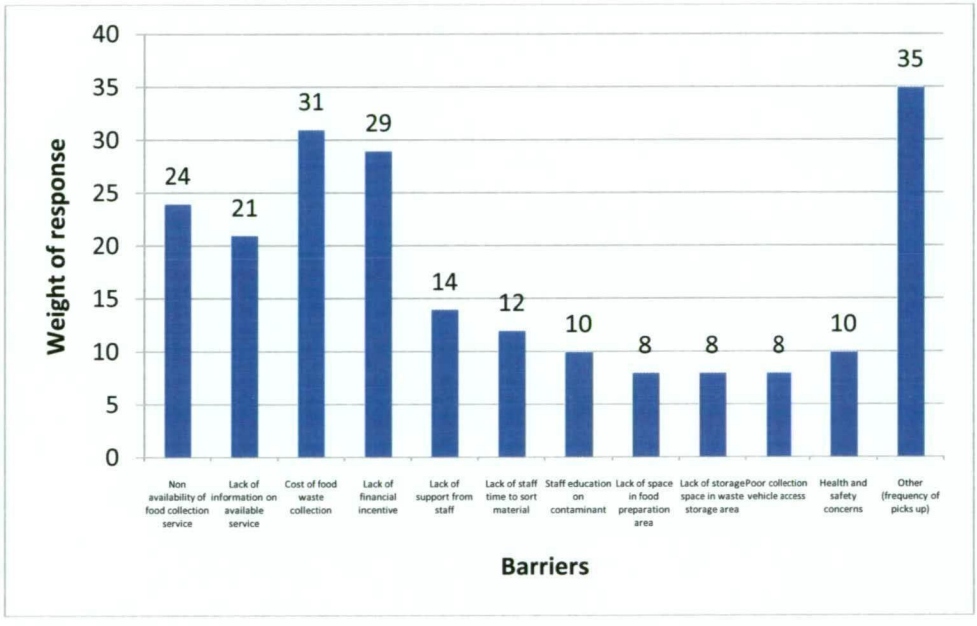


Figure 5.16.1: Perceived barriers to food organics source separation in the Food Retailing business group

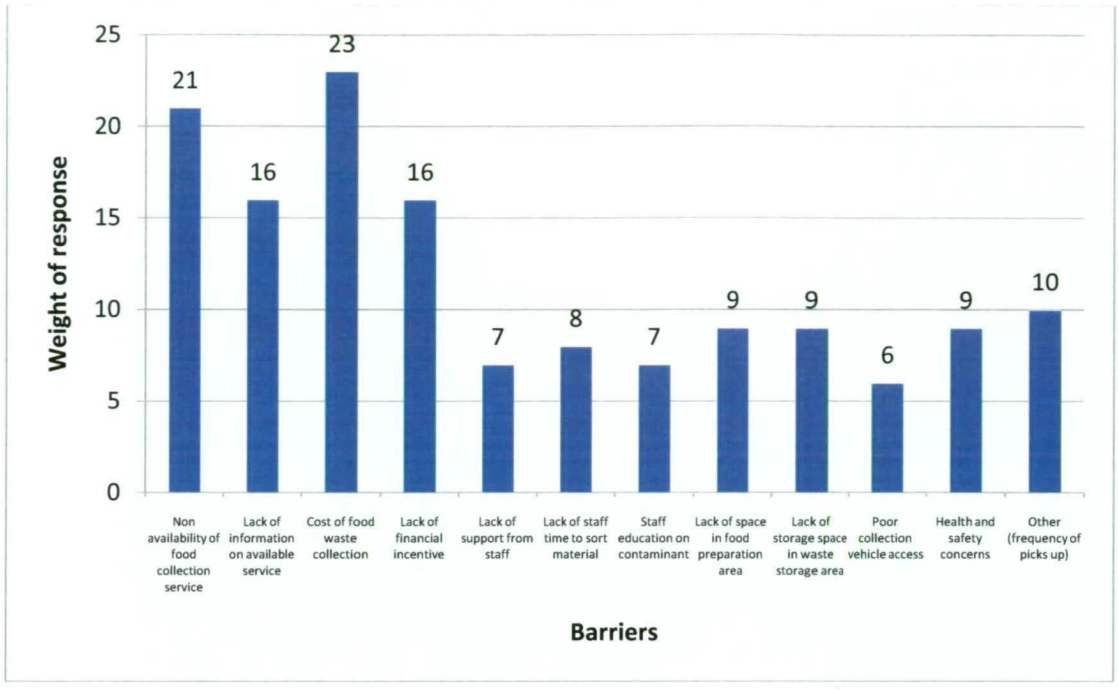


Figure 5.16.2: Perceived barriers to food organics source separation in the Education and Health Institutions business group

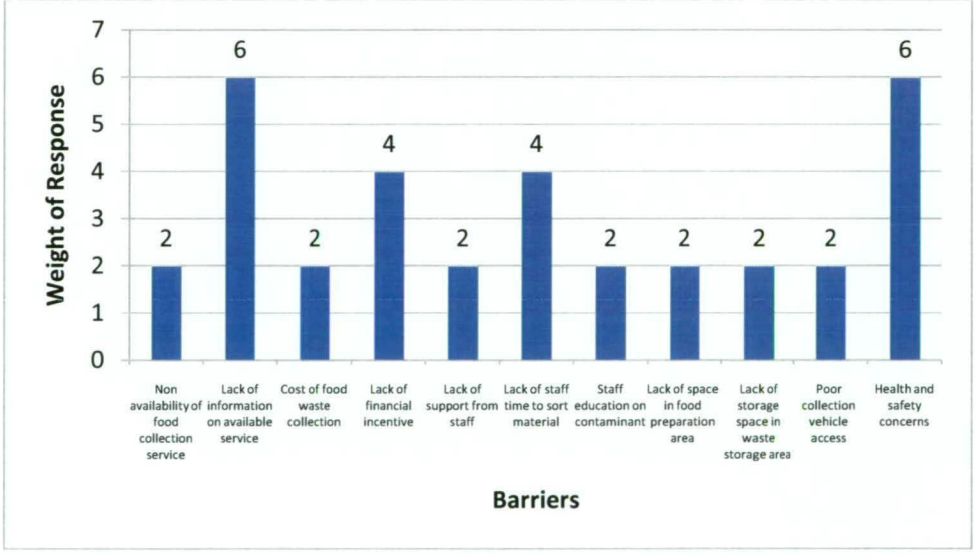


Figure 5.16.3: Perceived barriers to food organics source separation in the Manufacturing and Wholesaling business group

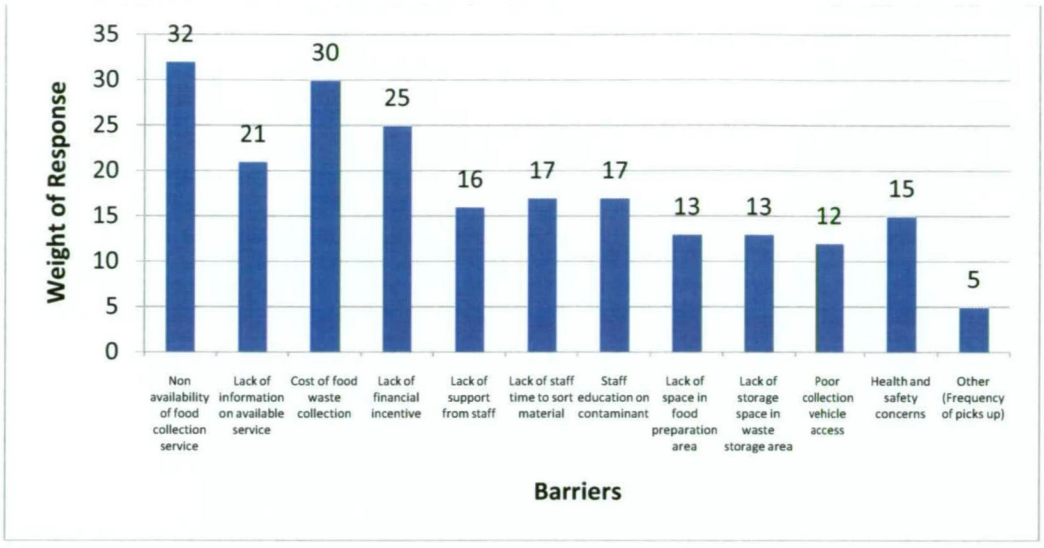


Figure 5.16.4: Perceived barriers to food organics source separation in the Accommodation and Food Services business group

5.6 Willingness to Minimise and Recover Food Organics

5.6.1 Interest in Alternative Pathways for Food Organics Management

The interest of businesses to recover food organics either through donation to food charities or by participating in a separate food organics collection service for composting was assessed. Businesses were asked to indicate their level of interest by using a numerical scale from 0 (not interested) to 10 (very interested). There was a moderate to high level of interest indicated by businesses in identifying alternative pathways for food organics management. Businesses showed a stronger interest in participating in a separate food organics collection service (61%) than they did in liaising with a food charity organisation (48%) (Figures 5.17 and 5.18). Tables 5.3 and 5.4 provide the disaggregated results for each business group.

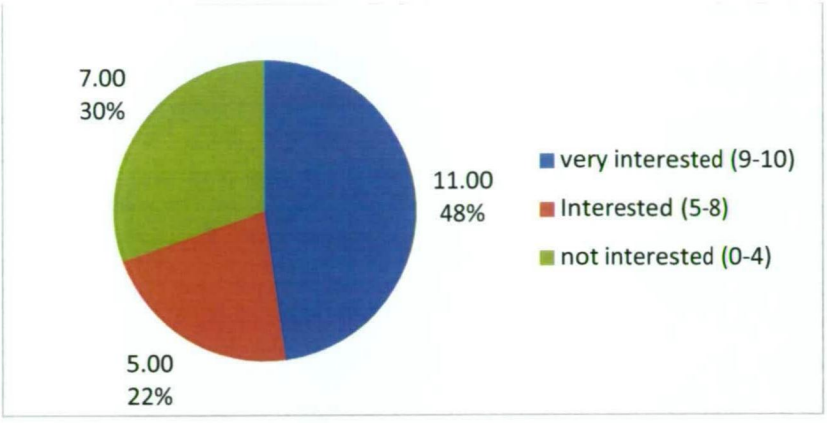


Figure 5.17: Interest in liaising with a food charity organisation for food surplus donation

Table 5.3: Interest in liaising with a food charity organisation for food surplus donation for each business group

	Accommodation and Food Services	Manufacturing and Wholesaling	Food Retailing	Education and Health Institutions
Very Interested (9-10)	37.5%	50.0%	75.0%	20.0%
Interested (5-8)	37.5%	0.0%	25.0%	0.0%
Not Interest (0-4)	25.0%	50.0%	0.0%	80.0%

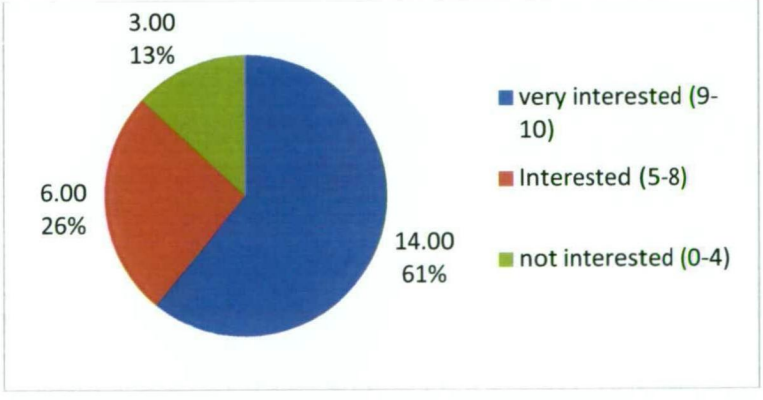


Figure 5.18: Interest in participating in a separate food organics collection service

Table 5.4: Interest in participating in a separate food organics collection service for each by business group

	Accommodation and Food Services	Manufacturing and Wholesaling	Food Retailing	Education and Health Institutions
Very Interested (9-10)	62.5%	50.0%	75.0%	40.0%
Interested (5-8)	25.0%	50.0%	25.0%	20.0%
Not Interest (0-4)	12.5%	0.0%	0.0%	40.0%

5.6.2 Willingness for Participating in a Separate food Organics Collection Service

Businesses were queried on their willingness to pay for participating in a separate food organics collection service. Thirty-nine per cent of the survey participants (9) indicated their willingness to pay for such a service compared to 35% (8) indicating that they were not willing to pay, while 26% were undecided (6).

Forty four per cent of the businesses willing to pay for a food collection service were from the Food Retailing (3 supermarkets and 1 grocery store), 33% from the Accommodation and Food Services (2 restaurants and 1 hotel) and 22% from the Education and Health Institutions (2 health institutions). Figure 5.18 displays the results obtained regarding the businesses willingness to pay for a separate food organics collection service.

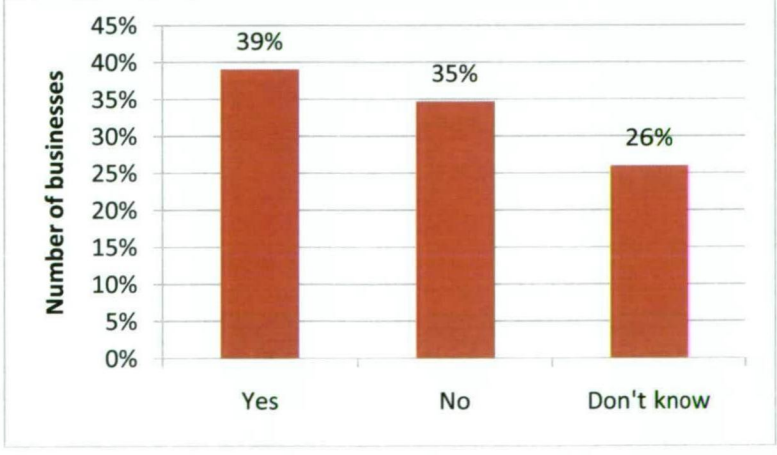


Figure 5.19: Willingness to pay for a separate food organics collection service

Businesses that showed interest in paying were asked to estimate the weekly amount they would be prepared to pay on top of their current garbage removal charge for such a service. One third of the businesses indicated that they were ready to pay on average $10-$20 per week on top of their current garbage removal charge. Two thirds responded they did not know how much they would be prepared to pay. All businesses were then asked whether they would be willing to pay for a separate food organics collection service if it were cost neutral for their operation. All businesses answered in the affirmative.

5.7 Chapter Summary

The survey results of 23 businesses from four business groups were presented in this chapter. Due to the relatively small numbers of participants in each business group the results reported in this chapter are indicative rather than representative. In this chapter summary I briefly summarise the most important results from the survey in order to prepare for the following chapter where discussion of the significance of these results is presented.

The first part of the chapter provided information relating to the business profile of each business group. Businesses within the Manufacturing and Wholesaling and Education and Health Institutions reported low seasonal variation in business activity and as such the generation of food organics was expected to be constant throughout the year. For Accommodation and Food Services and Food Retailing moderate variation in food organics was expected with businesses reporting summer as the highest business activity and winter the lowest.

The types and sources of food organics generated by businesses were also reported. Fruit and vegetables were the main food organics generated across businesses and represented 66% of all food organics generated. The source of food organics, however, varied from business to business.

All businesses reported the implementation of cleaner production measures to avoid the generation of food organics compared to only 48% taking steps to recover or reprocess food organics material. The main motivation behind the implementation

of such measures was the avoidance of lost revenue. The potential additional cost of participating in a separate food organics collection service was, however, perceived by businesses as the main barrier to partake in this type of service. The non availability of service and the lack of financial incentive to separate food organics from garbage for separate collection were also mentioned as important barriers. Despite that, businesses showed a general interest in identifying alternative pathways for food organics management. Alternatives to the disposal of food organics in garbage would have to be revenue positive or at least cost neutral. The following chapter discusses these results, reviews the barriers that inhibit food organics diversion from landfill, offers suggestions and highlights areas for further research.

Chapter 6 Discussion - Conclusion

6.1 Introduction

This discussion chapter is divided into four parts and addresses different issues and limitations that arose from the research. In the first part I draw upon insights gained from undertaking the literature review reported in Chapter 2 and discuss the need for change and opportunities for the management of organic waste in Australia. The remaining two issues discussed are based on the results of the survey conducted amongst businesses in HCCl. These issues include: (1) the barriers to the diversion (from landfill) of food organics; and (2) the measures undertaken and opportunities for food organics diversion for each business group. The fourth section provides a discussion on the strengths and weaknesses of the research method and identifies the need for further research in the field of food organics. The last section of the chapter provides the conclusion of the study.

6.2 Changing Organic Waste Management Practices in Australia

Waste management in Australia has seen marked improvements over the past 20 years following the introduction of the National Waste Minimisation and Recycling Strategy in 1992 (Productivity Commission, 2006). The ANZECC *Green and Organic Waste Management Strategy for Australia 1996* and the latter supporting document *Organics Market Development Strategy 1999* were the two major national pieces of legislation that addressed organics and promoted the source separation and recovery of this part of the waste stream. These strategies had the ambitious aim of reducing by 50% the amount of green and organic waste going to landfill by 2000 based on 1990 levels. However, while this aim was a good intention, there was little evidence that the 50% reduction target for organic waste has been achieved (LGAT, 2005; EPHC, 2010). Nationally, the recycling rate for all waste is 46%. Broken down into different forms of waste reveals that while, for example, 75% of paper and newsprint is recycled, only 36% of organic materials are diverted from landfill (EPHC, 2009a). The GHG emissions created by landfill in Australia are mainly the result of organic materials, which in 2008 contributed around 2.5% of Australia's

national GHG emissions (DEWHA, undated). Technologically advanced landfills have the capacity to capture between 80 to 90 per cent of GHG emissions; but these Australian landfill facilities are limited in number (Industry Search Australia and New Zealand, 2010). Given current concerns about climate change and the fact that organics are the most carbon intensive materials in landfill sites, a stronger focus needs to be put on increasing the recovery and recycling of the organic fraction of the waste stream. However, the Australian federal government has to date failed to provide any strong direction for state governments in its most recent waste management policies.

The newly introduced federal government *National Waste Policy: Less Waste, More Resources* sets the agenda for waste and resource recovery in Australia for the next decade. This document gives general directions to "enhance biodegradable (organic) resource recovery" (EPHC, 2009b p.13), but does not provide clear targets for the recovery and recycling of organics. Realistic and measurable targets are a key part of a waste management strategy as they can be used to reach a set goal under the strategy. Progress towards achieving the targets can be measured by using milestones that provide an opportunity to assess performance. Some state governments have already taken steps to accelerate the diversion of organics from landfill, notably through trialling large-scale composting and adopting 'Alternative Waste Technologies' (AWT). South Australia has also introduced the first landfill ban on vegetative matter aggregated by council on the basis that a system to segregate materials already exists. Some local governments have responded to the issue of organics in landfill by both experimenting with and introducing separate collection services for organic waste. While these initiatives point in the right direction and demonstrate that it is possible and feasible to implement organic waste diversion strategies, they have only scratched the surface in terms of what is needed to effectively address the issue of organic waste disposal in Australia.

In Tasmania there is a lack of state government policy in relation to organic waste management. The *Tasmanian Waste and Resource Management Strategy* introduced in 2009 requires the State government and local councils to "increase the diversion of organic (green) waste from landfill and develop policies for alternative management of organic wastes" (DEPHA, 2009 p.16). However, there is currently still no clear

understanding of the quantities or types of organic waste materials generated by industry and sent to landfill in Tasmania. This is due to issues with the way organic wastes are defined which affects the rigour and reliability of the waste data collected. This information is critical if waste processors are to assess the scope for inclusion of materials in processing operations, such as composting (McPhee, 2002). As such, like the national policy, the strategy set by the State government lacks baseline data, which is critical to the setting of targets and the development of management strategies.

Although the Hobart City Council is currently undertaking a food organics collection trial, key stakeholders in the Tasmanian waste management industry were of the view that there has been a lack of willingness form both the Tasmanian State and local governments to implement waste management programs to address the organic fraction of the waste stream. While such programs make sense environmentally, both the State and local governments have tended to avoid such initiatives as too politically risky. Stronger commitment and leadership is required from all tiers of government to effectively reduce the amount of organics disposed to landfill. Such commitments will enable communities to recoup the benefits of reducing GHG from landfill while assisting with building poor soils through the application of soil amendments produced via composting or anaerobic digestion (Brennan, pers. comm., 2010).

This lack of action to address the organic waste stream in Tasmania may be explained by the interrelated mix of poor governance and few economic incentives. One of the main problems for the organics recycling industry in Tasmania is that to ensure an economic return on investment private waste operators need a regulatory framework to support their activities. However, they also need a critical amount of waste to make the separate collection of organics and recycling economically worthwhile. According to industry stakeholders, a viable organics processing operation requires significant capacity to generate economies of scale. As part of the investigations of the recycled organics industry in each state for the 1999 *Organics Market Development Strategy*, Meinhardt (1999 cited by LGAT, 2005 p 13) argued that:

> Tasmania's relatively low population and small quantities of organic waste produced have inhibited development of the recycled organics industry in the State. Advantages of economies of scale do not exist, contributing to unviable costs for collection and processing of recycled organics.

The key stakeholders in the Tasmanian waste management industry agree that there is a need for economies of scale in order to make a separate collection of organics economically viable. However, they think such scales could be achieved if there were a consensus across all councils to recycle this part of the waste stream. In Tasmania the priority target markets for recycled organic products are horticulture, viticulture and broad acre agriculture (Zwart, 2007 cited by ROU, 2007d). Due to a perceived surplus of water in the western areas of the state, Tasmanian has been designated by both the state and the federal governments as a suitable place to expand agricultural production (West, 2010). Steps are already being taken to turn Tasmania into the nation's future 'food bowl' (Denholm, 2010) which may also extend the potential market for recycled organics in Tasmania.

Critically, both Tasmania and Australia are falling behind international best practice for organic waste recovery, reuse and recycling. Based on current practices in Europe, there are three main options for promoting the introduction of programs for the recovery and recycling of organics. These are: (1) increasing landfill levies across jurisdictions to render alternatives more competitive; (2) introduce a Landfill Allowance Trading Scheme (LATS) similarly to the one currently operated in the UK; and (3) legislate a landfill ban on organics, which has taken place in some European countries. These three options are discussed further below.

Increasing landfill levy to support organics diversion

Because waste collection and disposal is highly subsidised in Australia landfill levies are very low and do not include waste externalities. Thus, the true cost of waste disposal to society is actually greater than what is charged at landfill gates (The Allen Consulting Group, 2009). All sectors of the economy should be further encouraged by the Australian government to increase the recovery and recycling of organics through the introduction of incentives. Currently, economic incentives in the form of landfill levies are not high enough for businesses in the C&I sector to source separate their organics for recovery or recycling as disposal to landfill

remains the cheaper option (SITA Environmental Solutions, 2010). This situation is further complicated as landfill levies are not consistent across jurisdictions in Australia. The need for landfill levies to be increased so as to make separate collection of organic waste competitive was underscored during a recent Waste Management Association of Australia conference which had food organics recovery as a headline theme (Wallace, 2010). In NSW, the progressive increase in the landfill levy over the past few years has favoured an increase in organics recycling by increasing the competitive cost of the recycling industry against landfill. According to the DECC (2007) the recycling rate of garden organics in the Greater Sydney Region has increased from 40% in 1998 to more than 57% in 2004-05. This increase has enabled the proliferation of AWTs for organics recycling. The adoption of higher landfill levies across all jurisdictions will provide a strong driver for and incentivise investment in alternatives to landfill and source-separate of organics. Although the private sector is prepared to invest in alternatives technologies for organics recycling, low landfill levies send the wrong price signal (Ritchie, pers. comm., cited by Dorizas, 2010). Increased landfill levies will generate revenue that can then be reinvested to fund research and development for new technologies. Increases in landfill levies should also be accompanied by a separate policy for organics providing a long term target for organics diversion for the MSW and C&I waste streams. In order for such targets to be acted upon, regulation and governance would have to be devolved to local governments, who could assist the C&I sector to develop AWTs for dealing with organic waste.

Adoption of a Landfill Allowance Trading Scheme

Another solution to avoid the landfilling of organics in Australia could be the adoption of a Landfill Allowance Trading Scheme (LATS) which is based on a 'cap and trade' market instrument that establishes a limit on the amount of organics that local councils can dispose to landfill. Such a scheme was introduced in the UK in 2005 to reduce the amount of biodegradable municipal waste disposed to landfill so as to meet diversion targets under the EC landfill directive (see chapter 3.5). The legal framework for the LATS scheme was provided in the *Waste and Emissions Trading Act 2003* and as such would have to be legislated in Australia. The implementation of such a scheme in Australia would place a declining cap on the

amount of biodegradable waste that local authorities are allowed to send to landfill. Local authorities would be allocated tradable landfill allowances providing the right for landfilling organics and would be able to decide how to use them. Under the scheme councils that have exceeded their organics diversion target would be able to trade some of their allowances, bank it for future years, or even borrow up to 5% of the allowance from next year. A penalty system would also provide a disincentive to waste generators to breach the amount of organic waste allowed to be sent to landfill. This would also set the selling price of allowances (DEFRA, 2005).

Landfill ban on organic waste

A ban from landfill of organic waste is another direction Australia could take by following the example of European countries such as Denmark, Germany, or Austria. This policy would necessitate a structured process over a specific time frame with transitional steps and targets to incrementally ban all organics going to landfill. This would give landfill operators time to prepare before reaching the ultimate goal of zero organic waste in landfill. It is likely that such a ban on organics would drive investment in the recycled organics industry (North, 2010). The ban would need to be supported by legislation requiring source separation of organics for both the MSW and C&I waste streams. Education of consumers and industry would therefore be critical for the implementation was to be successful. Additionally, the ban would need to ensure that adequate agricultural end markets were available for recycled organics products in the form of compost or post anaerobic digestion products.

These three strategies offer possible ways of increasing the amount of organic waste diverted from landfill. However, the assessment of which mix of strategies and how to implement them in the Australian context remains to be determined.

6.3 Barriers to Food Organics Diversion

Increased attention has been paid to the impacts of food organics and the action of recycling food organics over the past decade in Australia. Yet only 10% of food organics generated are diverted from landfill due to the difficulty in source separating, collecting, transporting and processing this highly putrescible component of the waste stream (Warken ISE, 2007b). A key element in instigating change and increasing food diversion in the C&I sector is to ascertain what businesses perceive to be the barriers to adopting different practices and changing behaviour. In this section of the discussion a number of results are compiled under the broad heading of the barriers to the adoption of a separate organics waste diversion stream.

One issue broadly identified as a significant barrier to the adoption of food organics diversion was a lack of interest in the issue amongst businesses. This was evident early in the research with the low participation rate of the survey. Only 12% of businesses contacted participated in the study. Most of them reported a lack of time as the reason why they could not participate. This seemed to reflect a more sustained lack of interest and appreciation in the issue of food organics amongst businesses in Hobart. According to a survey conducted by the South Sydney Council amongst businesses in the food services and retail industry (undated, cited by Nolan-ITU, 2000b), businesses interpret food organics as "waste" rather than a resource, and hence favour the disposal of the material over its recovery and recycling. It is likely that an educational campaign directed towards the C&I sector would help to the shift perception of food organics as a valuable resource that should be recovered instead of sent to landfill. The Eenee design company also reported a lack of concern and interest from businesses on the issue of organic waste. When contacting businesses to assess their interest in a proposed organics collection service in Hobart the company found that most businesses were reluctant to be involved (Allison-Rogers, pers. comm. 2010).

In addition to a general lack of interest and concern with food organics, there were numerous specific barriers identified by businesses that prevented the separation at source of food organics. The four greatest barriers reported across the four business groups related to a mix of structural/information and financial/economic reasons:

(a) Structural/information barriers – (1) the non availability of a food organics collection service in Hobart and (2) a lack of information on available services in Hobart for the recovery of food organics.

(b) Financial/economic barriers – (3) the cost that would be involved in participating in a separate food organics collection service and (4) the lack of financial incentive to do so.

These findings are consistent with previous research on C&I organic wastes and C&I food organics conducted on the Australian mainland (Axis Environmental, 1996; TEC Green Office, 1997; Nolan-ITU, 1999; South Sydney Council, undated). In an organic waste survey conducted with 62 businesses, Axis Environmental (1996) reported that the greatest obstacle to food organics source separation for recovery and reprocessing was of a financial nature. The South Sydney Council (undated cited by Nolan-ITU, 2000b) reported both the non-availability of a separate collection service and the cost of participating in such a service as the main barriers to food organics separation. Thomas *et al.* (2007) reported similar barriers to recycling in their audit of C&I waste in the food and food-related business sector in Hampshire, UK with the most common barrier to recycling reported by businesses related to cost.

The barriers identified in this thesis differ, however, in certain respects from a similar study conducted by Parsons and Kriwoken (2009) on general recycling practices amongst Small and Medium Enterprises (SMEs) in Hobart. Research found that the four greatest barriers to recycling identified by SMEs were: storage container restrictions, a lack of information on recycling services, staff sorting time and storage area restrictions. While a lack of information was also identified as a major barrier by the businesses surveyed in this thesis, the other three main barriers identified by Parsons and Kriwoken only received minor weightings. Significantly, financial barriers were not as critical as reported by businesses researched in this study. This difference may be explained by differences in the design of Parsons and Kriwoken's research compared to the one conducted here. The SME study included a broader range of recyclables (than organics) involving the need for more and bigger separate storage containers hence requiring more waste storage space as well as more sorting time from staff. Businesses that were interviewed in the study reported on for this

study were involved in recycling cardboard and glass and, except for two businesses, indicated that storage space for additional containers was a minimal issue.

Below I discuss the barriers identified in more detail and provide quotes from interviews with businesses to better illustrate the context within which these barriers are understood and perceived. Structural and information barriers relating to the absence of a collection service and lack of information are first discussed together followed by financial and economic barriers relating to the cost of a collection service and the lack of financial incentives.

6.3.1 Collection Service – Absence and Lack of Information

The absence of a food organics collection service in Hobart was reported by businesses as the main barrier to the source separation of food organics (see Figure 5.16). It should be noted that at the time the survey was conducted, no commercial organic waste collection service was available in Hobart. Options to divert food organics consisted of donation of surplus food to charity, donation of food organics to pig farms or animal feed producers and source separation for on-site management or delivery to a composting facility. The high weighting given to this barrier is likely due to a lack of information on these available options rather than the absence of a service in Hobart. A large proportion of businesses expressed interest in diverting food organics from landfill (see Figures 5.17 and 5.18) but reported that a lack of information on the services prevented them from diverting their food organics (see Figure 5.16). Information on existing services is readily available however the lack of financial incentives for food organics separation may result in business apathy to seek information. Large chain supermarkets appeared to be the most informed on alternatives to food organics disposal. This may be explained by the two chains having recently started national food organics reduction programs across their stores.

Businesses also reported a lack of information on available services for food donation and indicated that concerns regarding the potential for civil liability involved with food donation deterred them from donating. The fear of litigation was a recurring barrier to surplus food donation to charities across businesses. The manager of a fruit and vegetable wholesaling business contended that "We don't

know anything about food banks in Hobart. We would be happy to donate but as long as we are sure that we won't be sued." A restaurant owner reiterated this position, noting that "Donation is difficult since we are afraid someone may sue us. Unfortunately that's a fact of life these days and that puts you on the edge a lot, you can't expose yourself to certain liabilities". However, while many respondents reported such fears as barriers to the diversion of food organics via donation, issues to do with civil liability have been adequately dealt with by the Good Samaritan Act 2008. Businesses should be made aware of the Good Samaritan Act so as to remove the fear of litigation when donating surplus food. Charities on the mainland have reported substantial increases in donations of food after businesses were informed of the legislation protecting them as donors (Godinho, 2009).

More generally, given the Tasmanian Government target of a 60% reduction in GHG emissions from 1990 levels by 2050 and the scarcity of landfill space at the McRobies site, it is in the HCC's interest to establish education programs informing businesses on the available options for food organics diversion. It is the HCC's responsibility to "facilitate sustainable solutions for waste management" (HCC, 2010) and dealing with food organics is one way of being proactive with the potential introduction in Australia of a carbon price. HCC should compile information on existing and potential diversion opportunities and target each industry sector by distributing information. Such a campaign would increase awareness amongst businesses of the benefit of food organics diversion and the efforts currently undertaken in Hobart to further recover the organic fraction of the waste stream. It may also help to identify interested parties for inclusion in the newly established organics collection service.

6.3.2 Financial Barriers – Cost and Lack of Financial Incentive

The survey determined that financial barriers – including the cost of collection and a general lack of financial incentive – were perceived by businesses to be a major barrier to the participation in a food organics collection service. The majority of businesses (87%) across the four business groups have their garbage removed by a private operator with the collection service generally covered by a 12 month contract.

These businesses indicated that they were charged based on the *size* of the container removed regardless of the *volume* of garbage. As such, if businesses were to participate in a separate food organics collection service, garbage cost removal would not be lowered unless it leads to a downsizing or reduction in the number of containers used for the disposal of garbage. It is more likely that additional recycling costs will be incurred by businesses.

It was apparent from the survey that while businesses were interested to participate in a separated food organics collection service, they were keen to keep expenses for waste removal to a minimum and were opposed to cost increases. This was encapsulated in the comments from a grocery store manager who asserted: "No, I would not pay [for a food organics collection service]. You wouldn't want to put another expense on your business. We are already paying so much to get our rubbish collected". A food catering worker from an education institution underscored that organisations would not be prepared to shoulder the costs for such a service: "The cost of collecting food waste would be an issue. If it actually cost you money there is going to be an impact on the bottom line".

Businesses in the manufacturing and wholesaling sector that were already diverting food organics for stockfeed at no cost through arrangement with local farmers also made a strong point that they would not be prepared to bear any additional costs for a food organics collection: "We give the food waste for animal feed to save on costs so for sure we wouldn't like to pay for food waste collection". Such arrangements between some food manufacturers/wholesalers and farmers may also explain why these businesses downplayed the importance of economic barriers to the source separation of food organics.

Other businesses were also confused as to why they should be financially penalised for separating food organics while others could keep wasting food organics at no cost. This was evident from the comments of a restaurant chef who argued:

> What I don't understand is that still there are people out there who can still waste food without actually being charged for it and people who actually don't waste have to pay more than people who still waste it. You should be encouraged and get advantages for doing this [source separating food organics].

Businesses would only consider participating in a separate food organics collection service if it were proven that it would be either cost neutral or cost effective. For example, the chef of a hotel restaurant thought "I would say 'yes' to paying for food waste collection; as long as it reduces the cost of garbage collection". Financial incentives are indeed an important factor that favours changes in behaviour that result in sustainable waste management. For example, while donating surplus food to charity is free of charge, economic barriers may also prevent businesses from doing so. Griffin *et al.* (2009) have shown in their research on a community food organics stream that food donations is regarded as a profit loss by some businesses and consequently food is generally discarded rather than being given away.

Environmental management has become a very important issue amongst businesses. The public is increasingly asking businesses to respond to the concept of corporate social responsibility including, *inter alia*, a better management system and a reduction in their level of waste. Research has shown, however, that in many cases while business owners express interest in the environmental impact their business activity may have it is seldom translated into better waste management practices (Redmond *et* al., 2008). This is because owners perceive changes to their waste management practice as having a cost that may not be passed onto customers and as such will have affect negatively their bottom line (Redmond *et al.*, 2008). Businesses tend to put a greater emphasis on financial security and profit while expenditure on waste management is kept to a minimum since it does not generate any profit. Businesses will however generally absorb increases in cost or fees that are introduced by governments through legislation and pass on a measure of such costs to the consumer.

Incentives from government and local authorities are necessary to encourage businesses to separate food organics for recovery and reprocessing. Businesses would not generally separate food organics based on altruistic values unless it is profitable to them or required under legislation. The best method of changing businesses behaviour towards food organics will therefore be the introduction of regulation or legislation jointly with landfill levy increases so as to provide the necessary economic incentives for source separation. HCC could also establish a best environmental practices award system to encourage businesses to take responsibility

for their waste and demonstrate to their customers that they were 'doing the right thing'. Advertising involvement in a food organics recovery program can improve the corporate image of participating organisations and in turn *improve* their financial performance.

6.3.3 Other Barriers

6.3.3.1 Collection Frequency

Collection frequency was mainly reported as a potential barrier to food organics separation by businesses in the Food Retailing sector and Health Institutions. These businesses either generate large amounts of material for which timely removal is necessary or have concerns due to potential health and safety issues given the putrescible nature of food organics. For example, a supermarket manager highlighted the amount of food organics generated by noting that "we are just worried about the collection frequency such service would have. We would need a collection every second day here". The manager of a health institution expressed a concern that "the main issue would be vermin and smell; we don't want that for our residents". Such anxieties were shared by other business groups, for example, a the chef of a hotel's restaurant noted that "sometimes the flies are really bad in the summer time and if the bins stay out there all week ... that may be a health issue". A restaurant owner also identified frequency of pick up as a potential barrier to the donation of food organics to charity according to previous experience stating that "The problem with donating food is the pick up, you have prepared everything, ready to go and then for whatever reason it is just left and no one collects it".

6.3.3.2 Staff Related Issues

Some businesses, notably restaurants, were of the view that difficulties may also be encountered with their staff if a source separate collection of food organics was to be introduced. While businesses agreed that support from staff would be gained easily once the new system was introduced there were concerns related to the cost in terms of time with staff unable to afford the time to separate material and the need for staff education on what can and cannot be separated. The chef of a hotel restaurant asserted that "the act of separating food waste is the main problem; we just

don't have the time in a kitchen. When it is busy the staff just chucks the food in the bin". The chef of another hotel restaurant was however of the view that "Everyone has time to separate food waste, people saying they don't have time to do it are lying". A restaurant owner reported concerns with staff education declaring that "Change is always hard to initiate so I believe education will be difficult". This concern over staff education was also reported by another restaurant chef who indicated a lack of time to provide education to staff notably with the high casual staff rotation and believed education should be provided by the service provider. The chef stressed that:

> It should be up to the company that collect the food waste to provide education and training in businesses. The staff should be explained how it should be done and how it works. It should not be our responsibility.

The implementation of a food organics diversion program will only be successful if staff is fully informed and involved. Staff education on correct procedures and the provision of promotional material to encourage staff participation and advertise the new system are a key to the success of the food organics source separation. Businesses should be provided with ongoing education programs and advertising material from the service operator. Such programs have been critical to the success of previous food organics collection services provided on the mainland (Environment, Planning & Resource Recovery Consulting, 2005). A lack of information and education on the provision of a new food organics collection service may result in low participation rate as well as high contamination levels of the material from participating businesses.

6.4 Measures Undertaken to Avoid the Generation of Food Organics and further Opportunities for Diversion

All businesses had recently implemented cleaner production measures to avoid the generation of food organics, yet only 48% reported undertaking measures to divert food organics from ending up in landfill. The two most prevalent methods of diverting food organics implemented by businesses were: (1) the provision of food organics directly to pig farms for stockfeed; and (2) the donation of edible surplus food to a charity or food bank. Academic research in the field of organic waste management from around the world has discovered similar results. A study by Okazaki *et al.* (2008) of food organics generation in Hawaii reported that the two main means of food organics diversion were also as food for feedstock and through donation to charities. Most businesses in the HCC study indicated that their main motivations behind the implementation of such measures were the avoidance of lost revenue and the environmental benefits of diverting food organics from landfill.

These measures implemented by businesses are discussed according to the four business categories due to substantive differences between their activities. The results from the Education and Health Institutions group are further differentiated into school canteens and health institutions due to noticeable differences between these organisational types. Opportunities for food organics diversion are also discussed according to the origin and type of food organics generated by each business group.

6.4.1 Education and Health Institutions

6.4.1.1 School Canteens

School canteens reported generating minimal amounts of food organics with a total weekly volume of 0.133m^3 generated, that is just over a 120L bin across the three school canteens per week. It was emphasised by school respondents and the Tasmania School Canteen Association (TSCA) that canteens in Hobart are run efficiently, with food supply and demand matched as closely as possible. Workers at the school canteen also reported the discounting and donation of unsold food to students, hence narrowing the opportunities for surplus food donation to charities.

According to TSCA (pers. comm., 2010), most primary schools in Hobart would focus on food organics avoidance as the canteens operate on very small margins and cannot afford to waste food. Wishes (pers. comm., 2010) argues that high school canteens generate more food organics than primary school canteens, due to the fact that "education in high schools in less integrated". Here, integration refers to high schools having greater variability in their daily student attendance and hence often over-cater for larger numbers than are required. A study conducted in the USA by Engström and Carlsson-Kanyama (2004) reported a similar difference in the level of food organics: 9-11% from primary school food services compared to 17% from high school food services.

Of the food organics generated by canteens, most originated from food preparation (65%). This proportion of pre-consumer food organics is high but is biased due to the fact that canteens report no leftovers from students. This is explained by the fact that school canteen staff has no control on post-consumer food organics and reported that post-consumer food organics were generated by students in the school grounds. The lack of a large seated common eating area in the schools surveyed would make it difficult to collect post-consumer food organics waste, as it would end up in different bins throughout the school grounds.

Hence, because of the very low level of food organics generated, school canteens appeared not best suited to being involved in a source separated food organics collection service. The school canteens indicated that they were neither interested in participating in a separated food organics collection service nor liaising with a charity for donation. One school canteen operator stated bluntly "we don't generate enough food waste to participate in a separate food waste collection service". Even those schools who declined to participate in the research nominated that the reason they declined was that they did not generate enough waste to warrant inclusion in such a survey.

It should be noted that the survey of school canteens did not ascertain how much food organics were generated across entire schools. Given that many students bring their own lunch it is likely that some food organics would be generated by uneaten leftovers. For educational institutions, a collection which sources food organics from

the playground instead of school canteens has the potential to be more worthwhile. The establishment of separate food organics collection system would have great educational potential because it would provide a means of informing children on the values of recycling and reusing 'waste'. There are concerns regarding the logistics and implementation of such system especially regarding the potentially contamination level of the separated material.

More viable opportunities exist for onsite processing of school organics, including vermi-composting or windrow composting. In 1999 the *Green Waste Matters! A Guide on Green and Organic Waste Management for Schools* was produced as an outcome of the National Heritage Trust and the Waste Management Awareness Program. The guide can also be used by schools to raise the awareness of young Australians on environmentally sound organic waste management practices (Angela Colliver Consulting Services Pty Ltd, 1999). According to the TSCA, attention is already being given to the issue of food organics, with most canteens already recycling organic waste through worm farms or compost heaps and some high schools in Hobart have their own vegetable patches and composting arrangements (TSCA, pers. comm., 2010). However, only limited measures were undertaken for the diversion of food organics within the schools that were surveyed with two of the schools canteens reporting that teachers took home small amounts of food organics for poultry feed.

6.4.1.2 Health Institutions

A significant volume of food organics was generated at the two health institutions, notably at the hospital where an estimated $20m^3$ of food organics was generated weekly – all of which was macerated and sent to the sewer. Pre-consumer food organics were kept to a minimum with the catering areas in both health institutions using a 'cook/chill' process involving the full cooking of food in advance followed by rapid chilling and storage at controlled temperatures. The use of this process allows higher production efficiency and lower food preparation costs based on bulk buying and mass streamlined processing. This facilitates the matching of food supply with demand and enables dishes to be stored chilled for up to 5 days. Due to these efficiencies in the preparation of meals, the proportion of food organics generated in

the catering areas of health institutions only accounted for 15% of the total food organics generated. Once reheated, food that has been cook/chilled should be consumed immediately due to rapid bacterial growth (Edwards and Hartwell, 2006). For that reason both catering managers of health institutions reported that donating surplus food to charities is not possible. The manager of an aged care nursing home argued that the industry was very sensitive:

> We can't donate to charity, we are a high risk business and legislation is very tight. We can't give our excess food to charities; they would not take it. Because our food is cooked today for tomorrow, we cook it and chill it right down really quick – which extends its shelf life – but once it is reheated that cannot be reheated again because of bacterial growth.

The vast majority of the overall food organics generated by health institutions consisted of post-consumption plate scraps (70%). This high volume of food wastage is in accordance with what other studies have reported. For example, Williams *et al.* (2003) found that the proportion of meal waste (the amount of food left uneaten) in health institutions can commonly be as high as 30-40%. According to this study, the health status of people within health institutions significantly affects the amount of uneaten food, with healthier residents of nursing homes leaving few food scraps compared to hospital patients. Due to the high proportion of post-consumer food organics, it is unlikely that local farmers would engage with health institutions for feedstock due to the risk of contamination from meat or dairy products.

Food organics diversion provides a possible opportunity for health institutions to fulfil their wider mission of looking after community health. There are two main opportunities for diversion: (1) participating in a separated food organics collection service for off-site composting; or (2) on-site management of organic material through the use of enclosed anaerobic technology enabling the generation of electricity. This enclosed technology has the benefit of avoiding odours and preventing the attraction of vermin, both of which are sensitive health issues for health institutions. The Frankston Hospital in Victoria initiated a food organics segregation program in 2009 for off-site composting involving both the kitchen staff during meal preparation and food service assistants working on the 'stripping belt' as part of the dishwashing process. The hospital reported that the segregation program has been extremely successful with a 70% reduction of food organics going to

landfill. Additional savings were made on the disposal cost of general waste (Sustainability Victoria, 2010). Organic waste processors should engage with health institutions and seek to secure food organics from these premises given the large volumes generated and the constancy of generation throughout the year. The aged care nursing home that was surveyed reported that contacts have been made to participate in the new organics waste collection service being established in Hobart.

6.4.2 Accommodation and Food Services

Like organisations within the Health and Educational Institution business group, restaurants and hotel restaurants were implementing cleaner production measures to avoid pre-consumer food organics generation in the kitchen. These measures included ensuring good stock rotation, matching food supply with demand, and re-using leftovers. However, no measures were undertaken to divert food organics away from landfill. Post-consumer food organics – in the form of plate scraps from customers – constituted the majority of food organics generated by restaurants (58%). Engström and Carlsson-Kanyama (2004) reported similar results for restaurants from their community-wide survey. Restaurants are only taking measures to minimise food organics in their kitchen as this is perceived as a lost revenue source. They do not pay attention to the amount of food left on plates by customers unless it is an indication of bad quality food. Comparatively, hotel restaurants reported that almost three quarters of food organics consisted of pre-consumer materials, with 52% generated during food preparation and 20% consisting of excess unserved food. Post-consumer food organics only accounted for 20% of the food organics generated in hotel restaurants. This difference between restaurants and hotel restaurants may be explained by hotels operating higher quality restaurants which prepare large amounts of fresh food on site resulting in more trimmings, peelings and off cuts being generated in the kitchen. One hotel chef underscored this low proportion of post-consumer food organics waste by noting that:

> There is not much coming back from the customer, the quality of food is good. Maybe there's not enough on the plate, but also the price of the menu may prevent food waste from customers.

In order to limit the amount of leftovers returning to the kitchen, restaurant managers and especially chefs should review the quantity and types of food left on plates (i.e. garnishes), and remaining in buffets. Monitoring of leftovers should allow staff to readjust serving sizes. While opportunities for food leftover donation are limited, restaurants and hotel restaurants have the opportunity to turn off-cuts from meat and vegetable into a meal that could be donated to charity. Moorilla Estate in Berriedale provides a weekly meal that can feed up to 30 people at the Bethlehem House Homeless Men's Assistance Centre (Second Bite, 2009). Given the large number of restaurants and hotels in Hobart, organic waste processors should seek to secure food organics from restaurants and hotel restaurants through their participation in a source separate food organics collection service. Education in these businesses will be critical to avoid contamination of the separated material.

6.4.3 Manufacturing and Wholesaling

Significant volumes of food organics were generated by the fruit and vegetable manufacturer and wholesaler (14m^3 per week). These businesses already had well developed systems in place for their food organics with all material diverted from landfill at no cost through arrangements with local farmers who use food organics as stockfeed for pigs. While these businesses expressed some interest in participating in a separate food organics collection service it is unlikely that they would participate in a service for which they would have to pay, especially as they currently donate food organics at no cost to pig farms. Although the fruit and vegetable wholesaler reported donating food products to a charity, quantities donated were minimal with the business expressing concerns over civil liability. Opportunities exist for extended donation from this business as a large proportion of food organics generated consist of products that are classified as "substandard" (edible but blemished or small products).

While food and vegetable manufacturing and wholesaling businesses are in a good position to donate food organics to feedstock, other business types included in this category, such as meat wholesalers, are not able to divert food organics this way. According to Sinclair Knight (1994) and Axis Environmental (1996) most food

manufacturers and wholesalers have established alternatives to the disposal of food organics in landfill (i.e. collection of meat by products collected for pet food processing). Food organic collection service operators should seek to engage with manufacturing and wholesaling businesses to secure large volume of food organics that are generally uncontaminated since these businesses have a better control on their food organics than businesses in other business group.

6.4.4 Food Retailing

Substantial amounts of waste were generated by supermarkets and grocery stores (over 37 m^3 per week across 8 businesses). Large amounts of food organics are typically associated with food retailing business as high food quality standards and consumer demands result in the disposal of still edible but imperfect foods. Indeed, supermarkets reported that 33% of food organics originated from damaged items and 28% from items not up to standard with the half of food organics generated consisting of fresh fruit and vegetables. Kantor et al. (1997) argued that high volumes of fresh produce waste are deemed acceptable by supermarkets due to high turnover rates that stem from large economies of scale. Indeed, a larger variety of fresh produce adds to the attractiveness of the store (Kantor *et al.*, 1997). These dynamics mean that supermarkets produce very high volumes of organic waste. Larger sized supermarkets had a much higher rate of food organics generation than smaller sized grocery stores. Supermarkets were extensively involved with the donation of fruit and vegetable waste to pig farms with all businesses surveyed reporting such practice while only one grocery store donated food organics to pig farms. One of the supermarkets also gave substandard fresh produce to Second Bite. Opportunities exist for further engagement with a charity organisation for the non participating supermarket and grocery stores to extend donation of "substandard" products and products that have passed the "best before" date but are still edible and food banks should seek to source more material from these businesses. Although fruit and vegetable are already largely diverted for animal feed in supermarkets 50% of food organics are still to be recovered. Given the constancy of business activity in supermarket and grocery stores and the large volume of food organics generated, organic waste collection operators should seek to secure material from these

businesses. According to the barriers identified, these businesses would need to be provided with either daily collection or every second day.

6.5 Research Limitations and Need for Future Research

Limitations of this study need to be considered. The low level of participation in the survey and the small non-representative sample obtained means that this research only provides explanatory and exploratory information. According to Groves *et al.* (1992 and 2004) the decision to participate or not in a survey is influenced by both survey specific factors (such as survey topic and incentives) and interviewee specific factors (such as respondents' interest in the topic, perceived risks and benefits in participation). Businesses could be provided with incentives toward participation (Groves *et al.*, 1992 and 2004). When contacted to seek participation in the survey businesses were provided with a non-monetary incentive. This was the provision of a cost-benefit analysis for the participation in a separate food organics collection service. Yet participation remained very low. It is also likely that in this research the business interested in the topic were overrepresented among respondents. This may have biased some of the results and explain the high willingness of respondents to participate in a separate food organics collection service (see Figure 5.18).

The low level of participation is also possibly due to the fact that the topic of food organics may have been perceived as sensitive for the corporate image of the business and considered commercial in confidence. The perceptions of risk and harm negatively impact the willingness to participate in surveys (Couper *et al.*, 2008). The results from the surveys were meant to be confidential. However, the perceived risk of disclosure may have deterred businesses from participating in the survey.

The survey of businesses that generated food organics for this research was done at one point in time (surveys were conducted from early winter to early spring). As such is a snapshot of the volumes and types of food organics and does not reflect changes in the seasonal volumes of food organics. Although businesses provided estimates in changes of the level of business activity from season to season, this did not allow an accurate estimate of the volume of food organics that would be generated over summer. The summer tourist season would have waste volumes much higher than that collected over the winter-early spring period. The results of this

research provide information that could help target large food organics generators to develop a separate collection service that would be economically viable. Given that economy of scale is an issue in most Tasmanian councils, there is also an opportunity for the HCC or a private operator to investigate the economic feasibility of a joint commercial residential green and food organics collection service similar to the one operating in Sydney. Future research is needed at a larger scale to ensure representativeness and gain a better understanding of the volumes of food organics generated in Hobart and which methods of disposal are used. Future research should also assess other waste associated with the disposal of food such as food packaging that constitutes an important part of the recycling stream.

6.6 Conclusion

Organic wastes represent 62% of all landfill waste, are the most carbon intensive materials in landfill, and are a major contributor to GHG emissions in the waste sector. Food organics is the major component of the organic waste stream and the second largest source of methane in landfills. However, only 10% of organic material generated is recycled nationally. There is a pressing need to increase the recovery of organic wastes to address both the issue of climate change and the scarcity of landfill space in Australian cities. This has been highlighted in the recently introduced *National Waste Policy: Less Waste, More Resources* (2009) and the *Tasmanian Waste and Resource Management Policy* (2009). Both of these documents call for an increased diversion of organic waste from landfill.

This research revealed that measures to avoid the generation of food organics were implemented at a greater extent than measures for the recovery of food organics. The implementation of such avoidance measures was motivated by financial concerns rather than by an altruistic desire to reduce waste. Donation of food organics for animal feed was the measure primarily used by businesses to recover food organics. A secondary measure involved the donation of surplus food to charity. Of 82.63 m^3 of food organics generated across all businesses, 25.51 m^3 (30.87%) was recovered. The Manufacturing and Wholesaling and Food Retailing business groups reported the highest rates of food organics recovery (100% and 30.82% of the material generated respectively). Food organics recovery within

businesses in the Accommodation and Food Services and Educational and Health Institutions sectors was very limited (0.07% and 0.23% of the material generated respectively).

Businesses reported a number of barriers to food organics diversion. The most important was the additional cost of waste disposal that businesses would have to bear if they were to participate in a collection service, along with the lack of financial incentives to do so. Businesses also reported as barriers the perceived 'absence' of a collection service and a lack of information on available options for food organics diversion. Despite these barriers most businesses indicated they were willing to participate in a separate collection service on the condition that it were cost beneficial or at least cost neutral.

To increase food organics diversion in the C&I sector in Hobart, businesses should be provided with information on existing services. However, businesses generally operate under legal and financial, rather than moral, constraints and it is unlikely that profit-driven organisations would separate food organics based on altruistic values. Businesses will be encouraged to take action if market conditions promote the possibility of cost savings on waste disposal. Low landfill levies in Tasmania currently provide a disincentive for businesses to divert their food organics and for private waste operators to establish separate food organics collection service that are economically viable. The behaviour of businesses towards food organics diversion will only change through the introduction of regulation and legislation jointly with increases in landfill levies so as to provide the necessary economic incentives for source separation. Additional research using a quantitatively determined sample of businesses would enable a more representative understanding of the volumes of food organics generated and the methods of disposal. Future research could also assess other waste associated with the disposal of food organics, such as food packaging, that constitutes an important part of the recycling stream.

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Appendix A: Participants Information Sheet

PARTICIPANT INFORMATION SHEET
SOCIAL SCIENCE/ HUMANITITES
RESEARCH

DIVERSION OF COMMERCIAL AND INDUSTRIAL FOOD WASTE FROM LANDFILL IN HOBART
FOOD WASTE SURVEY

Invitation

You are invited to participate in a food waste survey on food waste recycling among food and beverage businesses in Hobart.

The study is being conducted by:

- Guillaume Bonange, Masters Student, School of Geography and Environmental Studies
- Dr Lorne Kriwoken, Senior Lecturer, School of Geography and Environmental Studies

Guillaume will be supervised by Dr Kriwoken and will be completing the study in partial fulfilment of the requirements of a Master's of Applied Science Degree in the School of Geography and Environmental Studies.

1 'What is the purpose of this survey?'

Organic wastes can be decomposed by bacterial action into by-product compost. These include materials such as:

- food waste (i.e., food scraps, meat and bone scraps, fats and oils, bread, pastries and flour, food soiled paper products, and biodegradable cutlery);
- paper and cardboard (white paper, newspapers, magazines, cardboard boxes); and
- garden waste (i.e., grass clippings, branches from plants and tree clippings, leaves)

Organic waste represents 62% of waste entering landfill in Australia. When disposed in landfills, this type of waste can have significant environmental impacts. Indeed, decomposing organic waste in landfills releases methane, a greenhouse gas with a global warming potential 20 times that of carbon dioxide. Yet, only 33% of organic waste generated in Australia is currently recycled.

Food waste is the largest component of the organic waste stream. It is generated from sources such as: food manufacturing and processing facilities; supermarkets; institutions such as schools, prisons, and hospitals; restaurants and food courts; and households. Food waste represents 35% of municipal solid waste and 21.5% of Commercial & Industrial (C&I) waste that ends up in landfill.

While garden waste, paper and cardboard are largely recovered, the level of food waste recovery is very low nationwide.

The aim of this research is threefold: (1) assess the volume of food waste generated by a sample of businesses in Hobart; (2) determine how this food waste is removed and disposed; and (3) assess the barriers and opportunities to food waste diversion.

2 'Why have I been invited to participate in this study?'

You are eligible to participate in this food waste survey because you are currently operating a business related to the food and beverage industry and generate food waste as a by product of your activity.

3 'What does this study involve?'

The food waste survey consists of a face to face questionnaire which should take 15-30 minutes. The questionnaire gathers information on the volume of food waste generated by your business and what are the barrier and opportunities within your business to establish a source separation of food waste. The questionnaire includes four sections:

- Section 1 gathers general information of your business.
- Section 2 gathers information about what type food waste is generated by your business and where it is generated.
- Section 3 gathers information about your waste management system e.g. waste storage area as well as the containers used by your business, the frequency of removal of waste and the volume removed.
- Section 4 gathers information about the actions taken by your operation to reduce, re-use or recycle food waste. It also asks about incentives and difficulties.
- Section 5 assess your willingness to participate in a food waste collection program

The investigator will answer any question from the person surveyed and ensure all questions are answered. Once answered the questionnaires will be collected and brought back to UTAS for data interrogation.

It is important that you understand that your involvement is this study is voluntary. While we would be pleased to have you participate, we respect your right to decline. If you decide to discontinue participation at any time, you may do so without providing an explanation. All information will be treated in a confidential manner, and your name will not be used in any publication arising out of the research. All of the research will be kept in a locked cabinet in the office of Dr Lorne Kriwoken and will be securely destroyed five years after publication of the research.

Your completion and submission of this survey indicates your consent to participate in this study.

4 . Are there any possible risks from participation in this study?

There are no specific risks anticipated with participation in this study.

5 . What if I have questions about this research?
If you would like to discuss any aspect of this study please feel free to contact either Guillaume Bonange on 03 6226 2839 or Dr Lorne Kriwoken on 6226 2458. Either of us would be happy to discuss any aspect of the research with you. Once we have analysed the information from the energy audit, we will provide you a summary of our findings. You are welcome to contact us at that time to discuss any issue relating to the research study.

This study has been approved by the Tasmanian Social Science Human Research Ethics Committee. If you have concerns or complaints about the conduct of this study should contact the Executive Officer of the HREC (Tasmania) Network on (03) 6226 7479 or email human.ethics@utas.edu.au. The Executive Officer is the person nominated to receive complaints from research participants. You will need to quote [*HREC project number:*].
Thank you for taking the time to consider this study.
If you wish to take part in it, please sign the attached consent form.
This information sheet is for you to keep.

Appendix B: Consent Form

CONSENT FORM

Title of Project: DIVERSION OF COMMERCIAL AND INDUSTRIAL FOOD WASTE FROM LANDFILL IN HOBART

1. I have read and understood the 'Information Sheet' for this project.
2. The nature and possible effects of the study have been explained to me.
3. I understand that the study involves the assessment of the volume of food waste generated by THE COMPANY/BUSINESS NAME, opportunities and barriers to establish C&I food waste recycling and the completion of a questionnaire which should take about 15-30 minutes to complete.
4. I understand that participation involves no risk associated with the undertaking of the food waste survey except for the investigator who is covered by the university.
5. I understand that all research data will be securely stored on the University of Tasmania premises for five years and will then be destroyed.
6. Any questions that I have asked have been answered to my satisfaction.
7. I agree that research data gathered from me for the study may be published provided that I cannot be identified as a participant.
8. I understand that the researchers will maintain my identity confidential and that any information I supply to the researcher(s) will be used only for the purposes of the research.
9. I agree to participate in this investigation and understand that I may withdraw at any time without any effect, and if I so wish, may request that any data I have supplied to date be withdrawn from the research.

Name of Participant: _____

Signature: _____ Date: _____

Statement by Investigator

☐ I have explained the project & the implications of participation in it to this volunteer and I believe that the consent is informed and that he/she understands the implications of participation

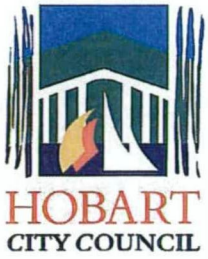
If the Investigator has not had an opportunity to talk to participants prior to them participating, the following must be ticked.

☐ The participant has received the Information Sheet where my details have been provided so participants have the opportunity to contact me prior to consenting to participate in this project.

Name of investigator _____

Signature of investigator Date

Appendix C: Support Letter



Enquiries to: Phil Walker
☎: 62 382812
✉: walkerp@hobartcity.com.au
Our Ref: PBW:w (document2)
Your Ref:

20 August 2010

To Whom It May Concern

Dear Sir/Madam,

LETTER OF INTRODUCTION FOR WILL BONANGE - FOOD WASTE TRIALS

This letter is to advise you of the Hobart City Council's support of Guillaume Bonange (Will) in his current university studies involving food waste generated by commercial operators.

Will has a Bachelor in Chemistry, and currently is completing a Masters of Applied Science in Environmental Studies, at the Tasmanian University. He has also been involved in a workplace learning placement with the Hobart City Council during May and June of this year.

Will approached this placement in a practical and efficient manner, and enthusiastically joined, and contributed to our team objectives, ensuring we obtain the best possible result from this trial.

During this placement with us Will was actively involved in the planning and introduction of Council's current commercial food waste trial which will continue until December 2010. He is also assisting in the collation and analysis of all data currently collected during this trial and monitoring our trial with great interest.

Will's current project involves the surveying of commercial manufacturers/operators that generate food waste within our municipality.

HOBART COUNCIL CENTRE, 16 ELIZABETH STREET, GPO BOX 503 HOBART TASMANIA 7001
TELEPHONE: (03) 6238 2711 TTY (03) 6238 2187 FAX (03) 6234 7109 AUSDOC: DX198
E-Mail: hcc@hobartcity.com.au Internet: http://www.hobartcity.com.au
ABN 39 055 343 428

It would be much appreciated if you could provide some time to assist Will with his project which ultimately will benefit all concerned.

Yours faithfully

(Philip Walker)
SOLID WASTE OFFICER

Appendix D: Survey Questionnaire

UNIVERSITY OF TASMANIA

DIVERSION OF COMMERCIAL AND INDUSTRIAL FOOD WASTE FROM LANDFILL IN HOBART

-

FOOD WASTE SURVEY QUESTIONNAIRE

Contact details:

Guillaume Bonange, University contact: 6226 2839; mobile: 0424551129
Dr Lorne Kriwoken, University contact: 6226 2458

Section 1: Profile of the Business

Q1. What is the name of the interviewee and his/her job title?

.....

Q2. What is the trading name and address of the business?

.....

Q3. Which of the following business categories best describes the nature of your business?

Manufacturing	Food Product and Manufacturing	
	Beverage and Tobacco Manufacturing	
Wholesale Trade	Agricultural Products Wholesaling	
Retail Trade	Specialised Food Retailer	
	Supermarkets and Grocery Store	
Accommodation and Food Services	Pub, Tavern or Bar	
	Cafes, Restaurant or Takeaway	
	Hospitality Club	
	Accommodation	
Education and Training	Preschool and School Education	
	Tertiary Education	
Health Care and Social Assistance	Hospital or Nursing Home	
	Residential Care Service	
None of the above		

Q4. How many days per week is the business open?

.....

Q5. How many hours per day is the business open/operational?

.....

Q6. Regarding the level of activity of your business which of the following statements would be most applicable to your business?

- Your business activity is constant all year around (less than 10% variation) ☐
- Your business activity varies by about 10% to 50% from season to season ☐
- Your business activity is highly variable from season to season (>50%) ☐
- Don't know / refused ☐

Q7. When is your business activity the....?

GREATEST

- Winter ☐
- Spring ☐
- Summer ☐
- Autumn ☐
- Don't know/ refused ☐

LOWEST

- Winter ☐
- Spring ☐
- Summer ☐
- Autumn ☐
- Don't know/ refused ☐

Q8. Do you close your business at any period during the year?

- Yes ☐
- No ☐
- Don't know ☐

Q9. How long is your business closed?

_____days/wks per year

Q10. In total, how many people does your business employ?

_____

Q11. How many of your staff are employed on a *full time / permanent part time / casual* or on a *seasonal* basis?

Staff employment	Full time	Permanent Part time	Casual or on seasonal basis
Number			

Q12. What is the level of staff rotation in your business every year?

- None ☐
- 1 to 25% ☐
- 26 to 50% ☐
- 51 to 75% ☐
- 76 to 100% ☐
- Don't know / refused ☐

Section 2: Food Waste Characterisation

Q13. From the following list, what types of food waste does your business generate? Out of a 100 percent of all the food waste you generate what proportion represents (cite the types of food waste generated)

Types of food waste	Yes/No	Proportion (%)
Fruit & vegetable material		
Pasta and rice		
Bread, pastries and flours *(Including rice & corn flours)*		
Meat and poultry		
Animal fats & oils		
Vegetable fats & oils		
Seafood *(Including shellfish, excluding oyster shells)*		
Dairy *(Solid and liquid)*		
Recalcitrants *(Large bones, oyster shells, coconut shells)*		
Other (Precise: _____)		

Q14. Do you know where your food waste originates from?

YES ☐ NO☐ If NO go to question 2d

Q15. Where does your food waste come from?
Can you please precise what proportion of the overall food waste your business generate is derived from each choice you have selected.

Origin of food waste	Yes/No	Proportion (%)
Leftovers – Uneaten food served to the public *(garnish, served uneaten food)*		
Leftovers - Excess food that has not been served to the public.		

Food preparation *(Meat offcuts, vegetable/fruit peelings)*		
Damaged Items *(due to poor handling)*		
Stock went out of date *(Incorrect storage/stock rotation, excessive purchasing with stock going out of date)*		
Other (Precise: _____)		

Section 3: Waste Management System

Q16. a) Does your business share its waste storage space with another business?

YES ☐ NO ☐ go to **Q17**

b) If YES, how much floor space do you share?

Length:.....m x Breadth:...m x Height:.....m = ...m^3

Q17. a) Are there any issues with current arrangements of your waste and recyclable storage area?

YES ☐ NO ☐ if NO go to **Q18**

b) What issue(s) have you identified for your waste storage area?
Please tick each issue identified.

i. The storage space is too small ☐
ii. There are pests and insects issue ☐
iii. There are odour issue ☐
iv. Access issue (for collection) ☐

Q18. a) Does your business potentially have additional space for a "food waste only" container?

YES ☐ NO ☐ if NO go to **Q19**

b) If YES, what volume could the container be?
V= .... m^3

c) Is this potential space indoors/outdoors?
Indoors ☐ Outdoors ☐

d) Does it have good/bad vehicle access?
Good ☐ Bad ☐

Q19. a) Do other businesses share the waste/recyclables containers used by your business?

YES ☐ NO ☐ If NO go to **Q20**

b) If YES, how many businesses share the container?

.....

c) What proportion of the container does your business fill?

- None ☐
- 1 to 25% ☐
- 26 to 50% ☐
- 51 to 75% ☐
- 76 to 100% ☐
- Don't know / refused ☐

Q20. Is food waste mixed with other garbage when disposed of or is it disposed of in a separately?

.....

Q21. What type of container is garbage stored in prior to collection?

.....

Q22. How many of the container(s) are used by the business to store garbage?

.....

Q23. What is the volume of the container(s) in which garbage is stored?

.....

Q24. How often is waste collected per week?

- Daily ☐
- Two to three times a week ☐
- Once a week ☐
- Once a fortnight ☐
- Less often ☐
- Don't know / refused ☐

Is collection…..:
- Scheduled ☐
- on a need basis ☐

Q25. How full are the containers on average when collected?

- Totally empty ☐
- 1 to 25% full ☐
- 26 to 50% full ☐
- 51 to 75% full ☐
- 76 to 100% full ☐
- Don't know / refused ☐

Q26. What proportion of the container(s) does food waste represent when waste is collected?

- None ☐
- 1 to 25% ☐
- 26 to 50% ☐
- 51 to 75% ☐
- 76 to 100% ☐
- Don't know / refused ☐

Q27. Which waste collection operator is in charge of removing your garbage?

- Hobart City Council ☐
- Veolia Environmental Services ☐
- Jones' Waste Management Pty Ltd ☐
- Aussie Waste Management ☐
- Trashaway ☐
- Discount Bins ☐
- Other ☐ Precise: _____
- None (removal done by business) ☐
- Don't know / refused ☐

Q28. On what basis does your waste contractor charge your business for garbage removal?

- By collection ☐ $_____
- By volume ☐ $_____
- By weight ☐ $_____
- Fixed monthly/yearly charge ☐ $_____
- Other method ☐ Precise: _____
  $_____
- Don't know / refused ☐

Q29. How does the waste contractor determine the waste collection fee for your business?

Regardless of the volume of waste disposed ☐
Depending on the volume of waste dispose ☐

Q30. Would the reduction of garbage disposed as a result of separating food waste generate savings on collection charges?

- Yes ☐
- No ☐
- Don't know ☐

Q31. a) Is your waste collection covered by a contract?
YES ☐ NO ☐ If NO go to Q33

b) If YES, what is the length of the contract?

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Section 4: Food Waste Minimisation and Recycling

Q32. Does your organisation currently take measures to minimise food waste generation and/or recover food waste?

- Yes ☐
- No ☐ Go to **Q34**
- Don't know/ refused ☐

Q33. What is the main measure undertaken to avoid food waste generation and disposal in your operation?

_____

Q34. Which of the following measures does your business take to avoid food waste generation and disposal?

Fill table

Q35. Which of the following measures does your business take to recover/reprocess food organics generated in your business?

For the measures undertaken can you precise what volume of food organics is separated from your garbage and how frequently is it separated?

Q36. How frequently is it separated?

MEASURES		Currently undertaken		Volume removed per week	Frequency of removal per week
	Do you…	**YES**	**NO**		
AVOIDANCE THROUGH CLEANER PRODUCTION	Reuse leftover food				
	Match food supply with demand				
	Buy material in bulk or in concentrated form				
	Purchase pre-prepared foods				
	Ensure good stock rotation				
	Discount products approaching used by date				
	Other (precise _____)				
RECOVERY AND REPROCESSING OF FOOD ORGANICS	Donate leftover food to food bank Which food bank? _____	Collected/Delivered *(circle)*			
	Provide food waste to an animal feed producer/rendering	Collected/Delivered *(circle)*			
	Donate leftover food for animal feed	Collected/Delivered *(circle)*			
	Undertake on-site composting or worm farming				
	Take food scraps home for composting	Collected/Delivered *(circle)*			
	Provide food waste to a composting facility	Collected/Delivered *(circle)*			
	Send food that has passed its used by date back to a central depot	Collected/Delivered *(circle)*			
	Other (precise _____)				
	Don't know				

Q37. What encourages your business to reduce/re-use/recycle food waste?

Please tick each appropriate answer

i. Avoiding lost revenue ☐
ii. Reducing the volume of garbage generated ☐
iii. Saving money on waste collection bill ☐
iv. Environmental benefit ☐
v. Helping the community in need ☐
vi. Head office corporate policy ☐
vii. Other please detail ☐

.....

Q38. What is the main difficulty/barrier to participating in a source separated food waste collection you identify?

_____

Q39. Do you consider the following as potential difficulties/barriers to separate and recover food waste? A 1 means it presents no difficulty and 5 means it presents a significant difficulty.

Potential Difficulties/barriers	**1**	**2**	**3**	**4**	**5**
Non-availability of food waste collection services					
Lack of information on available service (food banks)					
Cost of food waste collection					
Lack of financial incentive					
Lack of support from your staff					
Lack of staff time to sort food waste material					
Staff education on food waste contaminant					
Lack of space in your food preparation area for a separate container for food waste.					
Lack of storage space for a 'food waste only' container in your waste storage area					
Poor collection vehicle access (requiring small vehicle or manual handling)					
Health and safety concerns					
Other (please provide details)					

Section 5: Willingness to Recover Food Waste

Q40. On a scale of 1 to 10, where 1 is not at all interested and 10 is very interested, how interested are you in liaising with a food charity organisation to donate your food surplus?

RANK	1	2	3	4	5	6	7	8	9	10
INTEREST IN FOOD SURPLUS DONATION										

Any comment on this scoring:

Q41. On a scale of 1 to 10, where 1 is not at all interested and 10 is very interested, how interested are you in participating in a permanent food waste collection service for your organisation?

RANK	1	2	3	4	5	6	7	8	9	10
INTEREST IN FOOD WASTE COLLECTION										

Any comment on this scoring:

Q42. Would you be willing to pay to get a permanent food waste collection?

- Yes ☐
- No ☐ GO to **Q44**
- Don't know/ refused ☐

Q43. If yes how much would your business be willing to pay on top of your current garbage removal charges

- $1 to $2 per week ☐
- $2 to $5 per week ☐
- $5 to $10 per week ☐
- $10 to $20 per week ☐
- Nothing ☐
- Don't know / refused ☐

Q44. Would you be interested to participate in a permanent food collection service if it was cost neutral for your business?

- Yes ☐
- No ☐
- Don't know/ refused ☐