SORTING IT OUT

Food waste separation in large New Zealand hotels: Barriers and Incentives

Richard L Singleton

Thesis

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School of Geography, Environment and Earth Sciences
Victoria University of Wellington

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ABSTRACT

Food waste presents a resource management challenge for New Zealand communities, businesses and governance institutions. The energy, labour, soil, water and myriad other inputs used to grow, manufacture, distribute and prepare food are lost with each kilogram that is thrown away. Numerous technologies enable the energy and nutrient potential within food waste to be recovered. Systems of this type are most efficacious when food is separated from other waste streams at source.

This research demonstrates that New Zealand's existing waste related legislation has the potential to foster market conditions favourable to food waste recovery initiatives and technologies. However, the suite of policy instruments currently actuated provides weak stimulus for the adoption, innovation or expansion of food waste diversion ventures amongst stakeholders.

Current legislation does little to incentivise food waste separation within hotels. Many hotel operators are reliant upon third party provision of waste collection, recovery and or disposal services. Exceptions include operators for whom onsite food waste processing systems or arrangements with individual farmers (who collect waste at low cost) are viable.

Within this thesis, food waste, the New Zealand tourism product and the environment's capacity to assimilate waste are conceptualised as common pool resources requiring interconnected management regimes.

Key Words: Food waste, organic waste, recovery, diversion, waste management practice, New Zealand tourism, hotel, tourism commons.

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Acronyms

AD	Anaerobic Digestion
BTE	Background Tourism Element
CH_4	Methane
DEFRA	Department for Environment Food and Rural Affairs (United Kingdom)
DOC	Degradable organic carbon
DFO	Disposal facility operator
GA	Governance Authority
GHG	Greenhouse gas
HO	Hotel operator
LFG	Landfill gas
OW	Organic waste
MfE	Ministry for the Environment (New Zealand)
NGO	Non-government organisation
MoT	Ministry of Tourism (New Zealand) *became the Tourism Strategy Group (TSG) in 2011*
ST	Sustainable Tourism
TA	Territorial Authority (New Zealand district and regional councils)
TSG	Tourism Strategy Group
MSW	Municipal Solid Waste
NZWS	New Zealand Waste Strategy (abbreviation is followed by relevant year)
WRAP	Waste and Resources Action Programme (United Kingdom)
WM	Waste Management (refers to the practice, not the company)
WMC	Waste Management Contractor
WMMP	Waste management and minimisation plan

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1
INTRODUCTION

Food waste presents a resource management challenge for New Zealand communities, businesses and governance institutions. The energy, labour, soil, water and myriad other inputs used to grow, manufacture, distribute and prepare food are lost with each kilogram that is thrown away (Hogg, et al., 2010; Stuart, 2009).

Initiatives that *prevent* food waste from occurring ensure resources are preserved and provide the best environmental outcome (Kim & Kim, 2010). However, where food continues to be wasted, *recovery* provides a better solution than *disposal* (Hogg, 2006). Recovery enables the energy and nutrients contained within food waste to be utilised *(ibid)*. This thesis explores the barriers and incentives to implementing hotel food waste management practices that ensure the resource potential of food waste is maximised. That potential is best realised when food waste is separated from all other waste streams at its source: the hotel kitchen.

Figure 1.1 Hotel kitchen and staff. *Source: Yang, 2004*

1.1. The food waste recovery problem

This research is primarily focused upon food waste recovery (also commonly referred to as *diversion*).[1] The importance of food waste prevention is acknowledged and, where such issues bear relevance to 'the barriers and drivers of separating food waste in hotels' they are discussed. However, the principle aim of this work is to explore solutions to an environmental problem accumulating in the bins of hotels throughout New Zealand every day: discarded food.

Food waste constitutes a significant portion (53%) of New Zealand's largest single waste class, organic waste (Ministry for the Environment [MfE], 2007b). This research demonstrates that New Zealand hotels with restaurant, café and functions facilities produce significant volumes of food waste and some do not enable recovery of the material despite the proven environmental benefits attributed to such practices.[2] Instead, it is common practice for food waste to be consigned to landfills.

When decomposed in the anaerobic conditions typical of landfills, food waste generates methane (CH_4), a green house gas (GHG) with a global warming potential 25 times greater than that of CO_2 (Forster, et al., 2007; Intergovernmental Panel on Climate Change [IPCC], 2001)[3]. Waste generated CH_4 emissions are targeted for reduction and or limitation under the Kyoto protocol which New Zealand ratified in 2002 (MfE, 2007a).[4]

[1] *Diverted* from landfill or other technologies with adverse environmental effects.

[2] Waste audits performed in two large New Zealand hotels revealed that organic waste constitutes between 40% and 85% of the total waste stream. Total waste stream does not include recyclables: glass, some plastics, tin, paper and cardboard. It is expected that hotels with comparable room capacities, facilities, activities and occupancy rates produce food waste volumes within this range each year. Details relating to private waste audits are provided at Appendix Two (A-2.9).

[3] When considered across a 100 year time horizon.

[4] CH_4 emissions are sanctioned under the United Nations Framework Convention on Climate Change (UNFCCC) 1998:Article 2. (1) a.viii. New Zealand is obligated to file an annual GHG emissions inventory that includes statistics on emissions from the waste management sector.

Landfills require the allocation of large areas of land and specialised environmental management over extended periods of time. Food waste contributes significantly to the space requirements of modern landfills (Tchobanoglous & Kreith, 2002). Many landfills capture and destroy or utilise the CH_4 generated by organic wastes. However the efficacy of collection systems is contentious and the GHG emissions generated by rapidly decomposing food waste may escape to atmosphere before landfill caps are installed *(ibid)*.

Composting (including vermi-composting) and anaerobic digestion (AD) provide an alternative to landfill (for food waste) and are considered to provide greater efficiency in regards to CH_4 mitigation or capture. Of these two technologies, AD is considered to provide the greatest net benefit (Bakas & Herczeg, 2010; Hogg, et al., 2010; Waste and Resources Action Programme [WRAP], 2010a). Both composting and AD systems must be operated correctly[5] and often require food waste to be separated from other waste types at source *(ibid)*. Separation is essential if food waste is to be used as animal feed, a solution which also mitigates the GHG emissions associated with landfill disposal (Bingemer & Crutzen, 1987).

Social, environmental and economic trade-offs inherent to each of these *end of cycle solutions* must be balanced against the regulatory, technical and logistical context that determines the efficacy of each technology type. Whilst some recovery processes can present a satisfactory balance between these considerations, the development of industry to support food waste management systems can perpetuate a demand for discarded food, thereby undermining waste prevention initiatives that target other phases of the food production cycle (Stuart, 2009).

[5] For example, compost windrows can become anaerobic if managed incorrectly.

1.2. Food waste management in New Zealand

In New Zealand, data for the waste type classified as organics (or putrescibles)[6] has been reported by various agencies including disposal facility operators (DFO), local and regional councils and the Ministry for the Environment (MfE). Collecting and coordinating data relating to the composition and source characteristics of such an expansive waste category has proven problematic for agencies charged with responsibilities of this type. Opposition to reporting regulations combined with the complexity inherent to aggregating waste related information has resulted in stakeholders having limited knowledge of New Zealand's organic waste dynamics (including food waste). Information deficiencies can hinder the development of management policies and initiatives with advantageous social and environmental outcomes (MfE 2009c; Parliamentary Commissioner for the Environment [PCE], 2006).

Implementing policy designed to minimise environmental impacts whilst ensuring effective management of the food waste resource requires detailed understanding of the complexities involved. Food waste management issues occur concurrently amongst social, economic and environmental dimensions. The New Zealand government has acknowledged that decreasing the amount of waste disposed (via prevention and or recovery) can protect the environment from harm and provide environmental, social, economic and cultural benefits (MfE 2010b).

A key step towards achieving effective food waste management practices is to encourage prevention and recovery initiatives amongst those sectors known to generate significant amounts of food waste in relation to their other waste streams. The hospitality industry has been identified as such a sector (Ball & Abou Taleb, 2010; Waste and Resources Action Programme [WRAP], 2011c).

[6] The terms 'Organics' and 'Putrescibles' are both used by New Zealand's Ministry of the Environment to describe a waste class with a composition that includes: kitchen and food waste, green waste and other organic waste such as food processing waste and dead animals (MfE, 2009c).

Separating food waste (from other waste types) presents a challenge at each step of the waste cycle, from food production, distribution, procurement and preparation, through serving and clearing to accumulation as refuse, collection and disposal or utilisation. Solutions aimed at minimising environmental impact require cooperation between private and public sector interests at all levels. Effective waste management requires 'buy-in' from hotel owners, operators and staff alongside waste contractors, landfill managers and governance authorities.

This thesis aims to provide key stakeholders with sound research from which to develop effective waste management policies. The findings are of particular relevance to hotel owners, operators and staff, industry associations, waste management professionals and governance institutions.
It may be possible to extrapolate recommendations and conclusions to the hospitality sector at large. However, it should be noted that this thesis is focused upon food waste separation *within* hotels and the accessibility New Zealand hotel operators have to environmentally benign end of cycle technologies.[7] Examining prevention and recovery initiatives at points along the food supply chain that precede the hotel kitchen is beyond the scope of this thesis.

[7] In this regard the study is focused upon commercial food waste, not residential (household).

1.3. Aims and Objectives

The overarching aims of this research are:

1) To gain an understanding of the barriers and incentives to food waste separation in large commercial hotels.

2) To provide stakeholders with sound research from which to develop effective waste management policies.

The objectives of the thesis are:

1) To enable the food waste management practices of New Zealand hotels to be orientated within an international context by identifying the barriers and incentives, relevant debates, theoretical perspectives and knowledge 'gaps' present in the literature.

2) Identify the barriers and incentives encountered by hotel waste management stakeholders in relation to separating food waste. This group includes hotel owners, management and staff; disposal facility operators; waste management contractors and governance authorities.

3) Estimate the quantity of food waste typically produced by large hotels with restaurant facilities in the context of a meaningful variable such as guest nights (result is likely to be a range rather than a definitive quantity).

4) Extrapolate the *food waste per hotel guest night* estimate (objective 3) with Commercial Accommodation Monitor (CAM) data and produce *estimated RTO (Regional Tourism Organisation areas) and national hotel food waste production ranges.*

5) Estimate the GHG generating potential of the *estimated RTO area and national hotel food waste production estimates* (produced at objective 4) in the context of landfill.

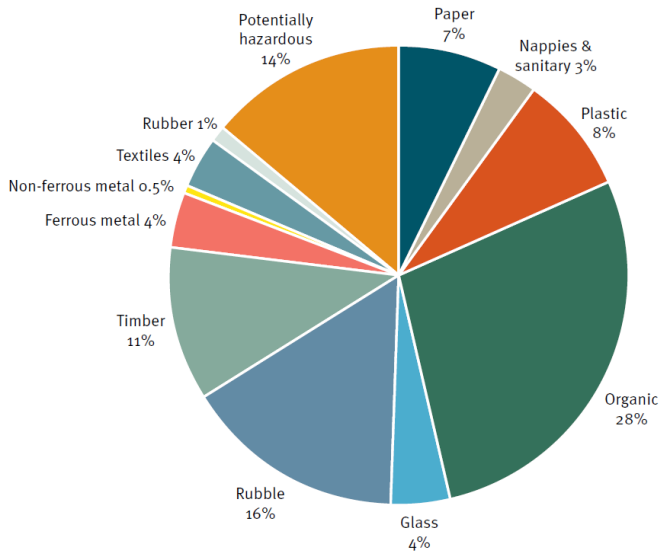
2
BACKGROUND

This chapter provides an overview of food waste management in New Zealand. Key concepts and governance mechanisms introduced in this section are analysed in an international context at the literature review (chapter four). Interview results presented in chapter five, and policy recommendations presented at chapters six and seven also refer to the contents of this section.

2.1. New Zealand's Food Waste

Organic wastes (including food waste) constitute about a quarter of the total waste deposited at landfills throughout New Zealand each year (MfE 2007a; MfE 2009c). Rudimentary calculation based on MfE reports demonstrate that approximately 884,000 tonnes of organic waste was interred within landfills in a one year period spanning 2007 and 2008. [8]

Figure 2.1: Waste Composition proportions – national indicator sites 2007-08



Source: *MfE (2009b:5)*

[8] The methodology and sources used in this estimation are detailed at Appendix Two (A-2.5).

Territorial authorities (TA) are responsible for managing solid waste. Waste management plans must describe how a TA intends to manage waste in a district and the waste hierarchy[9] must be considered (New Zealand Auditor General, 2007).[10]

Numerous policies, regulations and initiatives designed to address waste management (WM) issues have been proposed, designed and or implemented by community groups, non-government organisations (NGO), TAs, businesses and successive New Zealand governments. Those most relevant to the aims and objectives of this thesis, including similar initiatives in the tourism and hotel sectors are reviewed below.

2.1.1. 2002 NZ Waste Strategy & 2006 Review of Progress

In 2002 the Ministry for the Environment (MfE) and Local Government NZ (LGNZ) produced the government's primary policy on waste, the NZ Waste Strategy 2002 (NZWS 2002). The principle aim of the strategy was to develop more effective and efficient waste management and minimisation practices throughout the country. TAs are not obligated to comply with the Waste Strategy, however the document seeks to coordinate the strategic direction of national waste management and it is expected that TAs will develop plans in accordance with it (New Zealand Auditor General, 2007).

Targets of the NZWS 2002 most relevant to this thesis included:

> **Target 2.1** By December 2003, all territorial local authorities will have instituted a measurement programme to identify existing organic waste quantities, and set local targets for diversion from disposal.

[9] The waste hierarchy is a preferential scale upon which differing management options can be ordered. Under the Local Government Act 2002, TAs must prioritise options in the following order (from high to low): reduction, reuse, recycling, recovery, treatment, disposal (New Zealand Auditor General 2007:14). The hierarchy is discussed in greater detail at section 4.2.

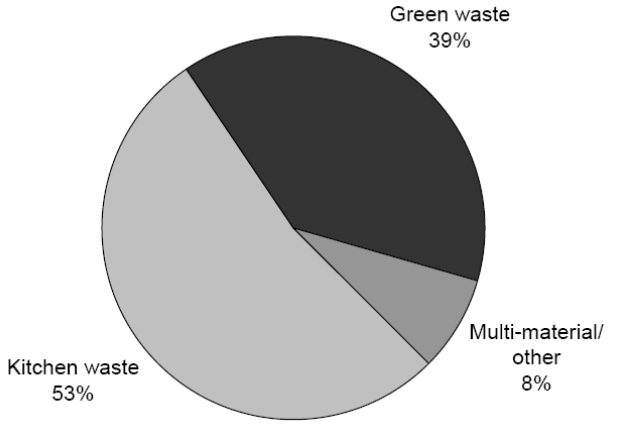
[10] The Local Government Act 1974 does not provide any specific directions in relation to the management of organic waste. However, it encourages territorial authorities to prioritise waste recovery over landfills disposal (New Zealand Auditor General 2007:53).

Target 2.3 By December 2007, a clear quantitative understanding of other organic waste streams (such as kitchen wastes) will have been achieved through the measurement programme established by December 2003.

Target 2.5 By December 2010 the diversion of commercial organic wastes from landfill to beneficial use will have exceeded 95 percent.
(Ministry for the Environment, 2002a)

Target 2.3 of the 2002 NZWS aimed to achieve a clear quantitative understanding of differing organic waste streams such as kitchen wastes (commonly known as, and referred to within this thesis as food waste). As illustrated in figure 2.2 below, analysis of this type was carried out over subsequent years resulting in an improved understanding of the main organic waste types (MfE 2007b).

Figure 2.2: Breakdown of the total organic waste stream, 2005/06



Source: *MfE (2007b)*

Figure 2.2 demonstrates that food waste represents a significant portion of the total organic waste stream. Figures provided in MfE reports of this era demonstrate New Zealanders dispose of approximately 468,000 tonnes of food waste to landfill each year (MfE, 2007b).[11] It is not known however what fraction is attributable to the commercial or residential sectors respectively, or the multitudinous sub-sectors active within these.

A 2007 review of the 2002 NZWS[12] acknowledged that achieving successful waste diversion practices is largely dependent upon sufficient knowledge of waste stream dynamics. The review also highlighted the need for local authorities to improve monitoring systems.[13]

Organic waste generation *sources* were not identified at a definitive sub-sector scale during the Target 2.3 analysis. Understanding waste stream dynamics at a sub-sector resolution would enable policy initiatives to be directed towards sectors (or sub-sectors depending upon definition) that can make economically efficient and environmentally significant changes. Such detailed investigation was not proposed in the 2002 NZWS presumably due to the prohibitive information costs involved.

This thesis intends to contribute to the organic waste management discourse by providing empirically derived food waste generation rates for the New Zealand hotel sub-sector (see objective 3).[14] The qualitative elements of the research are intended to enhance understanding of the barriers and incentives to food waste separation within hotels (objective 2). Recommendations and conclusions are applicable to other sub-sectors (particularly amongst hospitality) and bear relevance to the management of food waste amongst policy and governance contexts.

[11] The methodology and sources used in this estimation are detailed at Appendix Two (section A-2.5).

[12] The MfE 2007 review (conducted in 2006) was preceded by a *Review of Targets* published in 2004.

[13] This point was also reiterated in the report, *Changing Behaviour* published by the Parliamentary Commissioner for the Environment in 2006 (more detail is provided below).

[14] The importance of determining generation rates, rather than only measuring disposal quantities is recognised in both the 2002 Waste Strategy and PCE 2006.

The MfE 2007 review noted that systematic diversion of organic waste to landfill remained limited and recommended a greater focus on this priority area (MfE 2007b). Fundamental aspects to any successful diversion scheme include a measurement programme and diversion targets (PCE, 2006). Target 2.1 of the 2002 NZWS required all TAs to institute a measurement programme to identify existing organic waste quantities and set local targets for diversion from landfill. The target date was December 2003 and in 2006 the target had not been met. Some TAs were not recording data for waste either diverted from or sent to landfill. This situation was exacerbated by the lack of a uniform, standardised measurement system that could render data from differing sources as comparable (MfE 2007b). The 2007 review also noted that some TAs had not set diversion targets.

The 2002 NZWS recognised New Zealand's waste related legislation was inadequate for meeting the targets and goals set out within it. Moreover, uncertainty in the current legislation was considered as "a barrier to the use of economic instruments by central and local government" (PCE 2006:9).

2.1.2. Parliamentary Commissioner for the Environment Report 2006

In 2006 the Parliamentary Commissioner for the Environment (PCE) released a report titled *Changing behaviour: Economic instruments in the management of waste.* The report demonstrated little progress had been made on a number of the key actions presented in the 2002 NZWS.[15] These included central governments assessment of economic instruments (as mechanisms that incentivise waste minimisation and affect behaviour change) and the coordination of national waste data.

[15] It is important to note that the PCE (2006) report was not an audit or review of the 2002 NZWS. Instead, the primary focus was to examine the role economic instruments play in the management of waste and, in particular, in meeting the targets of the 2002 NZWS.

2.1.3. NZ Waste Minimisation Discussion Document 2009

In 2009 *Waste Minimisation in New Zealand: A Discussion Document* was produced by the MfE. This document was designed to facilitate consultation on proposed policies designed to accompany the Waste Minimisation Act 2008 (discussed below) and also sought feedback on the 2002 NZWS targets with a vision to update and revise them. Relevant, updated targets proposed in the 2009 document included:

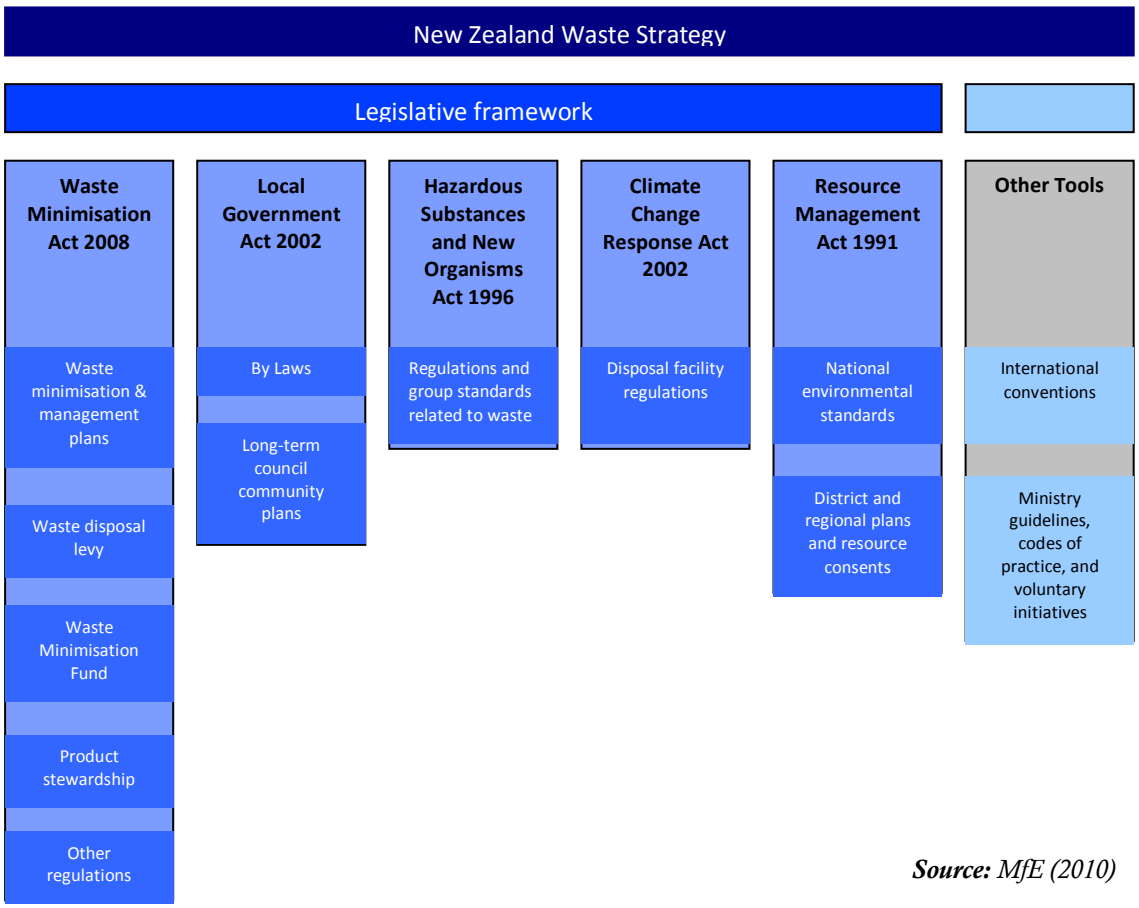
> **Target 1** By 2015, reduce the quantity of waste (tonnes) disposed to landfill per person per year by 20 per cent relative to an established 2010 baseline.
>
> **Target 3** By 2012, have a system in place for the on-going monitoring of the composition of organic waste, the amount disposed of at landfills and diverted from the waste stream.
>
> **Target 14** By 2012, the Ministry for the Environment will work with local authorities to develop a national reporting template that councils will use to report to the Ministry on progress against their waste management and minimisation plans and other waste related activities.

2.1.4. 2010 Waste Strategy

The New Zealand Waste Strategy 2010 marks a departure from the target based approach of the 2002 NZWS and 2009 Discussion Document, positing a "more flexible approach" with "two high level goals: reducing harm and improving efficiency" (MfE 2010a:3). The 2010 strategy contains no information regarding progress of the 2002 NZWS targets or the proposed targets contained in the 2009 Discussion Document. The 2010 strategy observes that many of the 2002 NZWS targets were "unable to be measured or achieved" and recognised the green house gas emissions associated with organic waste as an "other form of harm" (when differentiated with that posed by hazardous waste types) (MfE 2010a:3).

The 2010 Strategy is designed to play an overarching role in New Zealand's "comprehensive toolkit for managing and minimising waste", the principal elements of which are depicted, and summarised in figure 2.3.

Figure 2.3: New Zealand Waste Management policy framework



Source: *MfE (2010)*

2.1.5. Waste Minimisation Act 2008

The Waste Minimisation Act 2008 (the Act) provides for the imposition and adjustment of a Waste Levy (currently $10 per tonne) designed to raise revenue for promoting and achieving waste minimisation practices and to increase the cost of waste disposal, thereby incentivising disposal minimisation practices.

50% of the Levy raised funds are assigned to local authorities for the promotion or realisation of waste minimisation objectives established in their Waste Minimisation and Management Plans (WMMP). The other 50% are available via the *Waste Minimisation Fund* which is a contestable round designed to increase resource efficiency, reuse, recovery and recycling thus decreasing the amount of waste disposed to landfill. Principle objectives include investment in waste minimisation infrastructure and systems, and

developing educational and promotional capacity. Funding criteria are developed and allocations made by the Minister for the Environment (MfE 2010a).

2.1.6. Waste Minimisation and management plans

In accordance with the Act, all TA's must adopt a Waste Minimisation and Management Plan (WMMP). TA's were required to review WMMPs by 1 July 2012 and within every six year period following that date. Reviews are to be preceded by a waste assessment designed to attain information relevant to the WMMP and must include a set of options to meet the forecasted waste-related demands of the district (MfE 2010a). This regime ensures that diversion, collection and disposal alternatives are considered during planning processes (Hogg, et al., 2010).

2.1.7. Climate Change Response Act 2002

The Climate Change Response Act 2002 enables New Zealand to meet its Kyoto Protocol obligations. In 2007, GHG emissions from waste constituted 2% of NZ's total emissions. Solid waste[16] was the largest contributor within the sector generating 78.9% (MfE 2009a)[17].
Principle legislative instruments most relevant to the management of food waste and related to the Climate Change Response Act 2002 include:

The Emissions Trading Scheme (ETS)

Climate Change (Unique Emissions Factors) Regulations 2009

Climate Change (Unique Emissions Factors) Amendment Regulations 2010

Climate Change (Waste) Regulations 2010

National Environmental Standard for Air Quality: Standard for Control of Landfill Gas

[16] Solid waste is all waste generated as a solid or converted to a solid for disposal. It includes paper, plastic, glass, metal, electronic goods, furnishings, garden and other organic wastes (MfE 2002b).

[17]The other categories were: wastewater handling at 21.0% and waste incineration at .1% (MfE 2009c).

2.1.8. Emissions Trading Scheme (ETS)

The ETS requires all DFO's[18] to report information about their methane emissions from 1st January 2012 and to surrender New Zealand Units (NZUs) matching their emissions from 1st January 2013 (MfE 2011a).
DFO's are obligated to measure and record the gross tonnage and diverted tonnage of each 'class' of waste disposed at a facility in each calendar year *(ibid:4)*. A class may be defined as broadly as 'municipal waste' or may refer more narrowly to a specific type of waste, provided the DFO can monitor such a class satisfactorily *(ibid:7).*

The *National Environmental Standard for Air Quality: Standard for Control of Landfill Gas* (NES)[19] operates in conjunction with the ETS and requires landfills with a total capacity of over 1 million tonnes to collect and destroy or utilise landfill gas via technologies such as waste to energy systems.
Waste to energy systems generate energy/electricity by burning landfill gas (LFG) enabling DFO's to recoup expenses by offsetting the cost of externally sourced energy/electricity or by selling electricity onto the grid. Of the 60 landfills currently in operation, 16 (27%) are required by the NES to capture and destroy LFG.

[18] In the Act "a *disposal facility* is defined broadly, as a landfill or other site where waste is disposed of by long term placement in the ground or by incineration – but only when the facility is operated, at least in part, as a business and where some part of the waste disposed is from household sources. This means that all municipal landfill facilities are included in the NZ ETS. Industrial fills, cleanfills, or any facilities that accept no household waste, are excluded by the definition in the Act and are not part of the NZ ETS" (MfE 2011b).

This definition mirrors the Waste Minimisation Act 2008, so that disposal facility operators who currently have responsibilities under the Waste Disposal Levy will also be mandatory participants in the NZ ETS. Closed landfill sites are not covered by the definition of a disposal facility in the Act, and are not part of the NZ ETS. However, this applies only to facilities that are closed entirely. If a disposal facility that is still accepting waste has cells, layers, or other parts that are no longer used, NZ ETS obligations still relate to emissions from the site as a whole (MfE 2011b).

[19] Resource Management (National Environmental Standards Relating to Certain Air Pollutants, Dioxins, and Other Toxics) Regulations 2004. In the context of GHG emissions from landfills this legislation is commonly referred to as the National Environmental Standard to Control Greenhouse Gas Emissions from Landfills.

LFG is generated by both historic and new deposits. DFOs that have invested in LFG collection and destruction/utilisation technologies to meet their ETS and/or NES obligations (or have developed waste to energy systems of their own volition) could desire a consistent feedstock of organic material to ensure the full economic potential of the installation is realised.[20] Economic potential is derived via the energy produced and the DFOs NZU balance. In this regard the legislative framework could provide a perverse incentive in relation to food waste diversion.

2.1.9. Composting facilities and cleanfills

Composting facilities and cleanfills[21] are not included in the ETS. Waste that enters a disposal facility and is reused, recycled or removed from the facility within 6 months (or at any later time agreed to by the Secretary for the Environment) incurs no ETS obligations or Waste Levy charges as it is considered diverted tonnage (New Zealand Parliament, 2008). This can apply to organic waste types such as food waste when composted.

CO2 emissions generated during composting are not included in GHG emissions inventories because they are considered to be reabsorbed (via growing vegetation) the following year (IPCC 2006; MfE 2007a). At present, no national level regulations or mandatory standards exist for composting facilities. In the absence of such mechanisms sub standard practices could occur. The NZ Standard for Composts, Soil Conditioners and Mulches, NZS 4454:2005 is facilitated by Standards New Zealand and can be applied upon a voluntary basis. The perverse incentive discussed at section 2.1.4 may also manifest amongst recovery facilities. Operators could

[20] The New Zealand Auditor General (2007:11) recognised this issue and observed "there needs to be enough organic matter for ventures using landfill gas as an energy source to be commercially viable. The New Zealand Auditor General (2007:11) also notes "disposing of organic waste in landfills to generate gas for energy is somewhat contrary to the direction provided in the Local Government Act 1974 and the Waste Strategy, which encourage territorial authorities to divert waste away from landfills. Further, many territorial authority waste management plans…contain…zero waste policies or policies to divert waste from landfills."

[21] Cleanfills accept only inert materials such as concrete or brick, or virgin natural materials such as clay, soil and rock (MfE 2002b).

require consistent input of waste materials in order to optimise production capacity and ensure economic viability.

2.1.10. Landfill management capacity & planning

Pursuant to the Resource Management Act 1991, NZ landfill operators must meet regulatory standards to obtain resource consents that enable the development and operation of landfills. The standard of NZ landfills has greatly improved over the past 15 years and many substandard and small landfills have been closed. Landfill numbers decreased from 327 in 1995 to 60 in 2006 (MfE 2009c).

2.1.11. Landfill Cover

Landfill management requires the application of cover material. Organic cover materials, including compost exhibit the potential for microbial oxidation of landfill generated CH4 (Lou & Nair, 2009). MfE is currently considering whether to apply the Waste Levy to externally sourced landfill cover (at September 2011). Waiving the levy for material used to create landfill cover could create a greater demand for source separated organic inputs such as food waste.

2.2. Tourism Strategy

The Tourism Strategy 2015 acknowledges tourism must be "the first and most visible sector in NZ to … take up new environmental initiatives" and notes the importance of "actively taking steps to reduce and manage waste whilst engaging with local, regional and national authorities that provide waste management standards and facilities" (Ministry of Tourism, 2007:42).

The strategy identifies two key steps for improving waste management.

> "**17.** Tourism operators must regularly audit the amount of waste they produce, take steps to reduce, reuse, and recycle waste, and provide facilities that encourage visitors to do the same".
>
> "**18.** Work with local government to develop appropriate facilities, standards, and planning for waste management.
> Examples include … preparing regional waste strategies".

The strategy has a strong focus on protecting and enhancing New Zealand's image as a clean green destination for both domestic and international consumers. The prevalence of environmental initiatives within the strategy demonstrates the importance the sector places on enabling consumers to purchase a greener product, whether that is travel, hospitality or accommodation.

The application of initiatives identified within the strategy is voluntary for tourism operators. Qualmark's *Responsible Tourism* certification (also voluntary) is a key mechanism which enables operators to follow an industry defined sustainability standard. Criteria include the implementation of environmentally friendly practices like recycling or diverting waste from landfill.

This research is intended to bridge the interests of hotel operators, the Ministry for the Environment, local authorities, Qualmark, tourism industry bodies, the Tourism Strategy 2015 and the Tourism Strategy Group[22].

2.2.1. Tourism Strategy Group

The Tourism Strategy Group (formerly the Ministry of Tourism) has developed a set of twenty environmental indicators designed to provide an overview of the relationship between New Zealand's environment and the tourism sector (Ministry of Tourism, 2010a).

The overarching objectives of the indicator set are to:

a) monitor tourism's impact on the environment and
b) to monitor visitor's experience of New Zealand's environment

Two of the indicators relate to waste management, the latter bearing direct relevance to this thesis:

1. Regional Visitor Monitor respondents' satisfaction with rubbish bins and waste disposal facilities in their region of travel.[23]

2. Percentage of New Zealand Hotel Council members providing recycling facilities to staff and guests.

(Ministry of Tourism, 2010a:12)

[22] Formerly the Ministry of Tourism, currently a department within the Ministry of Economic Development.

[23] Baseline data from the Regional Visitor Monitor (RVM) for the year ended December 2009 shows that "visitors are generally satisfied with rubbish bins and waste disposal facilities in regions. On average, domestic visitors rate facilities 7.5 out of 10, and international visitors rate facilities 8.0 out of 10". The results demonstrate that the RVM scope and definition of waste disposal facilities did not extend to services provided within accommodation facilities (Ministry of Tourism 2010b).

Information pertaining to the second indicator was gathered via a 2008 survey sent to New Zealand Hotel Council members. The data was published in the Ministry of Tourism (2010a) Baseline Report and is presented in table 2.1 below. The results are assumed to provide a good proxy for the hotel sector overall, as 120 of New Zealand's large international chain, independent, privately-owned and boutique hotels constitute the New Zealand Hotel Council (Ministry of Tourism, 2010a).[24]

Table 2.1: Percentage of NZ Hotel Council '2008 Survey Respondents' providing recycling facilities

	Paper (%)	**Glass** (%)	**Plastic** (%)	**Tin** (%)	**Food Waste** (%)
All NZ	95	95	87	71	41
Auckland	100	100	96	68	20
Rotorua	88	100	75	63	63
Wellington	94	99	99	75	44
Christchurch	94	94	83	72	50
Queenstown	100	100	85	77	38

Source: *Ministry of Tourism (2010) reproduced from the New Zealand Hotel Council Annual Report 2008*

2.3. Information gaps

The question relating to New Zealand Hotel Council members providing recycling facilities received a 77% response rate in 2008 and was removed from the survey in 2009. The Ministry of Tourism (2010a) report notes that in order to garner a better response rate, a separate survey with an environmental indicator focus was to be sent to all New Zealand Hotel Council members electronically in 2010. However monitoring of this type has not been continued by the New Zealand Hotel Council (Singleton, 2010: pers. comm.)

[24] The Ministry of Tourism (2010a) note that a degree of caution should be exercised when interpreting the data as hotels with recycling facilities may have been more inclined to complete the question on recycling than those that did not.

Table 2.1, (derived from the New Zealand Hotel Council survey) does not provide information relating to the existence of food waste collection or disposal services within each respective region at the time the survey was conducted. Nor does it record the number of hotel operators with informal, low cost collection and or disposal arrangements with local farmers or compost producers.

As will be discussed throughout this thesis, the provision of localised, cost competitive (compared with landfill disposal) food waste collection services is considered a principal driver to food waste diversion practices. The New Zealand Hotel Council survey's omission of data relating to the implementation of recycling programs by hotel operators, in the context of local service availability represents an information gap.

The question that arises is: *'why are hotel operators who could be accessing food waste collection and disposal services not employing them?*

This research seeks to answer that question (as part of objective 2).

2.4. Limitations to Research Scope

Exploration of the environmental impacts of international and/or domestic tourism, agricultural practices and the transportation of organic waste are beyond the scope of this thesis. Furthermore, robust analysis of initiatives designed to prevent food waste at points along the food supply chain that precede a hotel, or for hotel operators to reduce food waste by employing waste reducing procurement practices lie outside the limits of a masters thesis.

2.5. Food waste recovery facilities in New Zealand

Only a small number of food waste recovery facilities currently exist in New Zealand These are listed in table 2.2 below along with green waste facilites in which food waste could also be processed. Whilst many green waste processing facilities have the potential to accommodate food waste, appropriate resource consents would be required.[25] Most aerobic composting technologies require some green waste to be combined with food waste to act as a bulking agent (typically 50%). Note that no anaerobic digestion facilities are available (Hogg, et al., 2010).[26]

Table 2.2: Existing Composting Facilities with potential for recovery of Hotel Food Waste

Facility Operator	Location	Technology
EnviroFert	Tuakau	Forced aeration static pile windrows.
Sustainable Waste Management	Ruakaka	CTI aerated „compost bag" system.
Waitakere City Council, Solid Waste Business Unit	Waitakere Transfer Station	VCU in-vessel composting unit (currently out of commission).
Wastebusters	Kaikoura	Horizontal Composting Unit.
Living Earth	Christchurch	Custom-designed tunnel system.
Capital Composting Limited	Wellington	Mechanical aeration in-vessel.
Selwyn District Council	Selwyn, Canterbury	HotRot in-vessel system.
Mackenzie District Council	Twizel	VCU
Rakaia Resource Recovery Group	Rakaia	Part mechanically-assisted IVC, part windrow maturation with added worms & cover.
Remediation NZ Limited	Taranaki	Composting & Vermicomposting.
TPI	Timaru	Gore-tex® covered windrows with forced aeration.

Source: *Reproduced from* Hogg, et al., (2010). Earthcare Environmental and Envirofert Household Organic Waste Cost Benefit Analysis Report, Eunomia Research & Consulting Ltd. Page 16

[25] In accordance with the Resource Management Act 1991.

[26] No operative anaerobic digestion facilities process household food wastes, other than where food waste is disposed of to sewer (Hogg, Wilson, et al. 2010). No operative anaerobic digestion facilities for commercial food waste could be identified.

3
METHODOLOGY

Methodologies applied throughout this research are described in this chapter. The intention is to assist the reader in discerning my approach to the research and to elucidate the influences that have motivated my selection of specific methods. Explicitly determining my positionality in this manner enables the dismissal of any sense of false neutrality and facilitates comprehension of the subjectivity and assumptions inherent to this particular research thesis. In the latter half of this chapter the qualitative and quantitative techniques used to meet the study's aims and objectives are described.

3.1. Personal intention and field of study

My intention in writing this thesis is to contribute to the work and vision many passionate New Zealanders, both past and present have committed their time, energy and resources to: developing initiatives, policies, legislation and systems that ensure New Zealand's resources are managed sustainably.[27] I hope to provide governance authorities, the tourism, hospitality and waste industries with sound research that will enhance the management of New Zealand's food, and food waste resource.

This research is conducted within the academic field of Environmental Studies. Environmental studies is acknowledged as a multidisciplinary field and therefore a research thesis of this type can be expected to draw upon differing research traditions and be informed by numerous theoretical perspectives (Maniates & Whissel, 2000; Soule & Press, 1998). Those I consider most constructive to analysis of my thesis topic have been selected for inclusion in the conceptual framework described below.

[27] A definition of sustainability is provided at section 3.2.4.

3.2. Conceptual Framework

The development of a conceptual framework is important as it enables clear visualisation of the concepts and assumptions, variables, relationships and theoretical perspectives that inform the study. Put simply, the conceptual framework is a researchers map of the territory being investigated (Miles & Huberman, 1994). The conceptual framework applied within this thesis *A food waste resource framework* (depicted on the following page) is constructed via the aggregation of key theoretical perspectives that bear direct relevance to the research question:

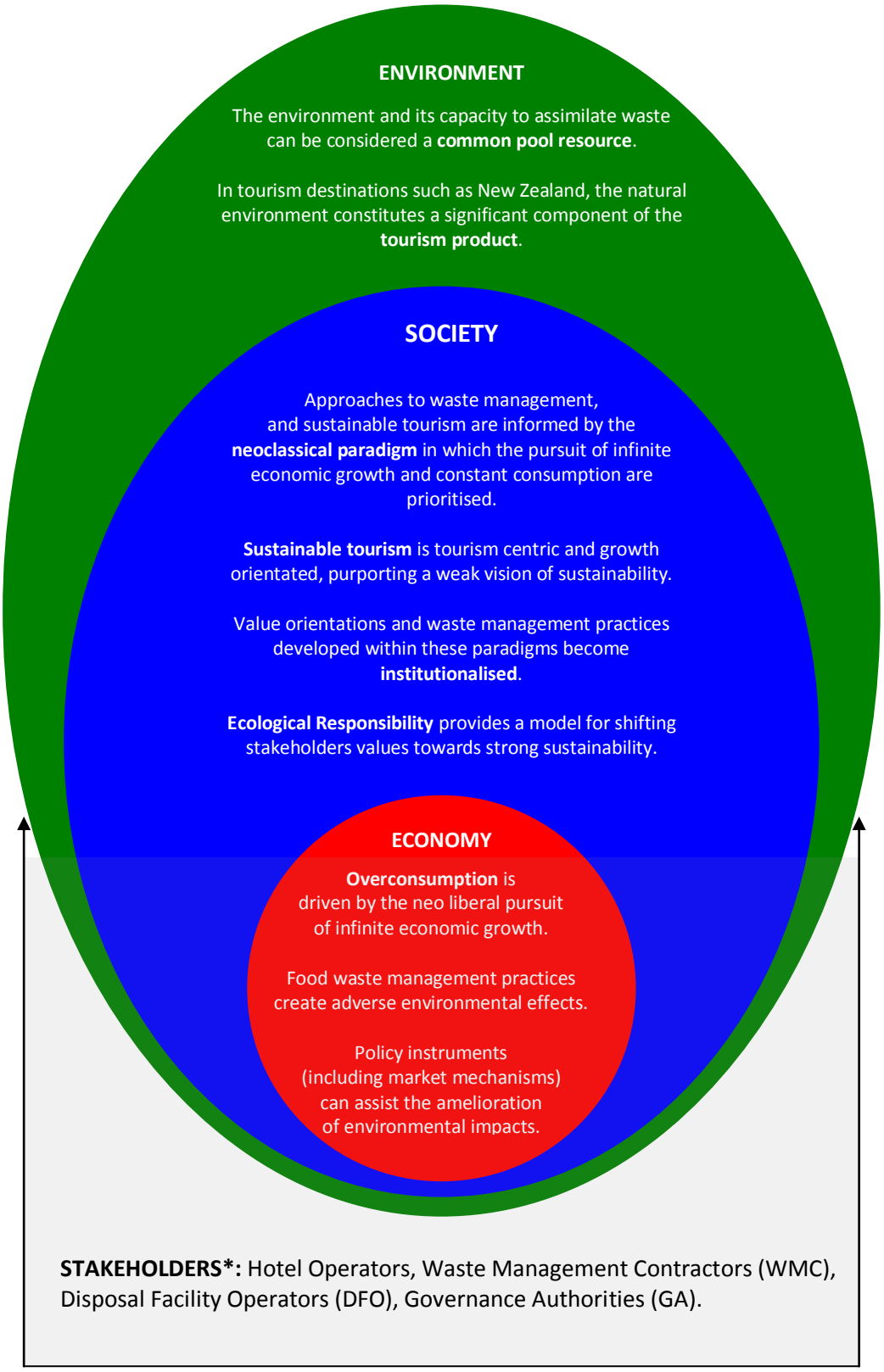
What are the barriers and incentives to separating food waste in large New Zealand hotels?

Rationale for the inclusion of each theoretical perspective and stakeholder group is provided in the background chapter and throughout the literature review where the environmental problems associated with the research question are also identified. Validation of the existence of environmental problems associated with food waste (section 4.1) leads to the foremost theoretical perspective, *an ecological conception of economic activity.* Within this paradigm the consideration of environmental impact is prioritised and the deleterious management of waste is linked to the neoclassical assumption and pursuit of infinite economic growth (Princen, Maniates, & Conca, 2002).

Individuals and organisations are considered to possess *value orientations* (Fairweather, Maslin, & Simmons, 2005) which, alongside food waste management practices can become *institutionalised* (Brown & Cameron, 2000).

The environment's capacity to assimilate waste is considered a *common pool resource* (Common & Stagl, 2005). Tourism 'products' (destinations, experiences) exhibit similar characteristics including congestibility and fluid boundaries (Briassoulis, 2002). Thus, the perspective is extended to the *'tourism commons' (ibid).*

Figure 3.1: Food Waste Resource Framework



**The resident population of any region, tourists and other hotel patrons are not explicitly included as 'key' stakeholders. These groups are considered members of society and so are encompassed within that broad sphere.*

3.2.1. Philosophical positionality

My positionaility within this research is best orientated via discussion of the *bioenvironmentalist* and *social green* philosophical perspectives described by Clapp and Dauvergne (2005). An important distinction between these two paradigms is the relevance of an interconnection amongst environmental issues, over-consumption and population growth. Whilst I accept that over consumption, defined as 'using more than is necessary' (Princen, et al., 2002:4) and 'consumption based on wants, not needs' (Clapp & Dauvergne, 2005:113) is a key component of multiple social and environmental issues, I unlike many bioenvironmentalists do not believe that population growth is necessarily a cause of equal significance, or that the two phenomena are indubitably linked.

Whilst arguments concerning population growth are not directly relevant to this thesis, issues relating to consumption and its corollary waste management are of particular salience and therefore the distinction is made explicit. At this juncture my positionality is most commensurate with the *social green* worldview, a perspective which argues that it is the inequalities inherent to contemporary globalisation which contribute primarily to environmental issues whilst population growth represents an exacerbating factor. Moreover, in the context of this research, production and consumption behaviour is aggrandized by conventional waste management practices[28] and it is these constituents which drive waste related social and environmental problems.

I view economic transactions holistically, from resource extraction through production and consumption to disposal. This approach differs from that typical of economic models which focus on the interaction of producer and consumer market behaviour via the forces of supply and demand (Princen, et al., 2002:15.6). I view human economic activity as an open subset of a finite and closed biophysical system, a perspective fundamental to the

[28] In the New Zealand context, conventional waste practices are typically either landfill or incineration. See section 4.1 for more detail.

discipline of ecological economics (Costanza in Princen, et al., 2002) with which my research positionality is also closely aligned. I reject the concept of consumer sovereignty and believe that individual preferences can be subject to moral evaluation and should not necessarily always be taken as given (Common & Stagl, 2005).

3.2.2. Environmental Pragmatism

I accept over-consumption has become embedded in free market economies and consider myself an environmental pragmatist (Light & Katz, 1996) pursuing effective, policy orientated solutions to environmental problems. Pragmatisim enables the researcher to consider issues in a broad context and emphasises the importance of incorporating multiple perspectives. No single philosophy is privileged; issues are critically evaluated based upon their relevance and applicability to the issue in question and the solution sought (Light 1996). I have endeavoured to apply the flexibility and moderate moral pluralism associated with pragmatism (Light 1996) [29] to the reflexive approach underpinning the research methods employed in this study.

3.2.3. Interpretive perspective

Elements of a postmodern interpretive perspective are present in this study and, combined with the pragmatic approach discussed above, have informed the expansive research themes.

Throughout the research process, I have been alert to the importance of assuming a symbolic interactionist standpoint (Tolich & Davidson, 1999), remaining aware of my own preconceptions and interpreting interview content or observations in the context from which such data originated. I have attempted to take the role of the other and to seek the *respondents meaning* (Tolich & Davidson, 1999) in all phases of this research.

[29] Where movement among moral principles is grounded on a single metaphysical view that acknowledges irreducible pluralism in the world (Light 1996:32.2).

Notwithstanding the existential fact that any participant observer can significantly shape the research context (Hammersley & Atkinson, 1983), interview questions were designed to minimise the influence of my own ideas and my status as an environmental studies student preparing to publish a thesis about the waste management practices of referable sub-sectors (the waste and hotel industries). Respondents were able to specify a requirement of confidentially in the final thesis presentation and any associated publications. Anonymity however could not be guaranteed due to the scale of the sectors involved.

Whilst these practices may have reduced some ecological invalidity (Hammersley & Atkinson, 1983) in this research, it is the reflexivity applied to the analysis of multi stranded data that characterises this study as an ethnographic work (Hammersley & Atkinson, 1983). This approach ensures the findings constitute defensible descriptions of food waste management practices amongst large New Zealand hotels.

3.2.4. Defining *environmental sustainability* amongst multiple contexts

Environmental issues associated with the conventional food waste management practices of New Zealand hotel operators are outlined in chapter four. Considered in sum or in part, these issues aid formulation of an argument central to this thesis:

Current practices render the conventional management of food waste in the New Zealand hotel sub-sector environmentally unsustainable. [30]

'Sustainability' is a contentious term with no universally accepted definition. In the context of this research, I align my positionality with the interpretation provided by Common and Stagl (2005:8):

[30] 'Conventional practices' are explicitly defined in the literature review (chapter four). They include landfill and incineration.

> Sustainability is maintaining the capacity of the joint economy-environment system to continue to satisfy the needs and desires of humans for a long time into the future.

3.2.5. Sustainable tourism and sustainable development

It is appropriate that any discussion regarding the social and environmental externalities associated with economic activity (specifically that of the hotel, tourism and the waste sectors) is viewed via the paradigm of *'sustainable development'*. Similarly, because this research occurs within the tourism sector, the *'sustainable tourism'* discourse is of direct relevance. These two concepts lack complementarity as sustainable tourism does not "necessarily equate with the aims and objectives of sustainable development" (Holden, 2008:158.8).

An analysis of this disjunct is provided in section 4.5. What is important to determine here is that my positionality within this research is not commensurate with *either of these paradigms* in their current, predominant manifestations. The former is criticised as being tourism centric (Hunter, 1997) and applying a narrow, localized focus to social and environmental issues (Saarinen, 2006). The latter, when interpreted according to the ubiquitous Brundtland definition, can be considered a resource conservationist, managed growth worldview (Hunter, 1997). Both represent weak sustainability. I advocate a stronger interpretation of sustainability and consider any condition which undermines the functional integrity of natural processes as unsustainable (Hunter, 1997). Functional integrity being defined as a state in which the interpretation of sustainability provided above can be ensured.

In an analysis of the diversity of paradigmatic approaches to sustainable development, Hunter (1997) suggests there is value in multitudinous interretations, and that each will require idiosyncratic tradeoffs applicable according to circumstance. It is with this sentiment that I argue my positionality constitutes a valid approach to the food waste management issue in New Zealand.

3.3. Methodological Assumptions

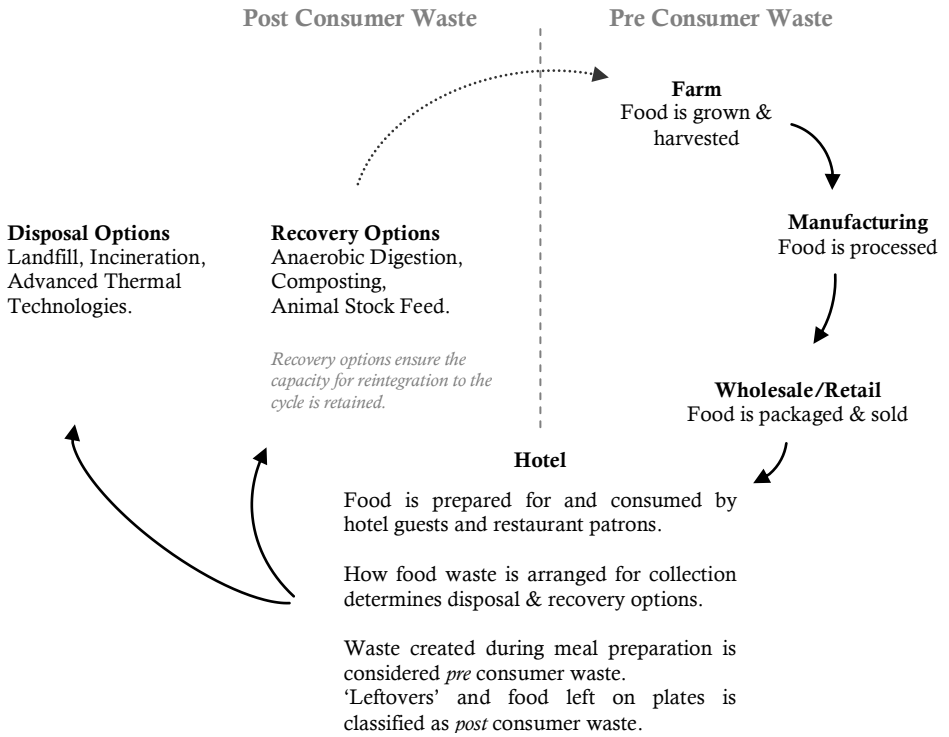
3.3.1. Defining waste

The definition of waste is culturally subjective (Hawkins & Muecke, 2003). This research occurs within a *post modern societal* context in which *market economy* provides the organizing principle for economic activity. In this context, *waste* can be defined as "something that is an unwanted by-product of economic activity" (Common & Stagl, 2005:98). This is distinct from *pollution* which is "any chemical or physical change in the environment due to waste emission that is harmful to any living organism" *(ibid).*

3.3.2. Pre and post consumer food waste

Pre consumer food waste refers to waste generated during early stages of the waste cycle (depicted below) such as food manufacturing and wholesaling. It also includes any waste created at a hotel during the preparation of food for consumption. *Post* consumer food waste is 'leftover' food that is either not served to customers or is rejected by customers. The conceptualisation of the waste cycle adopted for this research is depicted below.

Figure 3.2: Conceptualisation of the waste cycle in a hotel food waste context



3.3.3. 'Diverted waste'

Within this thesis the term 'diverted waste' is used in a broad sense and is applied to any waste that would have been disposed of via a *disposal* option if it was not 'diverted' to a *recovery* option.
Disposal options are end of cycle technologies which include landfill, incineration and Advanced Thermal Technologies. Recovery options include composting, vermi composting, anaerobic digestion and animal feed.[31]

Any food waste that is not *disposed* of is considered as diverted waste.[32] This includes (for example) food waste sent to a landfill site but then recovered (used for composting or anaerobic digestion) instead of being interred in the landfill.

[31] Disposal and recycling technologies are detailed at figure 3.1 above, section 4.1 and Appendix One.

[32] The reader should be aware of potential confusion between the definition of **diverted waste** used in this thesis, and application of the word *diverted* to other waste categories amongst the literature.

For example New Zealand's Ministry for the Environment (MfE) use *diverted material* to refer to "material that is no longer required for its original purpose and, but for commercial or other waste minimisation activities, would be discarded" (MfE 2001:7).
MfE also use *diverted tonnage* to refer to "material which goes to a disposal facility and is then *reused* or *recycled* at the facility or removed from the site for another purpose" *(ibid).*

These definitions are applied to the Waste Levy. DFOs are required to pay the levy on diverted material and tonnage as it enters a disposal facility, but the amount paid can be recovered when the material/tonnage is diverted.

3.4. Research Design

The process and techniques employed throughout this study constitute a research design closely aligned with the *qualitative interpretive* approach described by Tolich and Davidson (1999). This research type requires the researcher to be actively involved in the topic and to embark upon an *inductive* exploration developing formal theory both during and after the collection of data *(ibid)*.

Analytic induction (Manning, 1982) was identified as the most appropriate, inductive methodology, as this model facilitates movement back and forth between extant literature (explicitly enabling the incorporation of existing theories), the data collection process and the development of theory (conclusions in this regard) (Bansal & Roth, 2000).
Extant literature, interview transcripts and observation records were coded according to their relevance and usefulness whilst extracts were simultaneously counter scripted in separate files based on their appropriateness to themes. Applying this tandem research approach (Tolich & Davidson, 1999) to each objective revealed both the overt and covert aspects of the topic in question. The coding, categorising and counter scripting process facilitated a continuous review of the techniques used and enabled the methods, themes, questions, and prompts to be improved, refined or expanded.

Quantitative data relating to the food and landfill waste quantities produced by hotels was sought from all interview respondents. The data collection methodologies of data providers were assessed and any data set determined as incomparable was eliminated.[33]

These processes, combined with my open minded, critical and thorough approach enabled the principle themes to develop depth and ensured the study progressed in the reflexive, analytically inductive manner discussed above.

[33] Exhaustive descriptions of the methods used are provided at Appendix Two.

3.4.1. Research Aims

1) To gain an understanding of the barriers and drivers to separating food waste in large commercial hotels.

2) To provide stakeholders with sound research from which to develop effective waste management policies.

3.4.2. Objective One: Literature Review

The intent of the literature review was to position the food waste management practices of New Zealand hotels within an international context, provide comprehensive rationale of the conceptual framework and inform development of the interview and survey questions and prompts. This was achieved by identifying the barriers and drivers, relevant debates, theoretical perspectives and 'knowledge gaps' represented in available literature via seven research themes:

1. Disposal processes and associated environmental issues.
2. Extant knowledge of food waste management practices in the hotel industry.
3. Sustainable Tourism.
4. Problematic Consumption (including consumer value orientations).
5. The influence of institutionalization and social structure.
6. Eco labels and the value orientations of tourists.
7. Legislative and policy mechanisms.

Information was sought in accordance with the central research question *what are the barriers and drivers to separating food waste in large hotels?*

3.4.3. Search procedure and sources

An exhaustive literature review was performed amongst the following sources:

International scientific journals and databases: *ISI Web of Knowledge*^{SM} and *Science Direct* were used to search peer reviewed and published scientific and academic literature relevant to the thesis topic and published in English. Bibliography's of relevant works were also used to find other texts.

Library Catalogues: Books and Journal articles available via Victoria University of Wellington, Auckland University of Technology, University of Otago and University of Waikato library catalogues were accessed via Victoria University and the Library Consortium of New Zealand system.

Grey literature: Academic literature was prioritised however in some instances relevant information was only available amongst so called 'grey literature' including governance authority publications, high level non-governmental organisation reports and consultant reports.

No temporal limits were applied in the literature search.

3.4.4. Objective Two: Semi-structured Interviews

The second objective was to identify the barriers and incentives encountered by hotel waste management stakeholders in relation to separating food waste. Semi structured interviews were held with representatives from the following stakeholder groups:

a) Hotel Staff and Management.
b) Waste Management Contractors (WMC) (includes transfer stations).
c) Disposal Facility Operators (DFO).
d) Governance Authorities (GA) (includes industry body's and councils).

Interviews were conducted and observations made so as to provide rich source material for an emergent and inductive analysis (Tolich & Davidson, 1999) of the following themes:

a) Access to food waste collection and disposal services.
b) Perception of food waste quantities (including analysis practices).
c) Perceived and or actual costs of food waste separation.
d) Minimising contamination of separated food waste.
e) Menu types: A la carte and buffet.
f) Attitudes towards food and waste.
g) Organisational change for sustainability (including 'staff buy in').
h) Customer/client/tourist value orientations.
i) Environmental certification / eco labels.
j) 100% Pure NZ: A tourism commons?
k) Regulatory and Governance Issues (including the Waste Levy).

A four point cycle of data collection, reduction, organisation and interpretation enabled all aspects of the research to evolve throughout the entire process. In the interests of producing a robust and thorough qualitative interpretive research thesis, assumptions and process were subject to regular critical evaluation.

3.4.5. Location Selection

An overarching intention of this study is that the results can be extrapolated to the hotel sub-sector at large and if possible, the wider accommodation and hospitality sectors. Consequently, selecting the location for the interview phase of this research involved careful consideration of multiple variables.

Interrelationships amongst hotels, WMCs, DFOs and governance authorities are complex. The first challenge to location selection was to establish a regional grouping commensurate with that currently used by principle stakeholders and data providers. The boundaries defined by the New Zealand Regional Tourism Organisations (NZRTO) were used as this

enabled data collected via the Commercial Accommodation Monitor (CAM) to be applied[34]. The Regional Tourism Organisation (RTO) boundaries differ slightly from those of territorial authorities whose geographical demarcation is commonly used by most WMC, DFO and non tourism industry governance authorities.

Whilst a hotel chain may interact with multiple territorial authorities (TA), a single hotel is likely only to interact with one city or district council and one regional council. A hotel or hotel chain may interact with a range of WMCs and those WMCs may have multiple disposal facility options available to them. Such facilities may occur within the same TA jurisdiction as a hotel or outside of it. Some hotels are located in popular New Zealand tourism locations whilst others service a mix of tourism and business customers.

Information relating to these variables was aggregated on maps and in tables and the following aspects carefully considered:

a) Number of hotels per RTO.
b) Variance in hotel numbers between RTOs.
c) Popularity of RTO as a tourism destination.
d) Importance of RTO for business related travel and accommodation.
e) Number of hotels within RTO with Qualmark *Responsible Tourism* Certification.[35]
f) Variance between number of hotels within RTO with Qualmark *Responsible Tourism* Certification.
g) Star ratings (a quality grade from 1 *lowest* to 5 facilitated by Qualmark)
h) Hotel ownership – independent or consortium (chain) and variance between regions, star ratings and environmental certification.
i) Number of constituent Territorial Authorities (TA) in RTO.
j) TA involvement in transfer stations and disposal facilities within and between RTOs.

[34] More information regarding the Commercial Accommodation Monitor (CAM) is provided at Appendix Two.

[35] A requirement of certification is to demonstrate improving efficiency in an environmental indicator which could include waste. Thus, certification was considered a useful variable as it *may* indicate food waste separation is taking place and at the least demonstrates the organisation has developed a sustainability policy (a core requirement).

k) Operative disposal facilities within RTO (or absence of, in which case it is likely that transfer stations are used).

l) Known operative alternatives to disposal (for food waste) within RTO (eg. composting or stock feed processing facilities) or absence of.

m) Distance between hotels and disposal facilities or disposal alternatives.

After consideration of these variables and an evaluation of the scope and limitations of a masters thesis (including word length and time constraints)[36] it was decided that interviews based in the Auckland, Rotorua, Wellington and Queenstown regions would adequately serve the project's aims and objectives.

Wellington and Auckland are important business and tourism centres for both domestic and international visitors. Rotorua and Queenstown are two of New Zealand's most popular tourism destinations and attract numerous conference and corporate events alongside high numbers of domestic and international tourists. [37 & 38]

[36] Masters Thesis conducted according to the conditions of the School of Geography, Environment and Earth Sciences, Victoria University, Wellington.

[37] In 2009 Auckland hotels had 3.1 million guest nights (29% of the national hotel total). Wellington 1.3 million (12%), Queenstown 1.1 million (11%) and Rotorua 702,000 (7%). These four regions accounted for 59% of all hotel guest nights (Ministry of Tourism, 2010b:2).

[38] The Food Waste Resource Framework (presented at figure 3.1 above) focuses this research upon the role the New Zealand tourism product plays in the waste management practices of hotels. It is important to acknowledge that business clientele also play an important role, despite the fact they may have little or no interaction with the tourism product whilst staying at a hotel. These consumers can demand both cost effective hotel services and, in some cases, an environmentally sustainable hotel stay. They are encapsulated within the conceptual framework as 'other hotel patrons'.

3.4.6. Cohort Selection

Hotels[39] with restaurant facilities and a capacity greater than 100 rooms were selected in each region.[40] The cohort was selected to provide the most even distribution across the hotel star rating system possible (Qualmark 3 to 5 star) and to provide a representation of consortium (chain) and independently owned and or operated hotels.

Only one out of the ten hotels selected had not attained some type of environmental certification however a representative of that hotel stated they were working towards attaining both a Qualmark *Enviro Logo* and certification with EC3 *Earthcheck*. All other hotels had attained either Silver or Gold enviro logos from Qualmark and two had attained Silver certification from EC3 *Earthcheck*. In this regard, the cohort is biased towards hotels pursuing an environmental certification. A table detailing the location and characteristics of each hotel is provided at section 5.1.

Selecting the cohort from differing regions and choosing hotels with various ownership and management structures, star ratings and sustainability credentials[41] is commensurate with the 'comparative approach' considered advantageous to tourism research (Pearce, 1993; Stanford, 2008).[42]

Applying a 'comparative approach' enabled the researcher to identify patterns and processes amongst the data collected. Furthermore, comprehensive analysis of the information aggregate facilitated the

[39] The definition of hotel used in the New Zealand Commercial Accommodation Monitor (see Appendix Two) is applied to this study. Hotels are identified as 'establishments for which the principle business is to provide the public with lodging, liquor, meals and refreshments for consumption on the premises. Accommodation is arranged on a room/suite basis'. This classification includes resorts (MED 2010a).

[40] 20% of New Zealand hotels have more than 100 rooms (Ministry of Tourism 2010b). *Tourism Sector Profile: Hotel Sector*.

[41] Refers to social and environmental sustainability. Credentials of this type are typically demonstrated via eco-labels such as Qualmark's *Responsible Tourism* and EC3's *Earthcheck*.

[42] Nicholson and Pearce (2000:237.6) argue that, "in essence, comparative research involves the investigation of a problem in two or more places (or points in time), using a common research design so that equivalent data may be systematically collected, analysed and interpreted, and common findings produced and interrelated in order to address a general question or set of questions".

extrapolation of constructive observations with sector wide applicability. Thus the value of this research lies in the diversity of the cohort and the quality and consistency with which data was collected.

Throughout the research process known variables were carefully considered and a reflexive approach to new ideas and information applied. Respondents were invited to discuss the research topics in the context of their own region and in relation to other locations, whether in New Zealand or elsewhere. Personal experience and interpretation of the experiences of others were welcomed though the latter were applied to the thesis with caution and when used their derivation is made explicit. This approach, combined with the international literature review helps broaden the study beyond the Auckland, Rotorua, Wellington and Queenstown RTOs. Furthermore the quantitative data provides a useful perspective to the current waste management practices of some operators and establishes a context to which the findings of the interviews can be related.

3.4.7. Objective Three: Hotel food and landfill waste data analysis

> ***Objective 3)*** *Estimate the quantity of food waste typically produced by large hotels with restaurant facilities in the context of a meaningful variable such as guest nights (result is likely to be a range rather than a definitive quantity).*

All respondents were invited to submit quantitative data relating to the production of hotel food and landfill waste.[43] In order for the waste data of differing hotels to be rendered comparable, *guest night* statistics for the same hotels that provided waste data were also obtained. Any data that was provided by respondents was required to meet methodological prerequisites for inclusion. These are detailed, and any discrepancies reconciled at Appendix Two. Close inspection of the respondents data collection

[43] Because inorganic recycling (glass, plastics, tin, metals, cardboard and paper) is considered a standard practice undertaken by most hotels, 'landfill bound waste' does not include these items.

techniques has ensured the data analysis undertaken within this thesis is valid.

Three key results, presented at chapter 5 as ranges, were sought from the data:

a) Food waste produced per guest night.
b) Landfill bound waste produced per guest night.
c) The percentage of food and landfill bound waste streams combined, that is food waste.

3.4.8. Objective Four: Extrapolation of hotel waste data to sub-sector

> ***Objective 4)*** *Extrapolate the food waste per hotel guest night estimate (objective 3) using Commercial Accommodation Monitor (CAM) data and produce estimated RTO (Regional Tourism Organisation areas) and national hotel food waste production ranges.*

Using data provided in the CAM[44], the *food waste per hotel guest night* ranges estimated via objective 3 were extrapolated to a sub sector level. RTO and national estimates are summarised at chapter 5.

3.4.9. Objective Five: Sub-sector GHG emissions estimate (landfill context)

> ***Objective 5)*** *Estimate the GHG generating potential of the estimated RTO and national hotel food waste production estimates (produced at objective 4) in the context of landfilling.*

Using methodology applied in legislation,[45] the GHG generating potential of the food waste production ranges (created at objective 4) were estimated for each RTO and nationally.

[44] The data set CAM 1 RTO main variables was used.

[45] The methodology is provided in detail at Appendix 2 and was derived via:

4

MANAGING FOOD WASTE IN THE HOTEL & TOURISM CONTEXT

This chapter synthesises international literature relating to the management of food waste within a hotel and tourism context. The principle environmental issues associated with disposal and recovery processes are summarised. Pertinent theoretical perspectives including over consumption, sustainable tourism, organisational change for sustainability, and institutionalisation are introduced. The influence of value orientation, social norms, social structures and policy mechanisms upon waste management practices is also discussed.

Each section of analysis provides rationale for the conceptual framework applied to this research (see section 3.2). The content of this chapter also provides an academic context to the empirical dimensions presented in the following chapter, where the perspectives of research participants are introduced.

Climate Change (Unique Emissions Factors) Amendment Regulations 2010.
Climate Change (Waste) Regulations 2010.
Recommendations for methodologies for ETS landfill gas emission reporting. Tonkin and Taylor Ltd 2010.

4.1. Environmental issues associated with food waste

The collection, treatment and disposal of food waste can generate numerous environmental impacts and benefits (Zhang, Lee, & Jahng, 2011). End of cycle disposal and recovery technologies constitute two broad groups, each containing three principal technology types.

Table 4.1: End of cycle disposal and recovery technologies

Disposal Technologies	**Recovery Technologies**
Landfill	Anaerobic Digestion
Incineration	Composting *Includes aerobic, in-vessel and vermi-composting*
Advanced Thermal Technologies *Includes gasification, carbonization, pryolysis and plasma arcing.*	Animal / Stock Feed

Extensive analysis of the environmental impacts, impact mitigation strategies, benefits and controversies relating to each technology is beyond the limitations of this thesis. However, a brief summary is presented below and a more exhaustive review is provided at Appendix One.

There is consensus amongst the literature that anaerobic digestion (AD) provides greater environmental benefit than the other technologies listed in table 4.1 (Bakas & Herczeg, 2010; Department for Environment, Food and Rural Affairs [DEFRA], 2011; Hogg, et al., 2010; WRAP, 2010b). AD systems use micro organisms to breakdown organic waste within a vessel devoid of oxygen. CH_4 (methane) is generated during this process. The gas can be captured and utilised as an energy source. This process provides the potential to reduce the amount of fossil fuels used elsewhere. For example, if the electricity generated via an AD system is fed into the national grid, the generation load required of other technologies (e.g. coal fired stations) is reduced *(ibid)*.

The digestate and other by-products created during decomposition (both solid and liquid) can be used as soil amendments. These products can substitute the use of synthetic fertilisers, further reducing fossil fuel consumption and providing numerous benefits to soils and ecosystems (Ayalon, Avnimelech, & Shechter, 2000; Eunomia Research & Consulting and Waste Not Consulting, 2010; Gabrielle, Da-Silveira, Houot, & Michelin, 2005; Hogg, Lister, Barth, Favoino, & Amlinger, 2009; Lima, 2004; Suthar, 2009).

Landfill is typically a much cheaper disposal option than AD. Principle environmental concerns in the New Zealand food waste management context relate to the prevalence of landfill disposal (PCE, 2006).[46]

4.1.1. Food waste disposal in landfill

When decomposing amidst the anaerobic conditions typical of landfills, the degradable organic carbon (DOC) within organic waste enables the generation of CH_4 (Bingemer & Crutzen, 1987; Froiland Jensen & Pipatti, 2002). CH_4 is a green house gas (GHG) with a global warming potential (GWP) 25 times greater than that of CO_2 (Forster, et al., 2007).[47] CH_4 that is emitted to atmosphere from organic wastes within landfills contributes to climate change. This phenomenon constitutes the primary environmental concern in relation to food waste disposal to landfill and the rationale for this thesis.

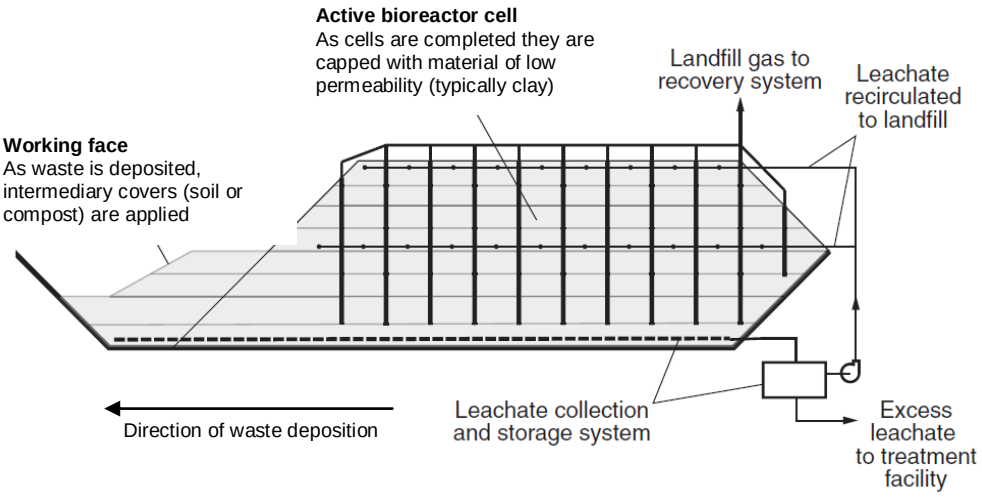
CH_4 generated by organic waste within a landfill can be captured and utilised as an energy source or destroyed (typically by flaring). Capture rate

[46] Landfill is the main method of waste disposal in New Zealand (PCE, 2006). The social and environmental externalities associated with landfill have been calculated as costing only marginally less than $100 per tonne, even with a landfill gas capture rate of 70% over the sites lifetime (Hogg, Wilson, Gibbs, Holmes, & Eve, 2010).

[47] CH_4 is a green house gas (GHG) with a global warming potential (GWP) 25 times greater than that of CO_2 when considered across a 100 year time horizon (Forster, Ramaswamy et al. 2007). CH_4 generated within landfills can be captured and utilised for energy generation or destroyed (IPCC 2006; Christensen, Simion et al, 2009).

estimations range between 20% and 70%.[48] As waste is interred, permeable intermediary 'covers' (typically soil or compost) are applied until a landfill 'cell' is completed at which time a cover with low permeability (typically clay) is applied. Intermediary covers are the principal source of both the aerobic and the anaerobic organisms responsible for organic waste decomposition. They are more permeable than cap material and therefore trap methane less effectively (Hogg, et al., 2010). Thus, even in facilities with capture technologies installed prior to waste deposition, some methane generated by decomposing food waste may escape to atmosphere before it can be captured. Despite advances in landfill gas (LFG) capture technologies, many landfills (throughout the world) do not possess comprehensive and efficient collection systems, or have not installed systems at all (Tchobanoglous & Kreith, 2002).[49]

Figure 4.1: Cross section of a bioreactor landfill with leachate recirculation and landfill gas recovery systems installed. Adapted from Tchobanoglous, G. and F. Kreith (2002:14.7)[50].



[48] "Sufficient quantities of organic matter need to be present to ensure that there is enough methane for commercially viable energy production" (NZAG 2007:53).

[49] New Zealand landfill gas capture regulatory requirements are detailed at section 2.1.1.1.

[50] Diagram in Tchobanoglous, G. and F. Kreith (2002) adapted from Solid and Hazardous Waste Education Centre, University of Wisconsin–Madison, 2000.

Concern over landfills also relates to the scale of such projects as they typically occupy large areas of land and must be managed for years after the cessation of waste deposition. Food waste contributes significantly to the space requirements of modern landfills. Leachate management also presents concerns (Barrett & Lawlor, 1997).

4.1.2. Identifying the optimum end of cycle solution for food waste

Research conducted in the United Kingdom demonstrates that 0.5 tonnes of CO_2-e emissions are generated for every tonne of food waste sent for disposal (WRAP, 2011c).[51] Amongst the technologies listed in Table 4.1, only AD offers the combined benefits of a significant energy yield coupled with the creation of a useful by-product and complete capture of all GHG. Other technologies can however offer a more cost effective solution whilst minimising the environmental impacts associated with landfills.[52]

Composting is a relatively cost efficient recovery option via which a useful soil amendment product (that can offset the use of synthetic fertilisers) is generated.[53]

Environmental issues associated with the use of food waste as animal feed are minimal. Animal health concerns are however prevalent and regulations surrounding the practice exist in some jurisdictions (Demirbas, 2010;

[51] This research thesis assumes the composition of food waste produced in the New Zealand hospitality sector is similar to that of the United Kingdom.

[52] The environmental impacts associated with transportation of food waste should be considered amongst any analysis of differing treatment options. Such consideration is however beyond the scope of this thesis.

[53] A 2010 study conducted in New Zealand for Environment Bay of Plenty by Eunomia Research and Consulting concluded that composting technologies were likely to be the most cost effective options for processing organic waste streams containing food wastes.
Aerobic composting generates minimal CH_4 and produces biogenic CO_2 assumed to be commensurate with what was sequestered via microbial activity and the growing phase of the biomass used as compost feedstock (Bogner, et al., 2008; Christensen, Simion, et al., 2009). Consequently, CO_2 produced by composting operations is not included in IPCC authorised GHG inventories (MED 2009). This approach is widely accepted yet is criticised amongst the literature (Hogg, et al., 2010). AD offers higher net carbon savings than composting by offsetting fossil energy generation (Friends of the Earth 2007).

Westendorf, 2000). Using food waste as animal feed is considered a good option, however it is not viable in all hotel scenarios *(ibid)*.

Wastewater and gases produced via Advanced Thermal Technologies (ATT) can pose environmental and human health risks. Systems designed to minimise and or eliminate such risks can be implemented. Syngas (a by-product of ATT) can be used as an energy source or as a feedstock. Biomass and gasified biomass can be used in coal fired power stations thereby substituting the use of fossil fuels (Hogg, 2006).[54]

4.1.3. The importance of separating food waste at source

For some technologies, particularly those designed to affect the disposal of mixed waste types,[55] identifying the specific contribution of food waste to the adverse environmental effects associated with each system is problematic. Nonetheless, the literature demonstrates that impacts associated with differing technologies can be reduced via minimisation of the food waste content within mixed waste streams (such as typical *municipal solid waste* MSW)[56]. Recovery technologies can generate greater environmental benefits than disposal systems (Bakas & Herczeg, 2010; Hogg, et al., 2010; WRAP, 2010b). However, such systems require food waste to be separated from other waste types (particularly inorganic materials) at source (i.e. at the hotel). Thus, a rationale, developed from an environmental standpoint for the source separation of food waste exists.[57]

The desirability and feasibility of source separation in a hotel context is dependant upon numerous other factors. These considerations are addressed throughout the remainder of this literature review.

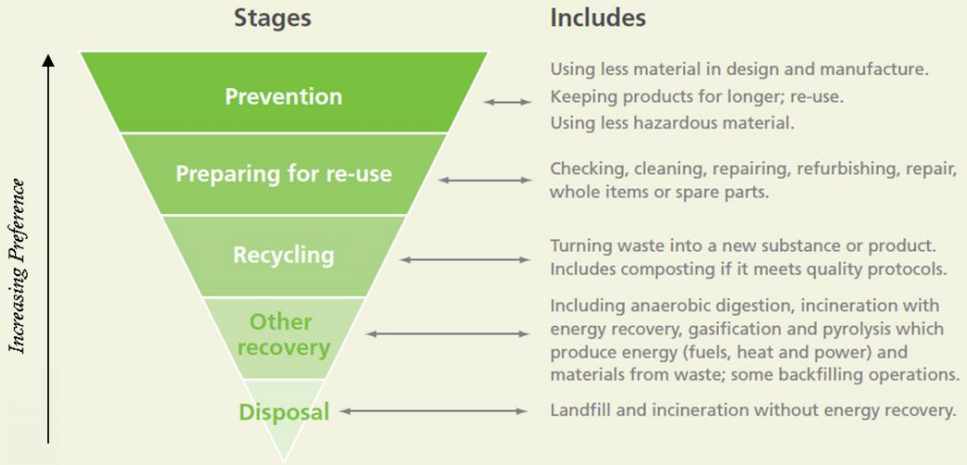
4.2. The Waste Hierarchy

[54] Advanced Thermal Technologies (ATT) are explained in greater detail at Appendix One.
[55] Landfill, Advanced Thermal Technologies and Incineration.
[56] Impact reduction is discussed in greater detail at Appendix One.
[57] A variety of applications for each technology type exist. For example there are numerous methods of composting. In some scenarios, separating food waste from all other waste types (garden waste for example) can enhance the performance of the system in question. Conversely, the efficient performance of other systems is dependant upon, or is unaffected by the inclusion of food waste (DEFRA, 2011)

It is typical for waste management and minimisation initiatives to be designed in accordance with the waste hierarchy, a preferential scale upon which differing options can be ordered (Barrett & Lawlor, 1997). Critics argue the hierarchy does little to alleviate reliance upon disposal processes because it takes an inherently prescriptive approach and does not address demand management (Price & Joseph, 2000). There is consensus amongst the literature that prevention initiatives provide greater environmental benefit than those targeting diversion and disposal (Cummings, 1992; Hogg, et al., 2010).

Princen, Maniates et al. (2002) argue efficiency improvements only increase consumption, a phenomenon known as the *rebound effect*. Furthermore, some technologies can create a demand for specific waste types. Such scenarios embed a production perspective[58] and undermine the efficacy of initiatives designed to minimise waste generation. Criticism also focuses upon the hierarchy's failure to incorporate life cycle impacts (discussed below) despite the inclusion of a prevention tier.

Figure 4.2: The Waste Hierarchy



Source: derived from DEFRA (2011.11) and commensurate with EU (2008:Article 4) Waste Framework Directive

4.3. Life Cycle Analysis

[58] The production perspective constitutes an approach to waste management which focuses upon disposal and recovery solutions rather than addressing the issues that underlie the creation of waste (consumption).Whilst this thesis is focused upon disposal and recovery, the importance of prevention is acknowledged, and is addressed where relevant.

Life cycle analysis (LCA) acknowledges the embodiment of energy within, or wastes and emissions (indeed any adverse social or environmental impact) generated throughout the entire production and consumption cycle of any particular food item, including during the waste disposal phase (DEFRA, 2011; Hogg, 2006). LCA is considered an important management tool as it enables comparison of differing environmental management options.

Comprehensive analysis of the life cycle related issues presented by each recovery and disposal option discussed below is beyond the scope of this thesis. However key considerations are introduced throughout the thesis where relevant and more detail is provided at Appendix One.

Notwithstanding this disclaimer, an acknowledgment of the important correlation between consumption and environmental impact permeates this thesis. Reducing consumption is a key method of reducing waste and the environmental benefits associated with prevention manifest throughout the waste cycle (Hogg, et al., 2010; Stuart, 2009).[59] For example, research examining the GHG emissions associated with household food waste in the United Kingdom has incorporated production, transport and disposal phases. The result, 4.2 tonnes of CO2e emissions for each tonne of food landfilled demonstrates the importance of food waste prevention initiatives (WRAP, 2011c). As discussed at the introduction, this research thesis acknowledges the importance of prevention yet is primarily focused upon food waste *recovery* (also referred to as diversion). The aims and objectives pertain to finding solutions for the food waste that continues to be generated by hotels throughout New Zealand.

4.4. Food Waste Management in the Hotel Industry

[59] A visual conceptualisation of the waste cycle, in a hotel food waste context is provided at section 3.3.

Literature that elucidates the quantities of food waste produced, common management techniques applied or typical end of cycle disposal processes employed by the tourism or hotel industries at regional, country or worldwide scales is limited to a small number of publications (references are provided in table 4.2 below).

Relevant studies that were found in the course of this literature review sought to define the portion of total hotel waste that is food waste and the amount produced (examined in relation to an activity measure like guest nights). Some studies also sought to quantify the number of hotels (in the study location) employing food waste management practices alternative to landfill. Despite the variations in the quantitative results (summarised in table 4.2 below), the literature demonstrates that consigning mixed wastes (which include food waste) to landfill is a typical practice within the hotel industry worldwide. Furthermore it is common for hotel operators to employ commercial collection and disposal agencies to perform this service. Notwithstanding these ubiquitous observations, some hotel operators are known to process organic wastes onsite (typically via composting or vermi composting) and others have developed collection arrangements with farmers or animal stock feed agents.

Table 4.2: Hotel food waste related literature - relevant quantitative results

Author	Study Location & details	Relevant Quantitative Result
Alexander (2002)	25 USA hotels	Food waste content of total waste stream = 46%
Cartier (1997)	Las Vegas hotels (USA)	Food waste content of total waste stream = 25 to 40%
Hoang (2005) [60]	3 HaLong City Hotels (Vietnam)	Food waste content of total waste stream = 61%

Table 4.2 cont: Hotel food waste related literature - relevant quantitative results

[60] Derived from tables 2.7 and 2.9 in Hoang (2005). Fruit, leftover food, vegetable and other (seafood, egg shells, flowers) waste were aggregated in this calculation.

Author	Study Location & details	Relevant Quantitative Result
WRAP (2011a)[61]	United Kingdom Hotels	Food waste content of total waste stream = 37% Between 60 & 70% of food wasted was avoidable. [62]
Kirk (1981) [63]	UK hotels and restaurants	15.5 percent of edible food was wasted.
WRAP (2010a)	Austrian Hotels	Hotels with more than 80 beds produce at least 80kg food waste/week. Restaurants generate 40 kg food waste per year per seat. Hotels without restaurants generate 0.4kg food waste per guest night.
Krieth (2002) [64]	First class hotels	1.3 kg residual waste[65] per room per day. 0.90 kg residual waste per meal per day.
	Medium class hotels	0.6 kg residual waste room per day. 0.45 kg residual waste per meal per day.
Axler (1973) [66]	Quality dining rooms and kitchens.	Produce about 0.45 kg of residual waste per guest meal served.

No literature which provided an analysis of anaerobic digestion, incineration or composting in relation to hotels or tourism operations specifically could be found in the course of this review. Similarly, no studies which quantify the amount of commercial organic waste diverted from landfill by the hotel, tourism or hospitality sectors in New Zealand could be located.

4.4.1. Food waste management practices within hotels

[61] WRAP is the *Waste and Resources Action Programme* established as a not-for-profit company in 2000 and backed by government funding from England, Scotland, Wales and Northern Ireland (WRAP, 2012).

[62] Avoidable food waste is food that could have been eaten had it been better portioned, managed, stored and/or prepared. It excludes inedible items like banana skins and apple cores (WRAP, 2011c).

[63] In Kirk, 1995.

[64] In Tchobanoglous & Krieth, 2002.

[65] Residual waste contains food waste and is also referred to as mixed, general or municipal solid waste.

[66] 1973 in Ball & Abou Taleb, 2010.

Most tourism and waste related publications tend to deal with waste in a broad sense aggregating differing waste types into categories such as 'all recyclables' and 'all landfill bound waste'. Such literature does not therefore confront the food waste issue directly nor provide waste prevention strategies directly applicable to food waste.

Nonetheless, the importance of designing waste initiatives in accord with the waste hierarchy[67] is emphasised amongst literature that does address food waste as a distinct waste stream (Kirk, 1995). Wenlock et al. 1980 (in Youngs, Nobis, & Town, 1983) observe that preparation for an à la carte service with no definitive idea of customer numbers (as in hotel restaurants) can result in greater wastage than when menu items are prepared in response to a specific customer order. Buffet style catering is known to result in even greater wastage if precautions and careful management techniques are not implemented (Collison & Colwill, 1987; Mitchell, 2001).

Hogg, Wilson et al. (2010) argue waste management initiatives which increase waste handling at source (typically those that require the separation of differing waste types) can produce a *waste prevention effect* whereby improved awareness initiates further waste reductions.[68]

WRAP (2011c:65) note that the "introduction of waste prevention strategies (within restaurants) will be challenging because of the need to ensure that customers feel they are getting value for money (e.g. portion controls cannot be too tight), the shelf-life of some products, and the difficulties in predicting business volumes".

4.5. Sustainable Tourism

[67] The Waste Hierarchy is presented at section 4.2. The version provided within this thesis differs slightly from that presented by Kirk (1995) however the principles are the same.

[68] Conversely, waste management practices which ensure engagement with waste is minimised can contribute to *distancing*, a phenomenon whereby people are unaware of the impacts associated with their consumptive behaviour as effects are indirect and therefore go largely unnoticed (Hogg. Et al., 2010; Princen, et al., 2002).

Tourism operators rely upon the quality and integrity of local environments to facilitate valued visitor experiences (Briassoulis, 2002; Hunter, 1997; Mensah, 2006). Environmental management practices can enhance destination competitiveness (Claver-Cortes, Molina-Azorin, Jorge, & Lopez-Gamero, 2007). Tourism activities put pressure upon the environment via the consumption of natural resources and the production of wastes (Bohdanowicz, 2006; Pigram, 1995; Tucker, 2001). Environmental impacts that can be linked to the hotel and tourism industries tend to be incremental and cumulative in nature (Holden, 2008) and commonly occur within jurisdictions shared with local communities whom also require access to infrastructure, resources and ecosystem services (Briassoulis, 2002; Healy, 1994).

4.5.1. The tourism commons

The environments capacity to assimilate waste (as solids, liquids and gases) can be considered a common pool resource (CPR) or open access service that is non excludable and subject to rivalry (Blanco, Rey-Maquieira, & Lozano, 2009; Briassoulis, 2002; Common & Stagl, 2005).

The background elements of tourism (BTE) whether natural, socio cultural or manmade (Jafari, 1974) for example an outstanding natural landscape, popular festival or remarkable city, share these characteristics (Healy, 1994).[69] Thus, the environment, BTE's and the infrastructure which supports both tourism and local communities constitute a 'tourism commons'. The tourism commons is, in effect, the tourism product (Briassoulis, 2002). Viewed in this context, the indivisible components epitomize congestible goods with fluid boundaries *(ibid)*. Moreover, both the tourism commons and the environments capacity for waste assimilation can, in some instances, extend to global systems.

4.5.2. Principles of Sustainable Development

[69] Jafari (1974) argues that it is the background elements that tourists travel to see. Tourism services, such as accommodation or transportation are merely incidental and only serve to facilitate experience of the background element.

The advent of social and environmental concerns associated with tourism has spurred criticism within the literature that 'social and environmental sustainability' is not adequately practised or pursued within the contemporary, omnipresent tourism model. It is argued that the principles of sustainable development were applied to tourism following the publication of *Our Common Future*[70] in 1987 (Saarinen, 2006) however, since then 'sustainable tourism' (ST) has become an independently functioning paradigm that is tourism-centric and growth orientated, purporting a weak vision of sustainability (Hunter, 1997). Within this paradigm, the viability of the industry takes precedence over social and environmental development goals (Holden, 2008).[71]

4.5.3. Strong and weak sustainability

Hunter (1997) argues that the ST literature has developed an anthropocentric and utilitarian rhetoric focused upon rationalizing a quest for 'balance' between environmental concerns and the interests of tourism industries. A stronger approach to sustainability, it is argued, would define limits for environmental and social adaptation rather than analysing tradeoffs solely upon economic criterion. Hunter (1997) recognises the context dependant nature of environment-tourism considerations and proposes four platforms upon which to posit the ST debate. These approaches to ST span a spectrum of weak to strong sustainability and, arranged in that order are:

[70] Report of the United Nations World Commission on Environment and Development (1987): *Our Common Future.* Also known as the Brundtland Report.

[71] These ideas are also discussed at section 3.2.5.

Very weak sustainability

Tourism imperative:[72] In areas where tourism is a new phenomenon it is prioritised as a development mechanism. Social and environmental degradation is justified on the grounds that tourism impacts are comparably lower than those of alternative development pathways (eg: logging). The most tourism centric of the four approaches, environmental protection policies are strongly influenced by tourism interests.

Product-led: Common in areas where tourism is well established. Environmental concerns are secondary to that of the tourism industry and actions are taken on the basis of maintaining the viability and growth potential of the tourism product.

Environment-led: Environmental concern is paramount. Tourism development is limited to the carrying capacity or sustainable yield of the natural environment and does not compete to the detriment of other economic sectors in the locality.

Neotenous tourism: Representing strong sustainability, this approach recognises that tourism development may be unsuitable given the local ecology and should therefore either not occur at all, or be so restricted that impacts are minimal. Such an approach is likely to limit activities to the juvenile stages of tourism development (Hunter, 1997).

Very strong sustainability

It can be argued that the food waste management practices typical of hotels are informed by a 'weak', tourism centric approach commensurate with that of the prevailing ST paradigm discussed above. Consequently, related environmental issues which do not directly affect the tourism product are largely ignored. The tourism imperative leads hotel operators to establish practices congruous with the 'product led' (Hunter, 1997) model pervading amongst established tourism industries (including New Zealand's). These conventions can act as barriers to comprehensive consideration of the social and environmental implications associated with food waste management practices. Moreover, it is the absence of a strong sustainability paradigm

[72] Most applicable in communities where a poverty and environmental degradation cycle occurs, where tourism has the potential to offset more environmentally destructive development pathways and to provide benefits that could contribute greater returns.

which leaves both the tourism and waste management sectors devoid of the ideas, creativity and incentives necessary to spur policies with either benign or beneficial environmental outcomes.

4.5.4. Governing the tourism commons

The issues discussed above are compounded by the complexity inherent to addressing environmental management challenges amongst a heterogeneous tourism commons containing multiple functions and stakeholders (Briassoulis, 2002). Local residents and non tourism businesses can contribute to sustainability issues and in some locales tourism investment may originate from outside the region in concern. The ensuing diversity of agendas, property rights designations and resource regimes can inhibit the coordination of solutions to environmental issues (Briassoulis, 2002; Healy, 1994). Furthermore, stakeholders may be reluctant to invest in maintaining or improving the integrity of the common pool resource, as non contributing free riders may benefit from the resource or service; the "investment incentive problem" (Healy, 1994:601.4).

In regards to food waste these matters are compounded by:

> the **magnitude** (food waste constitutes one component of WM issues and in some instances may not present the greatest concern),
> **scale** (issues can be local, multi regional, or international),
> **conspicuity** ('issues' go largely unnoticed or are not considered as problematic)
> and the **multi stakeholder complexity** of the associated environmental issues.
> Waste related environmental problems are caused not only by wastes from hotels. Other businesses and the residential sector all contribute. Similarly waste infrastructure can be owned, managed and governed by both state institutions and private corporations.

Achieving effective governance requires adaptability and compromise on the part of stakeholders and can be most easily achieved when the following conditions exist:

> 1) The resources and use of the resources by humans can be monitored, and the information can be verified and understood at relatively low cost.
>
> 2) Rates of change in resources, resource-user populations, technology and economic and social conditions are moderate.
>
> 3) Communities maintain frequent face to face communication and dense social networks (also known as social capital) that increase the potential for trust, allow people to express and see emotional reactions to distrust and lower the cost of monitoring behaviour and induce rule compliance.
>
> 4) Outsiders can be excluded at relatively low cost from using the resource (new entrants add … pressure and typically lack understanding of rules.)
>
> 5) Users support effective monitoring and rule enforcement.
>
> Dietz, Ostrom et al. (2006:142.5)

Dietz, Ostrom et al. (2006) emphasise manifestation of all conditions is rare. The challenge therefore, is to "devise institutional arrangements that either meet the conditions or meet the main challenges of governance in the absence of ideal conditions" *(ibid:143)*.

4.5.5. Summary: Contribution to the Food Waste Resource Framework

The background elements of tourism and the environment's capacity to assimilate waste are considered interconnected common pool resources. Effective governance requires consideration of multiple stakeholder perspectives, adaptability and compromise.

The term 'sustainable tourism' has multiple interpretations. Hunters spectrum (section 4.5.3) provides orientation positing four approaches ranging from weak to strong sustainability.

4.6. Environmental management and tourism organisations

The absence of evident causality between environmental problems and the activities of service sectors can enable environmentally adverse, waste management practices to persist (Foster, Sampson, & Dunn, 2000). Low level regulatory and/or consumer pressure provides little impetus for change (Kirk, 1997) and the environmental impacts associated with hotels often go unnoticed by both consumers and stakeholders (Miller, 2003). Operating environments of this type have enabled the institutionalisation of conventional food waste management practices (institutionalisation is explained below). Amongst such conditions, selecting, demanding or creating alternative, environmentally benign or beneficial food waste management practices can be a low priority for hotel operators. Furthermore, because the environmental impacts associated with end of cycle disposal processes do not adversely affect the tourism product directly, those businesses operating within a paradigm of 'weak sustainability'[73] are unlikely to recognise the contribution food waste management practices make to environmental degradation at large.[74]

4.6.1. Affecting change within organisations

Dunphy et al. (2007) note the *raison d'être*[75] between the tourism product and the environment can enable organisational change to occur more readily than amongst businesses for whom core activities conflict with ecological aspirations. In a review of extant literature on environmental management determinants in tourism, accompanied by some primary research, Alvarez Gil, Burgos Jiménez et al. (2001) identify factors that influence sustainability behaviours amongst hotels. These include the dominant tourism type, the

[73] See section 4.5.3.

[74] This phenomenon is known as distancing. People are unaware of the impacts associated with their consumptive behaviour as effects are indirect and therefore largely unnoticed (Hogg, et al., 2010; Princen, et al., 2002).

[75] Reason for existence.

age of facilities, size, chain affiliation, legal category, stakeholder pressure and management practices.

Other literature demonstrates the importance of executive level buy in, a positive correlation between environmental management practices and profitability *(ibid),* leadership (Beugré, et al., 2006), adaptability (Benn, Dunphy, & Griffiths, 2006) and the influence of three key motivational factors, *competitiveness, legitimacy* and *ecological responsibility* (Bansal & Roth, 2000).

4.6.2. Competitiveness

Bansal and Roth (2000:724.6) "define competitiveness as the potential for ecological responsiveness to improve long-term profitability". 'Responses', including the improvement of waste management practices, eco-labelling and green marketing are made in the interest of maximising returns rather than environmental concerns (ibid; Bohdanowicz, 2007). It is typical for cost benefit analysis to be applied in this resource based approach. 'Green' credentials are attained and environmentally friendly products or processes are developed or employed based on their ability to enhance market share and contribute to long term economic sustainability in the competitive marketplace *(ibid).*

4.6.3. Legitimation

Legitimation is synonymous with reactive adherence to institutional norms, regulations, values and beliefs. Firms intending to legitimate their operations often imitate their peers, bringing environmental practices 'up to standard' but remaining within the confines of what is often a mutually agreeable (amongst firms) threshold of compliance, to 'satisfice' (Bansal & Roth, 2000).[76]

Within a hospitality context, Hemphill, (1991); Lemonick, (1992) in Cummings (1992:258.2) note that "a waste minimization mentality is

[76] Bansal makes a link institutional theory and cites DiMaggio & Powell 1983 on page 728.3.

imperative to arrest public criticism and to retain or regain a public image as proactive and socially responsible".

Constraints' (norms, regulations, values and beliefs) are conveyed by stakeholders such as government, communities and customers. Research shows that those stakeholders most able to articulate legitimacy concerns in an influential manner have the greatest effect upon legitimacy focused firms (Bansal & Roth, 2000).

Individuals and organisations operating within a legitimation paradigm "do not often initiate significant change: they usually respond to changes that have emerged elsewhere in society" (Potter, McLaren, & Frame, 2009:8.2). In this sense they are agents *of* change. Those whom are driven by a strong sense of purpose, as discussed next, can be considered agents *for* change *(ibid)*.

4.6.4. Ecological Responsibility

Firms which embrace ecological responsibility are motivated to do so by beliefs, values and ethics borne of a concern for the good of society at large. Some initiatives can reduce profitability, however this is not viewed as problematic as the initiative is considered to provide value in other, less directly tangible ways. In this regard, decisions are idealized rather than rationalised (Bansal & Roth, 2000). Successful waste minimisation initiatives established with the intention of contributing to an important environmental and/or social cause can improve workplace pride and staff morale (Cummings, 1992).

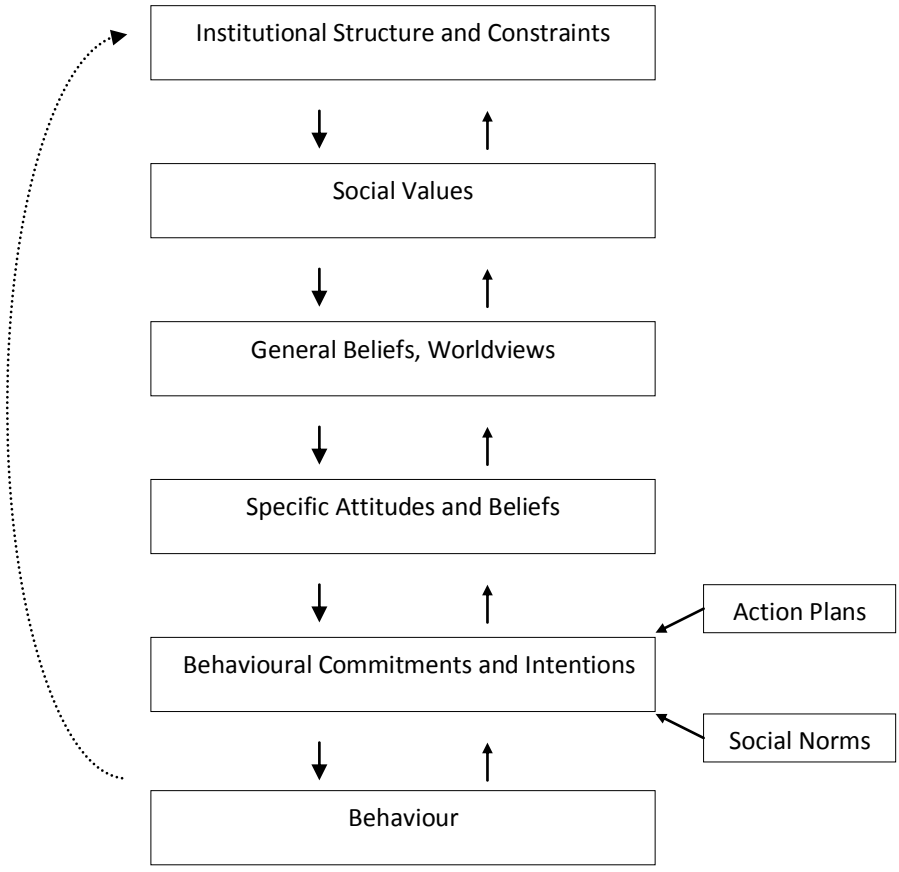
The advent, endurance and success of ecological responsibility within firms is often associated with commitment, understanding and leadership amongst senior management (Cummings, 1992) and is typically attributed to one, or a small number of key individuals (Bansal & Roth, 2000).

4.6.5. The role, importance and influence of Social Structure

Social structure can be perceived as a macro level phenomenon that bears influence upon, whilst coexisting in duality with, the individuals, organisations and institutions that constitute a society (Giddens, 1984).
Stern, Dietz et al. (1995:726.6) argue the value orientations of individuals are influenced by *social structure* in two principal ways:

> "Social structure shapes early experience and thus an individual's values and general beliefs or worldviews. It also provides opportunities and constraints that shape behavior and the perceived response to behavior".
>
> "Values and worldview are causally antecedent to more specific beliefs, which in turn are antecedent to personally held norms, intentions, and other proximate causes of particular actions. Values and worldview act as filters for new information or ideas".

Figure 4.3: The roles of institutional structure, social values, worldviews, attitudes, and intentions in determining consumption behaviour.



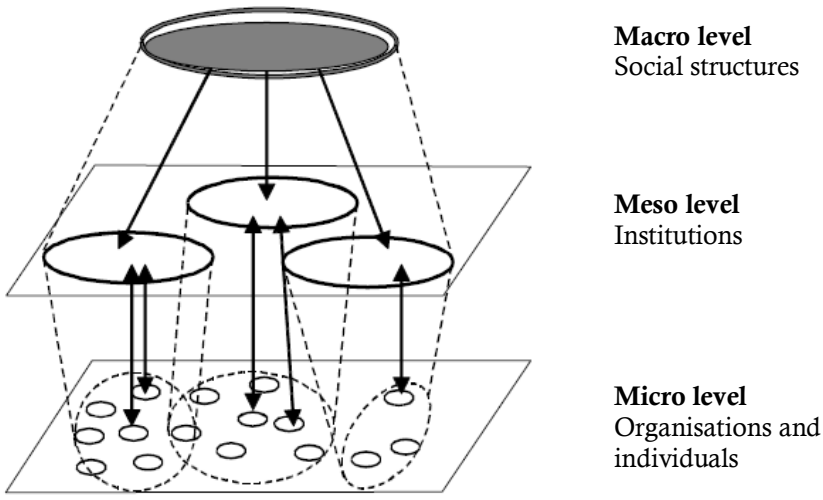
Source: Adapted from Stern et al, 1995 by Brown and Cameron (2000).

4.6.6. Institutionalisation of social practices and behaviours

Norms, values and beliefs can become institutionalised over time, establishing *social practices/behaviours* (with environmental affect) that can endure for extended periods of time amongst multiple contexts (Lammers and Barbour, 2006; Dillard et al., 2003 in Potter, et al., 2009) and with long lasting and wide ranging affects (Sewell, 1992). Institutionalisation is "both the process and the outcome of a process, by which a social practice/behaviour becomes usual, desirable, and/or taken for granted in organisations" (Larrinaga-Gonzalez, 2007:150 in Potter, et al., 2009).

"Organisations are structures of social relationship, social actors arranged in positions and roles; usually, but not always, deliberately arranged and designed to achieve some end" (Bouma, 1998). Organisations and the internal cultures that exist within them influence, and are influenced by both the individuals and the institutions that operate across organisational boundaries (Potter, et al., 2009). Thus, individuals and organisations possess the capability to act as agents of change (Caldwell, 2006).

Figure 4.4: Relationships between structures, institutions, organisations and individuals



Source: Adapted from Rotmans et al., (2003) and *Potter, McLaren et al., (2009).*

4.6.7. Organisational change for Sustainability

Benn, Dunphy et al. (2006) review literature relating to organisational change for sustainability, including the work of Hart and Milstein (2003), Dovers (2001), Jenkins (2002) and Freeman (1984) and present the following two phase model.

Table 4.3: Phases in the development of corporate sustainability

Phase	**Human Sustainability**	**Ecological Sustainability**
Stage One: Rejection	Employees and subcontractors exploited. Community concerns are rejected outright.	The environment is regarded as a free good to be exploited.
Stage Two: Non-responsiveness	Financial and technological factors exclude broader social concerns.	Ecological factors are excluded from decision-making.
Stage Three: Compliance	The emphasis is on compliance with legal requirements in industrial relations and safety.	Ecological issues unlikely to attract strong litigation or strong community action are ignored.
Stage Four: Efficiency	Technical and supervisory training augmented with interpersonal skills training. Community projects and HR value adding strategies are pursued only when a cost benefit to the company is obvious.	Environmental issues are ignored if they are not seen as generating avoidable costs or increasing inefficiencies. Sales of by-products are encouraged.
Stage Five: Strategic Pro-activity	Intellectual and social capital is used to develop strategic advantage through innovation in products / services.	Proactive environmental strategies such as product and process redesign are seen as a source of competitive advantage.
Stage Six: The sustaining corporation	Key goals both inside and outside the firm are the pursuit of equity and human welfare and potential.	The firm works with society towards ecological renewal and positive sustainability* policies.

*Positive sustainability: "Delivering sustained high performance, providing for just and equitable conditions in the workplace, contributing to social equity, and assisting in renewing the biosphere" (Benn, et al., 2006:156).

Benn, Dunphy et al. (2006) argue that organisations in the rejection and non-responsive phases are the most in need of change and that a gradual, planned, continuous and ongoing incremental change, rather than a dramatic, paradigmatic shift is the most effective strategy. Potter, McLaren (2009) caution however that numerous incremental changes may leave underlying dynamics unchallenged and actually reinforce the structure of existing systems.

Nonetheless adaptability, alongside persistence, purposefulness, information-richness, sensitivity, inclusiveness and flexibility are key to achieving a successful transition to sustainability within organisations (Dovers 2001 in Benn, et al., 2006).

Benn, Dunphy et al. (2006) argue the human capabilities and social capital developed within organisations is vital to the success of sustainability initiatives and advocate for the inclusion of all staff in any transitional program. Fostering a learning culture and institutionalising cogitative processes such as reflection and feedback is essential to the development of an 'enabling culture' (Benn, et al., 2006). A conjoint, 'bottom up and top down' approach provides staff (at any level within the organisation) with the capacity to develop and internalise new standards (Adler & Kwon, 2002). Hardy et al. (2003 in Benn, et al., 2006) concur but in an inter-organisational context, noting that collaboration is integral to learning, transition processes and the creation of new knowledge. The importance of collaboration and knowledge transfer (Darr & Argote, 1995) is of particular relevance to hotels, as many are constituent to large chains and all contribute to the tourism and accommodation industries as a whole (Álvarez Gil, et al., 2001).

4.6.8. Contribution to the Conceptual Framework

Food waste management practices can become institutionalised. This process is understood to be a function of the interaction between social structure, values, beliefs, worldview and social norms which manifest, adapt and consolidate amongst individuals and organisations. Organisations and individuals possess the ability to act as agents of change and alter institutionalised practices and social structures. Change processes can be comprehended, communicated and orientated via a useful framework such as organisational change for sustainability.

Thus the Food Waste Resource Framework[77] conceptualised within thesis includes a focus upon the social-psychological (Stern, et al., 1995) drivers of environmental concern. Motivating consumers, business operators and policy makers to alter behaviour is most effective when the cultural values and worldviews of people are reoriented via high level changes of the socio economic cognitive system (Brown & Cameron, 2000).

[77] The conceptual framework is depicted visually at section 3.2.

4.7. Eco-labels and the value orientations of tourists

Eco-labels enable tourism operators to assure stakeholders that business activities are conducted in accordance with standards designed to address environmental concerns, minimise impacts and enhance social well being (Fairweather, et al., 2005; Font & Buckley, 2001).

Labels are typically managed as voluntary compliance programs. Assessment criteria can be developed, sanctioned and verified by industry associations, certification agencies or hotel operators themselves. Verification is considered more credible if performed by independent, third party agencies (Font, 2002). There is little uniformity or cohesion of certification criteria, audit systems or non compliance penalties. Few governments regulate eco-label programs or related marketing claims (Buckley, 2002; Font, 2002).

4.7.1. Principal assessment methodologies

Most eco-labels can be categorised into one of two simple groups based upon their assessment characteristics. Whilst not absolute, this differentiation provides a useful orientation for discussing eco-label related issues elsewhere in this thesis.

Performance led: A standards based *performance* approach requires a hotel to meet or exceed specified benchmarks. These thresholds are determined by the certification agency following consideration of numerous 'peer' hotels with similar characteristics. Critics of this system point to the problematic nature of applying generic standards across hotels operating in differing contexts and the need to constantly update benchmarks whilst providing hotels with consistent targets according to which they can plan operational changes (Font, 2002).

Process led: Management focused, *process* led initiatives require the implementation of an environmental management system (EMS) or similar regime designed to achieve constant improvement in environmental performance (Font, 2002). This self governing system has been criticised for enabling operators with lax standards to gain accreditation on the basis of commitment to improvement alone (Synergy Ltd, 2000).

The informal Mohonk Agreement of 2000 established a consensus amongst the leading certification agencies of that era to address the issues relating to process led certification programs. A trend towards performance based initiatives began however process led eco-labels continue to persist in the contemporary marketplace (Font, 2002).

4.7.2. Effectiveness of Eco-labels

More than 100 eco-labels (the majority of which were developed in the 1990's) are used within the tourism, hospitality and eco-tourism sectors worldwide. In countries where multiple labels of varying 'quality, criteria, content and scope' proliferate, a saturation effect is observed and the ensuing 'consumer confusion' has led some tourists to ignore labels altogether (Buckley, 2002; Fairweather, et al., 2005; Miller, 2003; Wood & Halpenny, 2001). Kahlenborn and Dominé (2001) argue the ascendancy of a limited number of international labels throughout the industry could ameliorate confusion.

4.7.3. Tourists

There is evidence that consumers (of goods throughout the economy) consider the social and environmental practices of businesses when making purchase decisions (Goldstein, Cialdini, & Griskevicius, 2008; Miller, 2003), are becoming increasingly concerned about the environment of destinations they intend to visit (Mensah, 2006; Miller, 2003) and are demonstrating responsible intentions when acting as tourists (Stanford, 2008). However,

there is little evidence which demonstrates tourists apply discretion based on environmental criteria when selecting amongst differing options (Reiser & Simmons, 2005; Sharpley, 2001) or that an expressed willingness to pay for an eco-labelled product, over a non labelled product actually translates into a real purchase (Fairweather, et al., 2005; Miller, 2003).

Miller (2003) argues that the 'green consumerism' witnessed in the wider economy is driven by a self orientated consumer type motivated by personal benefit. The social and environmental impacts associated with accommodation operations are more remote (distancing). Tourists may display ambivalence towards eco-labels because the benefits associated with the label have less personal applicability than competing considerations such as price, location and star rating (Sharpley, 2001).

Miller (2003) contends that this "selfish altruism" can be successfully integrated with the desire for social and environmental protection often expressed by the same, primarily self interested consumer. That "the twin goals can be achieved" if the industry successfully demonstrates *how* it's social and environmental improvements benefit the consumer directly *(ibid).*

Miller (2003) emphasises the variation of consciousness amongst consumers and recommends that information be tailored according to tourist type. Similarly, Stern Dietz et al. (1995) argue information can influence beliefs and attitudes, so long as it is congruent with an individuals values and worldview.

4.7.4. Tourist types

Sharpley (2001) argues that in order for eco-labels to be effective, labeling must be based on an understanding of the different ways in which tourism is consumed. Tourism, like other commodities in a consumerist, post modern society is used to shape identity, indicate status and establish distinctions between differing social groups. Sharpley's (2001:47.7) salient point is that:

> "...for eco-labelling to be effective, it must encourage an individual to place environmental values before the *cultural significance* of tourism, or to translate cultural significance into environmentally appropriate (tourism) consumer behavior" (emphasis added).

Sharpley (2001) explicates the typology of 'consumption approaches' posited by Holt (1995) in a tourism context and identifies four principal tourist types:

> **Experiential:** Focus is upon natural, unspoiled or culturally authentic environments.
>
> **Integrating:** Consumers integrate the tourism product and their self-concept. The objective is to 'fit in', to 'be' a particular type of tourist.
>
> **Playing:** Interaction with other consumers (socialising) or the presence of other people is an important element of the experience.
>
> **Classifying:** Consumers communicate identity or status via the type of tourism product or 'style' of consumption. An air of exclusivity surrounds tourism activities that occur in remote locations, involve high costs or for which participant numbers are limited. Sustainable and eco-tourism ventures often fit this profile.

Providing a more detailed analysis of the typology or Sharpley's (2001) suggested labeling tactics is beyond the scope of this thesis. However, this brief summary demonstrates that eco-labels are considered (amongst the literature) most effective when developed in accordance with the behavioral characteristics of a target market.

4.7.5. Anthropocentric, biocentric and ambivalent tourist types

Fairweather, Maslin et al. (2005) draw upon the *New Ecological Paradigm* (NEP)[78] posited by Dunlap, Van Liere et al. (2000) and suggest tourists tend to be either anthropocentric, biocentric or ambivalent in their approach to the environmental issues associated with tourism. Fairweather, Maslin et al. (2005) argue the biocentric type is most likely to respond to eco-labelling, and is more likely to travel to destinations where the environment is at the forefront of the visitor experience.[79]

Sharpley (2001) demonstrates the importance of maintaining environmental quality at destinations traditionally patronised by environmentally inclined tourists as degradation could result in a decline in visitors of this type (in Fairweather, et al., 2005). The issue is of abject importance for destinations with a predominantly international market made up of environmentally inclined tourists. This profile is typical of many 'island' destinations with an 'eco-tourism' focus[80] and is applicable to the industry in New Zealand[81].

[78] Dunlap and Van Liere's *New Environmental Paradigm (NEP) Scale*, published in 1978, has become a widely used measure of proenvironmental orientation and the paper in which it was published (see bibliography) is considered a seminal work. Dunlap, Van Liere et al. revised the scale in 2000 and this version is cited in Fairweather, Maslin et al. (2005). The value orientations posited by Stern, Dietz et al. (1995) and Brown and Cameron (2000) and discussed at section 4.4 also draw upon Dunlap and Van Liere's work.

[79] Tourists with biocentric values tend to select destinations with high quality environmental attributes such as New Zealand (Fairweather, , Maslin et al. 2005).

[80] Ecotourism is nature-based, environmentally-orientated tourism (Fairweather, Maslin, et al. 2005).

[81] When developing the *100% Pure New Zealand* international marketing campaign Tourism New Zealand identified the 'interactive traveler' as the type most likely to "help maintain a quality visitor experience...and appreciate the product offered in New Zealand"(Stanford 2008).

"Interactive Travellers consume a wide range of tourism products; seek out new experiences and interact with natural, social and cultural environments; respect the environment and culture; are leaders; plan and book holidays directly; value authenticity; connect with others; enjoy outdoor activity; like to learn, and have a high level of disposable income" (Tourism News, 2003 in Stanford 2008).

Research published in 2012 has recast the international tourist attracted to New Zealand as an 'Active Consider' (Tourism New Zealand 2012).

Despite the insights regarding consumer motivation discussed above, the overarching trend amongst the tourism eco-label literature suggests that the presence of eco-labels, and tourists awareness of them (and the associated certification requirements behind them) do not predominant the consumption preferences of any class of tourist, whether biocentric, anthropocentric or ambivalent.

Nonetheless, eco-labels can 'involve' tourists in stewardship via consumption options, can raise environmental awareness amongst all types of visitors and foster increasingly responsible behaviour amongst tourists with a predisposition towards 'environmentally friendly' goods and services (Wood & Halpenny, 2001).
The analysis of differing tourist types presented above justifies the inclusion of *value orientations* within the Food Waste Resource Framework (see figure 3.1) and provides a context to the perspectives of interview subjects presented in Chapter 5.

4.7.6. Business demand for Eco-labels

Despite the consumer appeal and recognition issues discussed above, the proliferation of certified operators within the tourism industry indicates a demand for labelling schemes on behalf of businesses. Drivers including competitiveness, legitimation and eco-logical responsibility are discussed above at section 4.6.1. Acquisition of an eco-label may not evidently enhance competitive advantage (Font, 2002) and any differentiation gained may eventually diminish due to competitors seeking to legitimate (Fairweather, et al., 2005). However, accreditation has multiple applications. Eco-labels can assist businesses to meet Corporate Social Responsibility aspirations and commitments and may be used by regulatory agencies as "a criterion to grant permits; promotion agencies for inclusion in marketing campaigns; or insurance underwriters to issue policies and set

premiums" (Buckley, 2002:185.2).[82] Buckley (2002) cautions however that the level of information required to attain an eco-label may be insufficient when applied to these purposes.

4.7.7. Certification agencies

Certification agencies are criticised for prioritising the enlistment of clients (Fairweather, et al., 2005) and not adequately promoting eco-labels to consumers (Reiser & Simmons, 2005; Schott, 2006). These issues may be due, at least in part, to certification agencies reliance upon external funding (Font & Buckley, 2001).

4.7.8. The Individualisation of Responsibility

The environmental movement (including eco-labels) is criticised for perpetuating production orientated solutions[83] to environmental problems. Maniates (2002) argues that citizens concerned about environmental issues consider the 'sphere of consumption' the single arena of their lives where they "command the most power and feel the most competent". Maniates (2002) attributes environmental groups "labouring to highlight environmental ills" with garnering citizen concern but notes "the hope that an aroused public would organise and embark on collective, political action" goes awry as responsibility is individualised (amongst individual people and organisations).

---

[82] Corporate Social Responsibility (CSR) is a concept whereby corporations voluntarily integrate social and environmental concerns into their business operations (European Commission, 2001). CSR enables the self governance of social and environmental practices with the fundamental premise being to exceed rudimentary legal compliance Dunphy, Griffiths, & Benn, 2007). CSR is often regarded as an investment rather than a cost (European Commission, 2001) as it provides corporations with enhanced marketing opportunities (Lantos, 2001) and can contribute to comparative advantage (Branco & Rodrigues, 2007).

[83] Most environmental problems share a causal link with the production and consumption of goods and services however it is the production aspects that are most typically addressed when remediation or prevention is sought. If for example, excessive wastes strain sink capacities, recycling programs are introduced and wastes are utilised in a supplementary process producing some other good or service. Whilst such alternatives may ameliorate cardinal environmental problems, other issues (additional energy consumption, or disposal of the secondary product following use for example) can be associated with prima facie 'beneficial' changes (Clapp, 2002; Princen, et al., 2002).

Maniates (2002) proposes that governments and corporations favour the *individualisation of responsibility* because it shifts culpability onto consumers and generates solutions orientated economic activity (leading to consumption and economic growth) whilst legitimating notions of "consumer sovereignty and an autonomous, self balancing market". The panacea Maniates (2002) argues, is meaningful public engagement in politics leading to social change. Political participation, like the individualisation of responsibility can occur at both a personal and an organisational level. The salient challenge for the latter (particularly environmental groups) being to decouple institutionalised individualisation from purpose and facilitate effective political action.

4.8. Regulatory mechanisms and governance issues

The significant influence legislation and government policy bears upon the waste management practices of individuals and businesses is reiterated throughout the literature. There is consensus that landfill disposal tends to dominant waste disposal markets as it is typically the least expensive option (and in many locales the only option). Furthermore, the proliferation and success of diversion initiatives is dependant upon their price competitiveness with landfill (DEFRA, 2004; Deublein & Steinhauser, 2008; Eunomia Research & Consulting, 2006; Hogg, et al., 2010; PCE, 2006; Stuart, 2009; WRAP, 2011b). Thus, policy instruments designed to internalise the cost of environmental externalities associated with landfills, or to disincentivise landfill disposal, should be balanced with initiatives that ensure the viability of alternative solutions (PCE 2006). Mechanisms of this type are presented in table 4.4 below.

Table 4.4: Policy and governance mechanisms applicable to food waste management

Command & Control mechanisms:
Input restrictions *Restrict specific waste types from being applied to recovery and or disposal technologies.* *E.g. The EU Landfill Directive restricts the deposition of biodegradable waste in EU landfills.*
Collection / transportation by laws *By laws require operators to provide services for segregated waste streams or restrict the management of certain waste types.* *Typically facilitated via a licensing system whereby waste collection/disposal agencies must obtain a licence in order to operate within a jurisdiction.*
Development / renovation bylaws *By laws require any development or renovation (e.g. a hotel) to install facilities that enable specific management practices (e.g. separating food waste).* *Typically sanctioned according to size, financial turnover etc (e.g. hotels of 80 rooms or more with restaurants must comply). Actuation requires sufficient local infrastructure & services.*

Information related bylaws

Waste agencies are required to provide information, of sufficient detail to authorities.

Data can relate to composition, quantities, sources etc.

E.g. Christchurch City Council Waste Handling Facilities Bylaw.

Minimum technology requirements

Can pertain to disposal facilities or waste sources.

E.g. landfills may be required to install gas collection systems.

Process and Product Standards

Applied to processes and products associated with disposal alternatives such as AD, composting and the use of food waste as stock feed.

E.g. New Zealand Standard for Composts, Soil Conditioners and Mulches (NZS 4454:2005).

Waste Strategies

Provide a framework for the management and or minimisation of waste. Typically intended to encompass all stakeholders within a given jurisdiction, strategies are usually mandated at a national level with a requirement for regional and/or district authorities to implement localised strategies commensurate with the aims and objectives of a national level policy. Whilst strategies are often non-binding, the objectives can be supported via relevant legislation.

International Agreements

E.g. Advent of the Kyoto protocol contributed to the development of the EU Landfill Directive. Article 5 of the directive prohibits disposal of food waste in landfill.

Economic Instruments

Reduction targets

Can be applied at any and multiple points throughout the waste cycle.

When implemented to address the environmental impacts associated with disposal technologies, targets can stimulate the development of efficiency enhancements such as improved landfill gas capture. Similarly, targets can encourage the development of alternative recovery systems such as anaerobic digestion or composting.

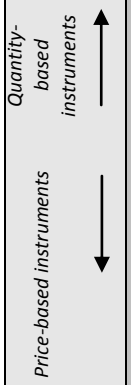
Alternatively, targets may be aimed at source reduction and seek to prevent waste generation. Identification of the optimum point in the waste cycle at which to implement reduction targets is the subject of contentious debate. Investment in technologies designed to reduce environmental impacts (such as CH_4 emissions) may create a demand for organic waste as sustained inputs are required to ensure the economic potential of investment is realised. In this regard reduction targets may create a perverse incentive.

Permit systems

Regulations define the total quantity of waste that can be deposited at landfills within a given jurisdiction (e.g. TA boundary). Quantity is defined based on metrics such as population, number of households, population growth etc.

Permits commensurate with the total quantity of waste allowed are distributed amongst stakeholders (e.g. waste collection and disposal agencies). Permits can be traded within and beyond the jurisdiction enabling TAs/stakeholders to sell unneeded permits to TAs/stakeholders with excess wastes. E.g. the UK Landfill Allowance Trading Scheme (LATS).[84]

Critics of tradable permit systems emphasise the importance of identifying and maintaining appropriate targets, price structures and governance regimes. Where such elements are remiss, the capacity for exploitation increases, as does the potential for the initiative to fail in reducing overall waste or emissions volumes.



Permit systems constitute a *Quantity-based* economic instrument. Under these conditions a market in the rights to engage in an activity is created. The environmental benefit is that the total level of activity is restricted.

This approach differs to that of *Price-based* instruments whereby charges, taxes, or subsidies are imposed upon environmental impacts occurring within either existing markets, or new markets created to facilitate such policies (PCE 2006:17).

Taxes and levy's

Charges are imposed per unit of waste disposed/processed at a facility or per unit of emissions. E.g. Waste Disposal Levy (see section 6.1.7) and the Emissions Trading Scheme (see 2.1.1.1). Polluting firms typically favour reduction targets and transferable permits systems. Taxes are typically considered as additional to the technological or systemic changes a firm must make in order to meet desired/sanctioned environmental outcomes.

Renewable obligation credits

Requires electricity suppliers to source electricity generated via renewable sources. Incentivises electricity generation via technologies that incorporate waste to energy systems (landfill, AD etc). Provides the most efficient technology with greater market leverage. Concerns relating to the creation of a demand for waste (discussed above, see Reduction Targets) are applicable.

[84] The United Kingdom implemented a Landfill Allowance Trading Scheme in 2005. The program will be discontinued in 2013. The decision to cease the scheme follows a national waste review which found that LATS is no longer the major driver for diverting waste. A landfill tax is considered a more effective reductive incentive (DEFRA 2012).

Collection Pricing Systems: PAYT and unit pricing

Pay As You Throw (PAYT) programs (variable rate) incentivise prevention by enabling consumers to reduce disposal costs by reducing disposal volumes. Conversely, 'unit pricing' contracts (fixed capacity or flat rate) provide consumers with the certainty of fixed costs and excess capacity to handle intermittent increases in waste quantities. See section 6.2.1.

Voluntary compliance mechanisms

Eco-labels (see section 4.8)

Individual business, consortium or industry commitments

Hotel operators can institute environmental polices (a typical requirement of eco-labels) which address food waste issues.

Examples of food waste related governance programs that encompass multiple stakeholders include the Accor hotel group's Environmental Charter, and the proposed UK Hospitality Food and Service Agreement.

References (table 4.4): (Accor Hotel Group, 2012; Ayalon, et al., 2000; Burnley, 2001; Commission of the European Communities, 2005; Cruz & Barlaz, 2010; Hogg, 2006; Hogg, Barth, Schleiss, & Favoino, 2007; Hogg, et al., 2009; Hogg, et al., 2010; Tchobanoglous & Kreith, 2002; WRAP, 2012)

5
INDUSTRY PERSEPCTIVES & HOTEL DATA

Results of the primary research are presented in this chapter. Interview responses (objective 2) and hotel waste related data (objectives 3, 4 & 5) are presented in accordance with emergent themes. [85]

5.1. Cohort description

Twenty one interviews were arranged however only nineteen people participated. One Wellington based Governance Authority (GA) representative did not appear at the first pre-arranged interview nor the agreed replacement time. This was unfortunate as the subject represented a broad spectrum of roles including governance duties and the provision of collection and disposal services. The absence of this interview leaves Wellington somewhat underrepresented in all categories other than *hotel operator.* However comparisons can still be made, and conclusions drawn from the information that has been collected.

One hotel operator based in Auckland withdrew from the interview (citing personal reasons unrelated to this study) and a mutually agreeable replacement time could not be arranged. Another interview with a different hotel could not be arranged during the Auckland visit and so only one Auckland hotel is represented.

[85] The aims and objectives of this research are detailed at section 1.3.

Ten interviews were conducted with representatives of nine hotels, eight of which separate food waste. Four respondents held executive management positions, three were executive chefs, two were executive housekeepers and one held the position of chief engineer.

Disposal facilities in Rotorua and Queenstown are managed by the local territorial authority (TA). Senior managers were interviewed and both the governance authority and disposal facility themes addressed.

Senior managers representing two separate waste management contractors (WMC) elected to be interviewed together in pairs, bringing the final number of interviews conducted to seventeen. Information pertaining to hotels and privately owned and operated WMC firms and disposal facilities is presented anonymously in accordance with the majority of respondents wishes.

Achieving objective three required the collection and analysis of quantitative food waste data from hotels. During the cohort arrangement phase it emerged that very few hotels had had waste audits performed and that only those hotels actually separating food waste were able to provide food waste quantity data. In the interests of consistency and in order to ensure data capture methodologies could be discussed with providers during the analysis phase, only hotels from the interview cohort were asked to contribute data for analysis. Five hotels contributed guest night, food waste and landfill waste data and two provided copies of waste audits. Data collection methodologies are detailed at Appendix Two.

Table 5.1: Interview Cohort

Waste Management Contractors (WMC)

WMC No	Location	WMC Type
WMC 1	ACKL	*Commercial collection contractor (all waste streams) whom also own/operate landfills. Provide food waste collection service disposing at an independent, privately owned composting facility (with no ownership connection to that company). Two representatives present at interview.*
WMC 2	ACKL	*Independent waste management consultant. Two representatives present at interview.*
WMC 3	WLGTN	*Commercial collection contractor (organic waste only, no bio-solids).*

Disposal Facility Operators (DFO)

DFO No	Location	DFO Type
DFO 1	ACKL	*Commercial Composting Facility (privately owned and operated).*
DFO 2	ACKL	*Landfill (privately owned and operated). Same company as WMC 1 (different representative). LFG capture & utilisation at landfill is operational.*

Governance Authorities (GA)

GA No	Location	GA Type
GA 1	QNTWN	*Queenstown Lakes District Council: Stefan Borowy, Solid Waste Manager.*
GA 2	ROTO	*Rotorua District Council: Peter Dine, Works Manager.*

Hotel Operators

Hotel No	Location	Separating Food Waste	Ownership Details	Star Rating	Environmental Certification	Food waste Quantity Data Provider
Hotel 1	ACKL	*Yes Compost*	*Independently owned*	5	Qualmark Enviro Gold	Yes
Hotel 2*	ROTO	*No*	*International chain*	3.5	Qualmark Enviro Silver	
Hotel 3	ROTO	*Yes Animal feed*	*International chain*	4.5	None	
Hotel 4	ROTO	*Yes Animal feed*	*National chain*	3.5	Qualmark Enviro Silver	
Hotel 5	WLGTN	*Yes Compost*	*International chain*	4	Qualmark Enviro Gold & Earthcheck Silver	Yes
Hotel 6	WLGTN	*Yes Compost*	*Independently owned*	5	Qualmark Enviro Gold	Yes
Hotel 7	WLGTN	*Yes Compost*	*International chain*	4.5	Qualmark Enviro Silver & Earthcheck Silver	Yes
Hotel 8	QNTWN	*Yes Compost*	*International chain*	4	Qualmark Enviro Gold	
Hotel 9	QNTWN	*Yes Animal feed*	*Independently owned*	5	Qualmark Enviro Silver	

** Two respondents were interviewed, separately, at Hotel 2. Referred to within the thesis as Hotel 2a and 2b.*
ACKL Auckland; ROTO Rotorua; WLGTN Wellington; QNTWN Queenstown.

5.2. Provision of food waste collection and disposal services

Table 5.2 (below) provides an overview of the collection and disposal arrangements of the hotel interview cohort. Operators located in large cities[86] (Auckland and Wellington) employ commercial contractors to take food waste to composting facilities whilst those located in smaller centres (Rotorua and Queenstown) have comparatively informal arrangements with farmers who collect food waste for animal feed. The single hotel that does not have a separation process sends food waste to landfill via a commercial contractor. All hotels (except one which is only two years old) had sent food waste to landfill prior to implementing a separation program.

Table 5.2: Hotel Operator Interview Cohort - food waste collection & disposal arrangements

Hotel	Location	Food waste separated at hotel	Collection Details	Disposal Process	Commercial food waste collection service available in area (other than farmers collecting for animal feed).
Hotel 1	ACKL (large city)	YES	Commercial contractor	Compost	YES
Hotel 2	ROTO (small city)	NO	N/A	N/A	NO
Hotel 3	ROTO (small city)	YES	Farmer (small, independent)	Animal Feed	NO
Hotel 4	ROTO (small city)	YES	Farmer (small, independent)	Animal Feed	NO
Hotel 5	WLGTN (large city)	YES	Commercial (Council facilitated)	Compost	YES
Hotel 6	WLGTN (large city)	YES	Commercial contractor	Compost	YES
Hotel 7	WLGTN (large city)	YES	Commercial (Council facilitated)	Compost	YES
Hotel 8	QNTWN (town)	YES	Compost On site worm farm	Compost On site	NO
Hotel 9	QNTWN (town)	YES	Farmer (small, independent)	Animal Feed	NO

ACKL Auckland; ROTO Rotorua; WLGTN Wellington; QNTWN Queenstown.

[86] A city is defined as a settlement with a population of 50,000 people or more (Local Government Act 1974). Estimated resident populations for 2011 are: Auckland 1,486,000; Wellington City 200,100; Rotorua District 68,900; Queenstown District 28,700. Source: Statistics New Zealand (2011).

5.2.1. Availability of collection and disposal or recovery services

Interview respondents considered any absence of a commercial food waste collection service in their respective regions as a significant barrier to implementing a food waste separation programme within hotels. Hotel operators in regions without a commercial or council provided collection service either did not separate food waste, had a collection arrangement with a local farmer who removed food waste for use as animal feed or had developed their own disposal process on site (effectively eliminating the collection issue). The hotels that had developed separation arrangements in the absence of commercial collection services were all located in the smaller centres (Rotorua or Queenstown). Those hotels located in the large cities did not begin separating food waste until a commercial service became available.

All respondents believed the absence of a disposal facility in their region (alternative to landfill) presented a significant barrier to food waste separation within hotels. All observed that it was very unlikely they would transport food waste to a disposal facility themselves and considered the existence of a disposal facility as a fundamental precursor to the provision of any commercial collection service.

5.2.2. Self disposal

In Queenstown, where no commercial food waste collection or disposal service exists, three hotels (all belonging to the same chain, only one interviewed) collaborated and built a worm farm at one hotel:

> "We already had transport running between the three hotels each day for laundry etc so it made sense to add the buckets of food to that." [87]

[87] Hotel 8

It was acknowledged that construction of the worm farm project was largely dependant upon the availability of land at the hotel site with no other designated use or significant economic potential.

5.2.3. Arrangements with farmers: Animal feed

Three hotels amongst the cohort have arrangements with farmers whom collect food waste in light vehicles daily. Neither party charges a fee. Respondents believe food waste collection is more viable for farmers located near to small centres than large cities (Auckland and Wellington) and that the provision of such a service is dependant upon travelling distances, times and costs being commensurate with the value of the food waste to the farmer. The importance of such a service being reliable, consistent and including a high standard of cleanliness with regard to bins and loading areas was acknowledged. All hotel operator respondents were pleased with the performance of farmers in this regard.

Hotel operator 2b (located in a 'smaller centre' and not separating food waste) rejected the notion of developing an arrangement with a farmer on the grounds that it was impractical and that:

> "...having it sitting around all day will mean hygiene concerns in terms of feeding that to animals."

Access between the kitchen, loading dock and street at hotel 2 appeared very similar to that of other hotels whose food waste is collected by farmers. All of those operators considered a single daily collection as adequate to ensure food waste remained fit for animal consumption. None could recall farmers ever presenting concerns regarding food waste storage or animal health and do not refrigerate food waste.

5.2.4. Commercial collection services

Respondents believed that a commercial collection service was essential to the development of food waste separation programmes in hotels located in large cites as the self disposal or informal collection arrangements observed in smaller centres were unlikely to be viable in such locales:

> "Here in Auckland you are not going to get farmers driving all the way in to the CBD to collect food waste. It's simply too far to travel." [88]

Respondents reflected upon the last five to ten years and observed the waste sector had been slow to develop food waste collection services during that time:

> "When we first started looking into finding someone to take our food waste a few years ago we actually couldn't find anyone. When we did they were planning to provide the service but it then took them over a year to actually get the thing up and running." [89]

WMC's observed service provision was hindered by both a lack of appropriate infrastructure and sufficient knowledge of key potential clients:

> "If you go to any of the areas outside of Christchurch, Wellington or Auckland there is no infrastructure for food waste collection. That problem (lack of infrastructure) dogged the development of a program in Auckland for the last five or eight years up until last year. You need a critical mass to actually make it happen, no ones going to set up a processing facility or collection service until they know their going to have enough business so it's all about actually getting something that's going to act as a catalyst to kick it off, and that's probably what's stopping it in most places." [90]

[88] WMC 1b
[89] Hotel 1
[90] WMC 2a

The impetus for provision of commercial food waste collection services in the Auckland region appears to have been a 2009 *Sustainable Management Fund* scoping program which identified potential clientele:

> "The funding was used to do a brief survey of hotels, hospitals etc and find out which ones were interested. A tender process identified the contractor offering the most appropriate service and then those parties were put in touch with each other. Of the ten or so hotels identified about six went ahead with it. Interestingly shortly after that service was set up the main collection and disposal competitor set up their own food waste program. Our project kicked things off but really all it did was create a bit of fuss around it. It didn't actually give them all that much, there was no money being awarded to anybody. I guess it threatened their market share and that was the push those companies needed to get on and prepare a proposal." [91]

A WMC representative (also DFO) providing a food waste collection service observed:

> "Even though we run the landfill it makes sense for us to provide a diversion service. Customers like hotels are asking for a service and the marketplace is competitive. If we don't provide it we'll loose clients entirely. We need to lead the way in this. Our focus is changing to providing a range of waste collection, disposal and processing services, with the full range of recycling options. We need to be a one stop shop with all the waste solutions".[92]

The commercial food waste collection and disposal services available in each study cohort region are listed in table 5.3 below. The large cities, Auckland and Wellington host very few services whilst none exist in the smaller centres of Rotorua and Queenstown.

[91] WMC 2b
[92] WMC 1a

Table 5.3: Commercial food waste collection and disposal services. [9] Study cohort RTO's. At August 2011				
Regional Tourism Organisation (RTO)	**Number of Hotels in RTO**	**Food Waste Collection Services Available**		**Food waste disposal facility linked with collection service** (other than landfill)
Auckland	71	Paper Reclaim (private company)		Envirofert (Compost)
		ReGenerate, operated by TPI/Waste Management (private company)		Envirofert (Compost)
		Biocosmo (private company)		Biocosmo Process (Fertiliser)
		Hungry Bin, onsite worm farms with service option available via *Low Impact* (both private companies)		ONSITE
Rotorua	21	None		N/A
Wellington	34	Kai to Compost	Wellington City Council (WCC) owned and operated	WCC: Capital Compost at Southern Landfill
		Organic Waste Management	Privately owned and operated	WCC: Capital Compost at Southern Landfill
Queenstown	31	None		N/A

5.3. Hotel food waste: Research findings

Waste audits were performed in two of the eight hotels participating in interviews.[93] All other hotels separating food waste had recognised food waste represented a significant portion of the volume of the entire waste stream and considered this informal observation as adequate justification for the implementation of a separation programme. Some reflected that awareness of the scale of waste volumes and their origin (i.e. vegetable preparation, post consumer etc) was improved following the implementation of the program and all acknowledged that separating food waste reduced the amount of waste destined for landfill.

> "When we began separating food waste the general (landfill bound) waste volume dropped by 20 to 30 percent per EC3 guest night." [94 & 95]

[93] Hotels 1's audit was performed internally by hotel staff and hotels 7's by a third party under contract.

[94] EC3 is an ecolabel (formerly Green Globe in the Asia Pacific region).

5.3.1. Hotel food waste quantity estimation (objective 3)

Four hotels from the interview cohort agreed to submit food and landfill waste data that they record as part of their environmental certification obligations. The data collection methodology of each hotel is detailed at Appendix Two. Combining data from three hotels[96] produces a range for food waste production of 1.0 to 1.9 litres per guest night. A range for the percentage of combined food waste and landfill waste that is food waste could not be established however, for hotel 7 it is 45.4%.[97] These results are presented in table 5.4 below.

Table 5.4: Food and Landfill Waste quantities per guest night (gn).
Selected hotels January to October 2011

Hotel No	Food Waste litres/gn	Food Waste kg/gn	Landfill Bound Waste kg/gn	Food waste % of landfill & food waste combined
Hotel 6	1.0	0.3	*Data not available*	*Data not available*
Hotel 1	1.3	0.4	*Data not available*	*Data not available*
Hotel 7	1.9	0.6	1.3	51.4%

5.3.2. Quantitative data limitations

A shortcoming of this is research is that the number of sources from which quantitative data has been attained is far too small to reveal any meaningful correlation (or lack of correlation) between hotels of differing star ratings, pricing structures or locations. Further research could attain a meaningful sample and examine the influence (if any) of such variables.

Nonetheless, this research does demonstrate that the quantities of food waste produced by large hotels are sufficient for existing organic WMC to

[95] Hotel 1

[96] The food waste data collection methodologies of one hotel were inconsistent with the other three hotels. Thus only three hotels are represented in Table 5.4. Assumptions are declared and any discrepancies amongst the differing hotels collection methodologies are reconciled at Appendix Two.

[97] Derived by weight, see Appendix Two for methodological details. Only some hotels provided both food waste and landfill waste figures. Landfill waste data collection methodologies were inconsistent amongst all hotels. Hotel 7 provided the best data resolution, therefore it is used.

consider them important clients. Moreover, because hotels produce significant volumes of multiple waste types, they are important clients to those WMC that collect all waste streams. As discussed in the next chapter, the importance of retaining waste flow and market share can spur WMC to provide specialist services such as food waste collection.

Therefore, further investigation of collection and utilisation options in areas where such services do not currently exist can be justified. Such investigations could be in the interests of governance authorities, WMC or DFO wishing to utilise food waste as a resource. Furthermore, the quantity of waste typically produced justifies the implementation of food waste minimisation initiatives by hotel operators and governance authorities.

5.3.3. Comparison with other data sets

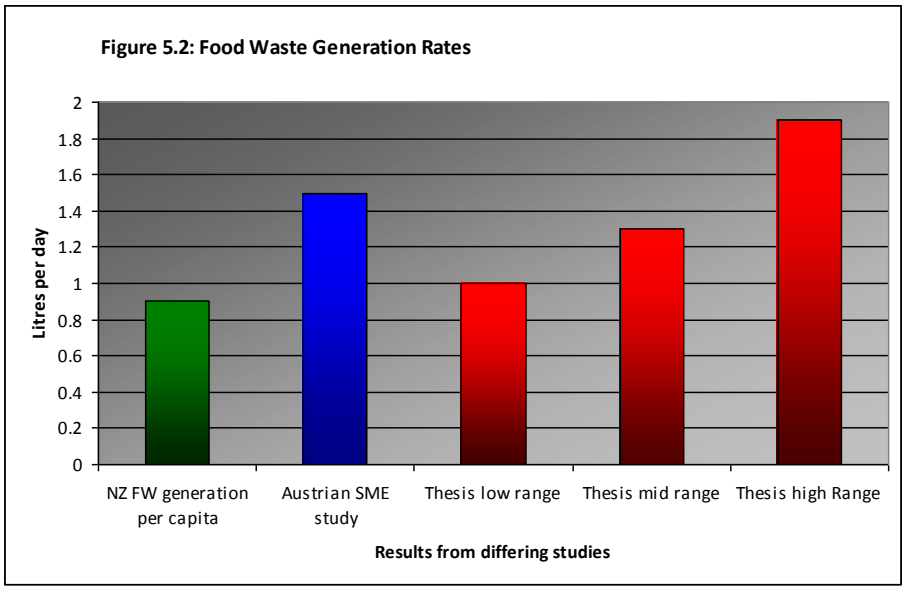
The results presented at table 5.1 are supported by the findings of the *Austrian small to medium enterprises case study* published by WRAP (2010a). The WRAP study demonstrates that restaurants generate 40kg of food waste per year per seat, and that hotels without restaurants generate 0.4kg of food waste per guest night. A rudimentary extrapolation of the WRAP (2010a) data reveals that restaurants could produce approximately 0.1 kg food waste per meal.[98] Combined with the 0.4 kg produced in hotels without restaurants the result, 0.5 kg per guest night (1.5 litres), fits within the range determined during this thesis (which examined hotels *with* onsite restaurants).[99]

Data derived from the MfE (2007b, 2009b) and Statistics NZ (2012) also provides some context to the range presented in table 5.4. Rudimentary calculation based on figures obtained from those sources reveals the New

[98] Assuming a restaurant is open 7 days a week for 52 weeks of the year = 364 meals. This maybe an overestimation of the number of days a restaurant is open, however that overestimation accounts for the inherent underestimation of the number of seatings per day.

[99] It should be noted that the inconsistencies amongst hotel data collection methods experienced during this research reflect issues encountered by researchers investigating hotel food waste in the United Kingdom (WRAP, 2011c).

Zealand, daily food waste generation rate per capita is 0.3 kg or 0.9 litres.[100] Results are compared in figure 5.2 below.



5.3.4. Extrapolation across sector (objective 4)

The range of 1.0 to 1.9 litres of food waste per guest night was applied to regional guest night statistics provided in the Commercial Accommodation Monitor (CAM)[101]. Results for all New Zealand RTOs combined are presented in figure 5.3 below.

Figure 5.4 (below) provides a comparison amongst the study cohort RTOs.

The ranges identified at section 5.3.1 are static because food waste quantities are assumed not to fluctuate seasonally. Guest nights however do, and so data in figures 5.3 and 5.4 is presented across a year (with a resolution of one month). October 2010 to September 2011 is used as the reference year as it is the same period in which the *food waste production data* of the hotels was recorded. It should be noted however that guest nights are likely to vary year upon year due to factors that influence hotel patronage (destination popularity, economic variables etc). [102]

[100] The methodology and sources used in this estimation are detailed at Appendix Two (section A-2.5).

[101] Data collection and calculation details are provided in Appendix 2.

[102] The hotel accommodation sector typically experiences a higher demand from October to April and lower demand from May to September. There is usually a drop in December due to fewer business guests during the holiday period (Ministry of Tourism, 2010b:2).

Figure 5.3: New Zealand RTOs Combined
Hotel food waste production volume (ranged estimates) by month
October 2010 to September 2011

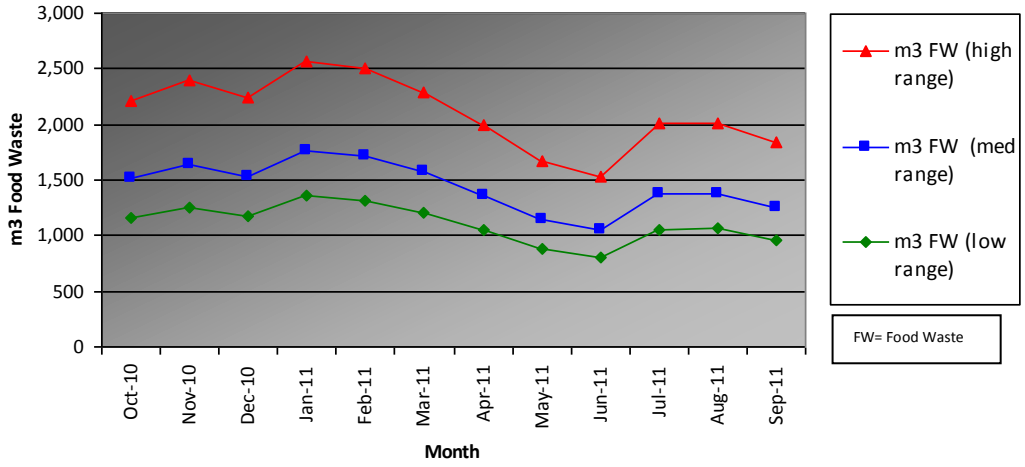
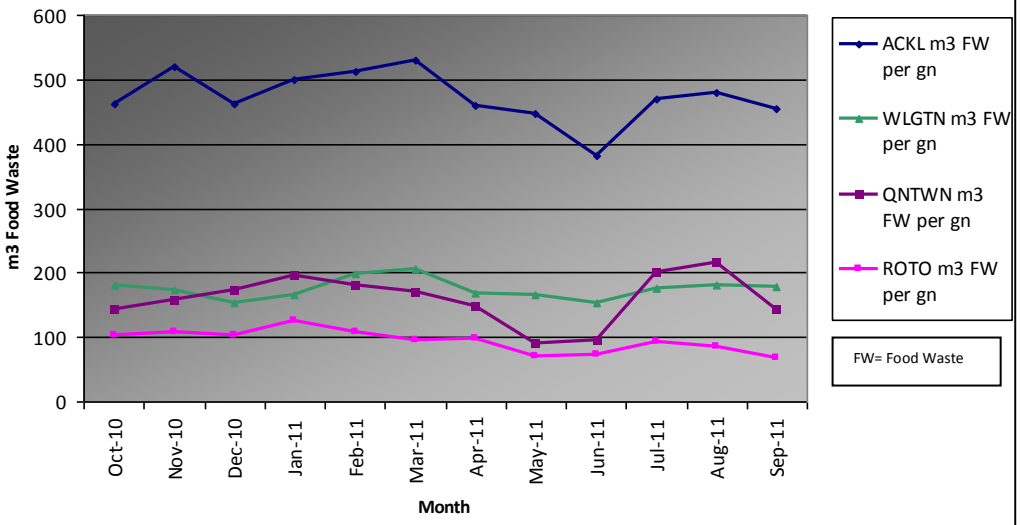


Figure 5.4: Comparison of food waste production volume estimates
Study cohort RTOs (medium range estimate)



Whilst figures 5.3 and 5.4 represent an estimate, the results demonstrate a substantial amount of food waste is likely to be produced by New Zealand hotels each year. Waste production is strongly linked with economic growth (PCE 2006; Stuart, 2009). New Zealand's tourism sector has experienced positive growth throughout the last decade (Statistics New Zealand, 2011)

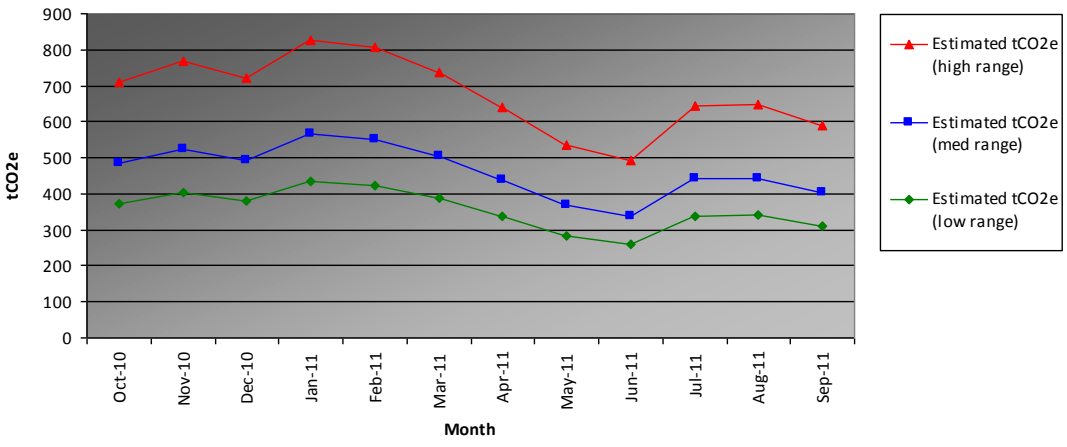
[102 cont.] The Rugby World Cup 2011 was hosted in New Zealand. The first game was played on 9th September and all pool matches completed by 2nd October. All knockout matches (semi quarter and full finals) were played in October 2011. Guest Nights for October 2011 are not included in the data set.

and the industry anticipates this trend will continue (Tourism Industry Association New Zealand, 2011). Environmental impacts associated with hotel generated food waste can be expected to fluctuate in step with gross domestic product (GDP). Adverse effects will worsen if mitigation initiatives are not implemented. Similarly, opportunities presented by food waste as a resource will persist and potential will grow along with quantities produced by the sector (Sjöström & Östblom, 2010).

5.3.5. GHG Emissions estimation (objective 5)

GHG emissions estimates determined in this study range from 0.32 to 0.61 kgCO2e per guest night. GHG emissions are consistent with organic waste production levels. Estimated ranges for all NZ RTOs combined are presented in figure 5.5 below. The figures (and graph) presented assume zero capture of GHG. If the food waste was processed via AD, GHG emissions would be negligible as all gases would be captured and utilised (WRAP, 2011c). If the food waste was interred in landfill with gas capture and destruction or utilisation technology installed, some CH_4 could be captured and destroyed. Capture rate efficiencies are estimated to range between 20% and 70% (Hogg, et al., 2010).

Figure 5.5: New Zealand RTOs Combined
tCO2e generation potential attributable to hotel food waste production (ranged estimates)
October 2010 to September 2011



5.3.6. Perceived costs

Hotel respondents utilising self disposal facilities or no cost collection arrangements with farmers did not undergo waste audits or assess the potential fiscal ramifications of implementing food waste separation systems.

Hotel respondents considering commercial collections did assess costs, two formally via waste audits and the others in a more informal manner, however those respondents cited other reasons (discussed elsewhere in this chapter) for pursuing the food waste programme. A WMC providing collection and disposal services for all waste types had observed a similar pattern of behaviour amongst their clientele:

> "Certainly if a hotel chooses to have food waste collected separately it's going to cost them more money. They generally tend to do it because they want to be doing the right thing, or be seen to be doing the right thing. So we haven't really been asked to do many waste audits focused on food waste, because hotels know it's going to cost them more anyway, so they are happy to estimate the cost based on experience and then just start." [103]

The single respondent without a separation programme in place believed that if waste costs were expected to rise due to food waste collection and or disposal the programme would not be implemented:

> "If the pure dollars and cents showed that it cost more to remove the food separately it is unlikely we would do it" [104]

The respondent was not asked if they were prepared to apply staff time to investigation of the costs involved.

[103] WMC 1b
[104] Hotel 2a

5.3.7. Affects upon productivity

All respondents who had implemented separation processes believed productivity had been neither reduced nor enhanced, however some acknowledged that such concerns had presented a barrier to undertaking the practice initially:

> "Before we brought the food separating in everyone thought it was gonna be a hassle and mean everything took longer in the kitchen but actually it was fine. After a few teething problems it runs just as smoothly as before. We found it means there's less rubbish (landfill bound) in the bins and they weigh less, so they're less heavy to drag around." [105] & [106]

5.3.8. Actual Costs

The interview and data analysis processes revealed that comparing waste collection costs between hotels is extremely problematic and no absolute comparisons can be made. WMC do not charge identical rates across all hotels in a district (or even amongst those in close proximity, let alone nationally). By bundling the collection arrangements of differing waste streams into the same contract, fixing collection frequencies or determining contract renewal dates, differing pricing arrangements can be negotiated. Similarly, a consortium of hotels could negotiate a national contract thereby reducing costs for all hotels within the group. Thus, within this thesis, only the *actual costs* experienced by hotels within the research cohort can be analysed.

In the study regions where commercial food waste collection is available (Auckland and Wellington), the food waste collection costs experienced by hotels varied largely depending on the collection service provider. In Wellington, a council facilitated food waste collection service was found to be 68% cheaper than the only competitor, a privately owned commercial

[105] Hotel 5
[106] Hotel 5

operator (also food waste only). The food and landfill bound waste collection options selected by two Wellington hotel operators are compared in table 5.6 below. The comparison is made on a volumetric basis as that is how the majority of options presented in table 5.6 are billed.

Figure 5.6: Food and Landfill Waste Collection pricing per 100 liters. Options selected by two Wellington hotel operators.

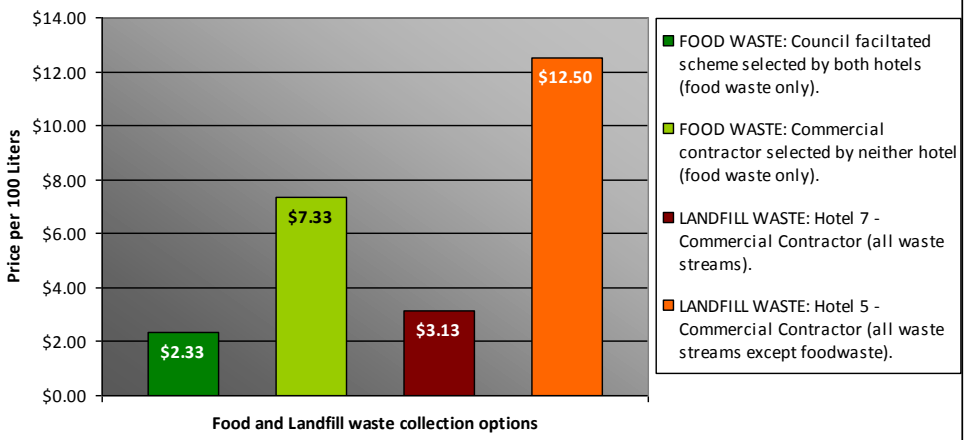


Figure 5.6 reveals the remarkable variability in food waste collection pricing in the Wellington region and demonstrates the complexity inherent to waste management decisions, costing and incentives. Both hotels use the same food waste collection service but employ different contactors for the collection of landfill bound waste.

For Hotel 5, food waste collection is 81% cheaper than landfill whilst for hotel 7 food waste collection is 25% cheaper. Comparison is problematic however as Hotel 5 compact landfill bound waste which is then collected in 240 litre bins on a PAYT basis.[107] Hotel 7 uses a fixed capacity 3m^3 bin which is collected daily without compaction. Food waste settles uniformly when placed in food waste only bins as the small particles are generally sloppy and heavy. Landfill bound bins on the other hand can contain large bulky items that create air pockets and random spaces. The representative from Hotel 7 did not consider 'waste formation' as a valid argument for justifying the differences in collection pricing:

[107] For more information regarding PAYT and flat rate pricing refer to section 6.2.1

> "That doesn't make sense, sure, landfill stuff might create pockets, but we are talking about food waste, so it doesn't matter whether I put food into the skip (landfill) bin or the food bin. It will take up the same amount of space in either. It sinks down because it's scraps. It's the same amount of stuff. Surely that (the food waste charge) can't be actually what it costs them plus a margin similar to what they bring on the landfill stuff. I think it's all a bit of a niche craze right now and they're going for it." [108]

The commercial contractor represented in table 5.6 disposes of food waste at the same, council owned facility as the council run food waste collection program. When queried regarding costs the contractor noted:

> "well yeah, I pay the same rate to dump food as green waste, it's called mixed organics. So yeah, if my dump fee was cheaper then my collection service would be cheaper for the client too."

When asked about the impact of the council facilitated scheme upon the commercial contractor's business and or market share, the respondent (the latter, WMC 3) was not concerned noting the scheme was limited to 50 customers and was "already fully subscribed."

An Auckland based WMC providing both a food waste and a landfill waste collection service cautioned against making absolute comparisons between the collection prices (their food waste collection is $6.79 per 100 litres). Observing that the logistics and scale of each service differed significantly the respondent noted:

> "…you are not going to be comparing apples with apples. The trucks are different, the bins are different, the travel distances between pickups and dump offs are all different. The work required at the end of it all (disposal facility) is different too." [109]

[108] Hotel 7
[109] WMC 1b

Hotel 1 in Auckland began separating food waste with a small firm specialising in organic waste recycling at $13 per 140L bin. However, the hotel changed contractors when a large and established waste management firm (with services for all waste streams) introduced a competing service at $9 per 140L bin.

5.3.9. Bags and bin liners

The cleanliness of bins was identified as a potential barrier however all hotel respondents currently practicing separation noted this *could* be overcome by WMC providing a swap out service (dirty bins for clean) at each collection (at no additional charge), cleaning bins on site or via the use of liners or bags. The use of liners or bags was considered by all respondents to add to the cost of food waste collection, increasing the barrier of price:

> "If the bags for example are expensive, it's a barrier. A $40 packet of bags is worth 3 hours labour to me. You've got to weigh up the savings to the costs."[110]

One private WMC emphasised that providing flexible conditions in their service arrangements was key to attracting and retaining customers. The WMC noted that they enable clients to do "pretty much anything in regards to bin types and bags" including allowing food waste to be placed in standard plastic bin liners "which we cut open later, tip out the food waste and hiff the bag (to landfill), and "collecting food waste in buckets which we then empty into the wheelie bins for them (the clients)." [111]

Conversely, another private WMC found themselves bound by their own collection equipment:

> "We can't tip the bins so we just have to take them away as is, and we can't clean them either, other than giving them a hose out, so we require our customers to use biodegradable bin liners." [112]

[110] Hotel 2b
[111] WMC 3
[112] WMC 1b

Respondents complained that biodegradable bags can be weak and may begin degrading immediately following exposure to moisture.

5.3.10. Bin types

Respondents noted subscription to a food waste collection programme significantly increased the number of bins in the kitchen. Whilst it was acknowledged that landfill bound waste volumes may be reduced, respondents noted the number of landfill waste bins located in the kitchen needed to remain the same as they were typically stationed at places where both food and landfill bound wastes are generated[113]:

Most hotel interview respondents found private WMC to be extremely accommodating in altering bin types so that food waste collection receptacles could fit into existing arrangements (note the example from the previous sub section in which a WMC discusses emptying small 20 litre buckets *for* the client). However the experience differed with a publicly funded programme:

> "We were finding that 240 litre bins full of food waste were too heavy for some staff to shift around, so we decided to change to 120's, but *name omitted* wouldn't collect, well, I mean they would collect them but they wanted to charge the same rate as a 240, so that was insane. For them it's a bin pickup but to us it's half the amount of waste, so that was going to double the bill!" [114]

5.3.11. Renovation

Altering a hotel's waste management system to accommodate the separation of food waste can require changes to the layout of kitchens and service areas.

[113] Hotel 2b
[114] Hotel 7

All hotel interview respondents noted that their kitchens were not designed with multiple waste stream separation in mind. In all cases, arrangements had been made for plastics, glass and tin recycling systems over previous years (which is typically just the provision of wheelie bins) but the recent addition of food waste separation required rearrangement of work spaces over and above what was required for the inorganic recycling. In some cases this involved adjusting the height of, or cutting holes into bench tops, or rearranging spaces to accommodate extra bins.

No respondents had renovations planned however those practicing food waste separation noted any future refurbishment would be more likely to integrate food waste separation requirements because the system had become part of the hotels normal operating procedures. The hotel with no separation process thought it would be unlikely that food waste separation would be considered during any future renovation. A WMC observed that whilst space and renovation might present a barrier, identifying solutions would be up to the hotel operator as "renovation advice or project management was not their core business." [115]

5.3.12. Food waste costs in relation to overall operating costs

Whilst hotel operators are likely to suspect that food waste represents a significant portion of the waste stream, conventional practices (co-mingling food waste with general landfill bound waste) persist as waste collection typically runs smoothly 'as is' and has little affect upon profitability. Investigation of waste stream dynamics and alternative waste management options requires consultancy (often in the form of a waste audit) and or valuable staff time (evaluating and reorganising the waste system).

> "Because waste costs are low in comparison to other operating expenses, hotel operators are inclined to prioritise the allocation of funds to activities known to provide returns upon investment, such as marketing or guest area refurbishment." [116]

[115] WMC 1b
[116] WMC 2a

5.3.13. Changing existing waste contracts

All hotel operators interviewed reported having positive experiences with collection companies when adjusting landfill bound collection capacities and frequencies, even in instances where they had chosen a competing service provider for the food waste collection.

> "When we changed over to the food waste programme it reduced our landfill waste, but I just rang up and asked them to pick up the bin 3 times a week instead of every day and they were fine with it"

Despite a hotel's ability to easily adapt collection capacities and frequencies, landfill waste collection costs do not change in accord with waste displaced to food waste collection "tonne for tonne, because billing typically includes a bin rental, a collection fee and a content charge"[117] (calculated as weight or volume). Thus even if the landfill collection capacity or frequency is reduced, food waste collection costs manifest as additional because "the sum of the two services end up costing more than the original landfill collection."[118]

5.3.14. PAYT (pay as you throw) and Fixed Capacity Billing

Respondents involved with commercial collection services observed that food waste collections tend to be billed as PAYT whilst landfill bound collections are fixed capacity.[119] Despite hotel operators introducing landfill bound waste minimisation initiatives such as food waste separation and shifting that component of the waste stream to PAYT, operators noted that their landfill bound waste stream remained on a fixed capacity billing system. Respondents observed this scenario could be discouraging to food waste separation initiatives because the introduction of food waste programmes may not be matched by a reduction in landfill waste charges.

[117] WMC 2a
[118] WMC 2a
[119] Differing billing systems are explained at sections 4.9.10 and 6.2.1

> "Hotels need to retain their spare capacity, their ability to dispose of waste if they suddenly produce more than expected. So it's natural for them to want to hold on to those big landfill bound bins even though they are doing the food waste thing. But keeping the bins means staying on a fixed billing rate, so in some cases the landfill billing probably won't actually change, there will just be much less waste in the bin every time it gets taken away." [120]

No hotel operator respondents had attempted to change their billing systems for landfill waste from fixed capacity to PAYT following the introduction of food waste separation. However, one noted that they had managed to reduce the number of landfill bound collections per week:

> "Once we started separating food waste we reduced our landfill collection from 5 times a week to 3. That saved us money. I think we're spending less on waste now in total" (council subsidised food waste collection). [121]

All hotel operators interviewed noted the importance of having food waste collected daily, "before it becomes malodorous". [122]

5.3.15. Minimising contamination

Food waste collectors and disposal facility operators require clients to ensure food waste bins do not contain inorganic material. Plastics, including condiment wrappers and steel cutlery are common contaminants. Respondents noted a well run, efficient separating system and adequate staff training can ensure the vast majority of such items find the right bin. Magnetic lids or strips on food waste bins also help reduce cutlery loss. One composting facility operator reported their ability to screen foreign items out of the compost product at the final stage of production meant contamination was "not really an issue at all"[123]. Whilst WMC and Disposal Facility

[120] WMC 2a
[121] Hotel 5
[122] Hotel 4
[123] WMC 2b

Operators (DFO) reserve the right to refuse food waste bins on grounds of contamination, respondents observed it is not typically a problem.

> "I was expecting to see really high levels of contamination when we started up this (food waste collection) service, but actually they are really, really low." [124]

5.3.16. Staff Buy in

In hotels where changes to enable food waste separation have been made, the typical experience was that these had "not turned out to be as bad as staff had expected"[125] and that whilst adaptation took "some effort"[126], with time staff "tweaked the system till it worked as well as the old one"[127]. Respondents noted however that the success of any systemic change requires staff 'buy in':

> "I think that sometimes there isn't a common vision between the two levels, of management and the people in the kitchens. Everyone needs to be on the same page, otherwise, sure there will still be some food waste being separated, but if you look in the landfill bin, half the food waste will still be ending up there anyway. It's all about really good communication." [128]

Respondents also emphasised the importance of raising staff awareness about why new processes are being implemented, including the social and environmental benefits attributed to it:

> "I think the implementation of the food waste separation would have been a lot more successful if I had done the same powerpoint presentation I did with management, about how its turned into fertiliser, with all the staff. I would have got more buy in I think. But that was just not logistically possible." [129]

[124] WMC 1a
[125] Hotel 5
[126] Hotel 7
[127] Hotel 6
[128] WMC 1a
[129] Hotel 1

5.3.17. Organisational Change for Sustainability

Notwithstanding the observations regarding staff buy in and training above, an overwhelming sentiment of all respondents was the importance of leadership and commitment from management. Respondents believed that making changes was entirely context dependant and that the variables of ownership and organisational structure (chain or independently operated hotels) had little influence upon the autonomy of senior managers to make changes to waste disposal arrangements, including those that increase costs:

> "A general manager, at any of the properties, could make a decision like this in an instant. They are autonomous and they could just do it. They are under KPI's (key performance indicator) to every cent that is spent and therefore everything needs to be justified, but still, they could do it." [130]

> "It definitely wouldn't have happened without management sticking at it and saying this is just how it's gonna be now. In this company, it's really hard to get anything happening unless you are backed by someone higher up." [131]

A respondent in a senior management position discussed how institutionalised practices can act as a barrier to the implementation of change:

> "I was as high as you get in management at a UK hotel. I was in charge, but making changes was still difficult because some people had been working there for 30 years. I wasn't going to be able to change them overnight. I wasn't there for long enough to be able to do that. I had about 450 staff. So I had to get the department managers to buy into something and then create a trickle down affect. It's really not easy." [132]

[130] Hotel 2a
[131] Hotel 5
[132] Hotel 9

5.3.18. Attitudes towards food and waste – the importance of training

All respondents commented upon the importance of fostering a 'culture of respect for food' within hotel kitchens, believing such an approach informs both the selection of disposal processes and any 'attitudes' held towards the wasting of food 'in house'. Furthermore, respondents considered a 'grounding in the culinary arts' as instrumental to the development of the knowledge and attitudes inherent to a 'respectful culture' focused upon producing quality food, minimising waste (prevention) and disposing of wastes responsibly.

The majority of interview respondents believed European hospitality staff, especially chefs, had a more holistic attitude towards food and food waste than New Zealanders and Australians and supposed that, for European chefs, such behaviour constituted a social norm in their home countries.

> "The European education system in the culinary arts is far superior to that anywhere else in the world. Our education system (in NZ) in regards to becoming a qualified chef is a joke, they don't learn any of that stuff with off cuts being regarded as ingredients and that, they don't learn any of those procedures about every possible bone being available to make a beef stock or every lobster shell being used to make a bisque… to them (NZ trained chefs) it is just bones – throw it out, whereas all of the European chefs I've worked with they limit waste to the 'enth gram, *because* it's food." [133]

> "If food waste diversion is going to be introduced (in New Zealand), the success of it will depend on who is in charge of the kitchens. The Europeans will be saying 'well of course, why can't we do this? Whereas for New Zealanders who have never encountered it, for them it's as foreign as recycling was in the first place. If it's a system you're not used to you wonder why you have to do it." [134]

[133] Hotel 4
[134] WMC 2a

Respondents also discussed noticing that "food orientated people"[135] including some chefs care deeply about where the food they prepare is grown and how "many wish that scraps could be reused on the land because that just makes sense." [136]

Respondents acknowledged current procurement processes enable the minimisation of in house food waste through specific purchasing, but cautioned that the practice contributes to the erosion of culinary knowledge discussed above:

> "I think the skill base in NZ is dropping because we are buying in so many prepared foods. I mean, I get my meat supplier to cut portions for me. Then I get exactly what I pay for. If a chef does it, a 200 gram steak can become a 250 gram steak. That's part of the reason why chefs today don't know how, or aren't looking out to save and then use broccoli stalks and things. They don't need to make stocks and sauces. I don't know about the training institutions personally, but I'd say the education is lacking in the New Zealand kitchens. A chef starting off now will probably never learn those skills. And it's because you can buy a whole lot of food with a chef's yearly salary, so from a management perspective, you end up buying in the prepared stuff and having fewer chefs." [137]

> "One driver that could make a real difference would be getting education into places like the Auckland University of Technology (AUT) Restaurant School and actually getting the students to learn about food waste recycling, both that it can be re used, or composted or any of the alternatives to landfill." [138]

[135] Hotel 2a
[136] Hotel 4
[137] Hotel 2b
[138] WMC 2b

5.3.19. Menu types: À la carte and buffet

Respondents regarded the food waste created during an à la carte service to be minimal, especially in comparison to that associated with buffets. [139] Respondents were keen to share strategies for minimising 'the inevitable' buffet wastage (prevention) and to emphasise that, whilst buffets are notoriously wasteful, in everyday practice, economic rationality drives sensible preparation and chefs do what they can to minimise waste:

> "I do things differently to the old style of making big meals and just piling everything up. We do everything on a smaller scale and have small platters with food enough for 10 to 15 people. So for example if I know I have 150 people booked then I will make about 8 platters and just take them out 2 or 3 at a time. That way the majority of the food stays in the safe zone of the chiller until it is needed and if it is not eaten I can use it the next day or whatever." [140]

[139] An interview respondent from a Rotorua hotel (Hotel 4) that provides a hāngi style buffet (as a Māori cultural tourism experience) observed that neither Māori attitudes or cultural perspectives towards food waste where considered when the hāngi style buffet was added to the "attractions at the hotel" (this aspect emerged during this particular interview and was not a focus of the research). The respondent noted that there is often a "culinary culture clash" at the hāngi event and many international tourists "don't actually like the hāngi taste" (the food is cooked in a geothermal steam vent). "Because they don't always actually like it we need to provide a large variety foods, so that they can try a little of everything and get a whole meal". The respondent also observed that no specifically 'Māori practices were applied to the preparation of hāngi food.

[140] Hotel 3

5.4. Being Green

Interviewees were asked *'what motivates a hotel to consider implementing a food waste separation program?'* Although opinions were mixed, all responses correspond with the ecological responsiveness categories outlined at section 4.7 of the literature review: competitiveness, legitimation and ecological responsibility. Salient exemplars are presented below. Most responses included some reference to the role and influence of environmental certification (eco-label) programs which are addressed explicitly in the following subsection.

5.4.1. Competitiveness

> "I would say it's worthwhile from a marketing point of view to be seen as clean and green. It's more for the overseas type tourists that look at the hotel rating and the Qualmark ratings. They see advertising, and they see the Qualmark rating and they think that's good, then see the enviro silver (eco label) and they think oh fantastic. And tour buses definitely want that." [141]

> "We get a lot of companies, including international potential corporate clients, who ask questions like are you environmentally certified, do you have an environmental business plan or policy etc. Often they are looking to be green themselves and so, as a supplier to them, we need to be green. We have an environmental purchasing policy ourselves. So there's a neat flow on effect there. So the push (to be sustainable) isn't just from the certifiers, there is also a demand out there in the marketplace." [142]

5.4.2. Legitimation

> "I think the environmental rating brings us up to a certain level amongst the other hotels around here, and I guess that without it – we are back to the old distinctions of cost, location and facilities." [143]

[141] Hotel 2a
[142] Hotel 1
[143] Hotel 8

"It is done from a business interest, you see all the big companies doing something environmental, if they don't do it they'll be left behind." [144]

"I don't think that food waste in a landfill making climate change would really be the thing that makes a hotel owner change the way they deal with the waste. It's more about being as green as possible and joining in with the trend." [145]

5.4.3. Ecological responsibility

"Our environmental initiatives are all of our volition. We haven't started doing them to keep pace with other hotels in the area. We are doing them because they make sense to us as people." [146]

"I think concern over global warming and other problems plays a part in the chain, and this hotel wanting to improve the way we do things. There is definitely an overall vision for all the hotels in the chain to improve, it might take 20 or 30 years but that's just the reality." [147]

5.4.4. Environmental Certification: The role and importance of eco labels

The interviews revealed that eco labels such as Qualmark's *Responsible Tourism* and EC3's *Earthcheck* provide some impetus for the investigation and or implementation of food waste separation processes by hotel operators. All respondents acknowledged however, that certification can be attained via improvement amongst other 'environmental indicators' such as the diversion of other waste streams, electricity efficiency or water conservation. Respondents observed they were more likely to pursue 'other initiatives' if they were seemingly more cost effective than food waste separation and that they were unlikely to pursue initiatives that were not mandatory.

[144] Hotel 3
[145] Hotel 2a
[146] Hotel 9
[147] Hotel 5

Four of the seven hotel respondents whom separate food waste *and* carry an eco-label attained that label before they began separating food waste. Those respondents acknowledged they did not need to implement a food waste separation program to retain the label they had attained initially.

Opinions regarding *'why food waste separation was implemented if not required for certification'* were mixed. Two observed that food waste separation was implemented as a result of "continual improvement of the hotels environmental practices driven by a desire to live up to what we are promoting ourselves as" and in that regard considered the "presence of the eco label as a statement of environmental integrity to be a greater driver than the actual eco label criteria".[148 & 149]

One considered the consortium's (chain hotel) own environmental charter to bear greater influence upon environmental practices than the eco label and attributed implementation of the food waste separation to "following the charter" rather than the eco label. [150]

Another noted that, the eco label criteria "at the time" required them to "continuously improve their practices" and therefore all waste streams were targeted. They were "unsure" whether they would have implemented food waste separation "had demonstrating *continual improvement* not been a mandatory requirement at the time". [151]

One hotel operator implemented a food waste separation program because it was an environmental improvement "more readily achievable and economically feasible than other improvements like electricity or water efficiency upgrades". [152]

A summary of the separation practices, star ratings and eco-labels of study cohort hotels is provided in table 5.5 below.

[148] Hotel 4
[149] Hotel 6
[150] Hotel 5; The respondent did not immediately recognise the hotel's environmental charter as an ecolabel in and of it's self.
[151] Hotel 8
[152] Hotel 7

Table 5.5: Hotel Operator Interview Cohort
Hotel food waste separation practice, star rating and eco label

Hotel	Location	Food waste separated at hotel	Star Rating (of 5)	Environmental Certification / Eco Label	Food waste separation already implemented before Eco Label first attained
Hotel 1	ACKL	YES	5	*Qualmark Enviro Gold*	NO
Hotel 2	ROTO	NO	3.5	*Qualmark Enviro Silver*	NO
Hotel 3	ROTO	YES	4.5	*None*	*N/A*
Hotel 4	ROTO	YES	3.5	*Qualmark Enviro Silver*	YES
Hotel 5	WLGTN	YES	4	*Qualmark Enviro Gold*	NO
				Earthcheck Silver	NO
Hotel 6	WLGTN	YES	5	*Qualmark Enviro Gold*	NO
Hotel 7	WLGTN	YES	4.5	*Qualmark Enviro Silver*	YES
				Earthcheck Silver	YES
Hotel 8	QNTWN	YES	4	*Qualmark Enviro Gold*	*NO*
Hotel 9	QNTWN	YES	5	*Qualmark Enviro Silver*	*YES*

Three hotel operators had food waste separation programs in place prior to application for an eco label[153]. These respondents noted subscription to the eco label facilitated the 'tightening up' of procedures, formalisation of collection and disposal arrangements and the implementation of monitoring systems.

> "We only started monitoring waste volumes because of the requirements of the environmental certification programmes." [154]

> "The hotel's had an arrangement with a pig farmer for years, but it was always inconsistent. Some days he might not come and if the bins got full, any more food waste would just go into the landfill bin. Because we joined with Green Globe and an ISO[155] one, we needed to sure things up, now he comes everyday and no food goes to landfill." [156]

[153] Hotel 3 is currently in the process of applying for an eco label.
[154] Hotel 4; NB: Long standing, informal collection arrangement with pig farmer.
[155] International Standards Organisation
[156] Hotel 3

All respondents believed participation in an eco label program 'facilitates the adoption of sustainability initiatives'. Most eco labels require the formulation of a 'green group'. Respondents considered this aspect of particular importance observing the forum enables staff to discuss the merits of differing initiatives openly, with economic justification being considered alongside social and environmental criterion.

> "Part of the Qualmark thing is to have monthly green meetings, so that provides a forum for people to come forward with sustainability ideas, but it's hard to tell whether, without that, if someone from say the kitchen staff came forward with an idea, whether it would be followed up if the reward structure of the enviro rating thing wasn't there. It definitely provides an incentive." [157]

Conversely, one respondent noted they did not need the impetus of an eco label's criteria to facilitate discussion or investigation of sustainability related ideas.

> "We've always been open to things like that and will always take time to check them out, if it makes sense, let's do it. We don't really promote any of our sustainability stuff, or the eco award (eco label) because we are just doing what we should be doing, it's just what our guests would expect. If a member of staff thinks we can do something in a more on to it way, I'll take a look." [158]

All respondents believed that once enrolled in an eco label program, capital or systemic changes that increased costs could be justified on the grounds of 'meeting the criteria'. Each respondent emphasised the existence of 'limits' upon such spending.

> "I can always lean on the crutch of Qualmark or the star rating if I need to justify that stuff with the owners. But the significance of those increases has

[157] Hotel 8
[158] Hotel 9

been relatively small I suppose. The profitability has not been belted around because of what we've done." [159]

All respondents considered recycling glass, plastics and paper to be *'normal behaviour'* amongst hotels. All thought separating food waste was currently *'not a norm'*, that it *'could be in the future'* and that '*inclusion within eco label criteria would assist normalisation of the practice'*.[160] One respondent elaborated upon this theme.

"I noticed though that the hotels working in with international standards through something like EC3[161] see the food waste thing as more normal, because other hotels around the world do it, than say those ones just working towards New Zealand's own standard (Qualmark's *Responsible Tourism*) where it's still pretty uncommon." [162]

5.4.5. Eco-label requirements

Respondents were asked to comment on the process of attaining an eco-label and in particular, the degree to which they found the criteria challenging.

*"*The first time we tried to get those green ticks it was a piece of cake, especially the EC3. It wasn't that hard. We had to do some things but were already doing a lot of it anyway because it saves money." [163]

"I think there are two main reasons why we are experiencing a slow uptake in hotels joining us (a WMC commenting on subscription to a food waste collection program). Firstly of course is cost, and secondly is that they don't have to do it to get a green star (environmental certification). They can get a

[159] Hotel 4

[160] Respondents should have been asked whether they thought normalisation would be more likely if food waste separation became a mandatory requirement, however I did not ask that particular question.

[161] An eco label, formerly Green Globe in the Asia Pacific region.

[162] WMC 1a
[163] Hotel 4

star by doing other things and because food waste can be hard to change and cost more maybe they just leave it." [164]

Following the question regarding the stringency of eco label criteria, respondents were asked whether they thought eco label criteria should be altered (made easier, harder or kept exactly the same) over time by the certification agency.

"I think shifting the goal posts upwards would be a really good thing and create a better benchmark would be great, let's achieve excellence." [165]

"I think the eco label thing has been good for raising awareness, but over time they need to continually up the anti, so that we're pushed to keep improving. It would have been ridiculous if it had been really hard to get it originally, no one would have joined, but once a hotel has it – I think it should be increasingly hard to hang on to it." [166]

"I guess we got our eco-star from doing easy stuff. To be honest, the harder stuff is just gonna end up in the too hard basket. But they (certification agency) should increase the hardness because that would force us to make the harder changes. That's the way it should be." [167]

5.4.6. Customer/client/tourist value orientations

When questioned about the importance of value orientations amongst tourists, respondents either had no response or simply observed that sustainability initiatives '*might be recognised'* and or *'appreciated'* by tourists. Respondents provided stronger opinions when asked whether they thought environmental practices would factor as an '*important decision making criteria for tourists'*. All respondents expected tourists to '*rank price, location and facilities ahead of environmental practices'*. Some respondents believed corporate

[164] WMC 1b
[165] Hotel 2a
[166] Hotel 8
[167] Hotel 2b

clients considered sustainability initiatives to be important, however none thought corporate clients would rank sustainability equally or ahead of price, location and facilities when making purchase decisions.

5.4.7. 100% Pure NZ. A tourism commons?

There was consensus amongst respondents that the tourism sector "is not doing enough" to enhance or at the least maintain the *100% Pure NZ* brand[168] and that *promoting the tourism product in this way* has become farcical. This sentiment was also expressed in regards to "New Zealand's sustainability as a whole" with respondents observing that the environmental management practices of other sectors, particularly dairy farming have a detrimental effect upon the tourism product.

> "New Zealand is not unique in it's beauty. It's the ease of getting to that beauty which is unique." [169]

> "What's gonna happen if one day these tourists spread the word and say don't go to New Zealand, the lakes are polluted from all the farming etc." [170]

> "I don't think NZ is clean and green at all. I have friends who come here from countries like Germany and they just laugh." [171]

The importance of the natural environment to the success of New Zealand's tourism product and other export industries is strongly emphasised within industry literature. Typical exemplars include:

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[168] Tourism New Zealand (TNZ) enhanced the*100% Pure* campaign with a new element *100% Pure You* in early 2011. TNZ intend to use *100% Pure You* amongst the majority of international marketing work going forward. This includes advertising, international PR activity and online marketing. *100% Pure* is used in event and sponsorship activity (TNZ 2011).

The interviews conducted for this research relate to the *100% Pure* brand only.

[169] DFO 1
[170] Hotel 2a
[171] Hotel 9

> "Tourism adds value to other export sectors by promoting the *100% Pure* brand internationally. Natural scenery and the environment are the primary reason international visitors travel here. It forms the basis of thousands of tourism businesses and also underpins much domestic travel" (Tourism Industry Association New Zealand, 2011:12).

> "If we are going to convince people to still come to NZ despite global warming concerns, then we have to make sure we present a country that is exemplary in terms of taking care to reduce carbon emissions. Clean and green has to be genuine" (Anne Braun-Elwert, Alpine Recreation in TIANZ, 2008:19).

A governance authority representative observed that the tourism industry should engage more directly with the environmental issues affecting their respective regions. The respondent noted the inaction had enabled fiscal disparities to develop, particularly in regards to waste.

> "Tourists create a big amount of waste but the ratepayers cover paying for it. That situation is more intense in the tourism places with small populations like Queenstown, Rotorua and Taupo. It's not gonna go away in fact it'll probably just get worse".[172]

[172] GA 1

5.5. Regulatory and Governance Issues

Interview respondents were asked to comment on waste related legislation within the context of *the barriers and drivers to food waste separation in hotels*. Most responses related to the role and efficacy of the current landfill waste levy ($10 per tonne) and the majority of those came from WMC, DFO and GA respondents.

5.5.1. Waste Levy

All respondents whom expressed views regarding the waste levy considered it to be too low to encourage the diversion of food waste from landfill.

> "I don't think the Waste Levy is high enough to change behaviour. At $10 a tonne people are saying 'so what'? The landfill guys just drop their gate rates to compensate. Until you can get that levy up to $30 or $40 behaviours not gonna change. International practice has got it way up to $100 or more. Only then will it become difficult for the landfill guys to drop their prices to compensate".
>
> "As the waste levy rises and the cost of landfill disposal goes up it is likely that food waste collectors will hike up their prices too. But they would have to do that in a way that remained competitive with the alternatives. Unfortunately, while the levy is low the only other real alternative will be landfill. That scenario will continue until the levy gets high enough that there is a disincentive for the landfill to drop their price to compensate for the levy. Once you reach that point you can have real true market pricing operating. Then more alternatives and technologies like composting, anaerobic digestion, pyrolosis will come in to the market and the combination of those will dictate the market price" [173]

A GA representative noted that the allocation of funds collected via the levy is disproportionate to the quantities of waste produced:

[173] DFO 1

"The levy is paid is by the ratepayers, but the fund that comes back is based on population. So we only get back 2/3rds of what we pay back, or maybe even less, almost 50%. It'll be similar for other regions with low populations and big tourism. I mean, we could also apply to the contestable fund, but that's a significant process in itself. As a deterrent the levy's good, but it needs to be funding projects that are effective. We put that issue forward during the submission round of the Waste Minimisation Act (WMA) but nothing came of it, too difficult I guess.

The thing is we've actually got our own levy in place. It's a LGA levy that is higher than the central government levy at $36 a tonne. We put it on as a disincentive to landfill and as a means of funding our own waste minimisation initiatives. It'd be better for our programs if we had complete control of all the levy funds collected at our gate".[174]

5.5.2. Resource Consent Issues

One interview respondent[175] noted that their selection of a food waste collection provider was influenced by restrictions upon food waste waste composition. In particular, the respondent considered a ban upon raw meat and fish to be problematic and so chose a collection and disposal arrangement with no restrictions.

A WMC[176] whom collects for the DFO[177] discussed above was asked *'do you think hotel operators may be reluctant to contract with you because the DFO cannot, under the conditions of the resource consent, have more that 1% of raw meat waste'?*

The WMC responded that the level of raw meat waste a hotel was likely to produce was minimal and that when combined with other waste at the facility would be far below the 1%, and that therefore this was not an issue. When the DFO was questioned in this regard, the representative responded that it would not be an issue, for the same reason given by the WMC.

[174] GA 1
[175] Hotel 1
[176] WMC 1
[177] DFO 1

6
DISCUSSION

Within this chapter, results of the primary research are discussed, contrasted and compared with the theoretical perspectives, data and information presented in preceding chapters. Assessing the emergent themes in this manner enables the research to be critiqued within the context of the Food Waste Resource Framework. The process facilitates the formulation of a list of barriers and incentives which is presented in table 6.1 below. Actions and recommendations with potential to ameliorate barriers or enhance incentives are presented alongside each of the items which are arranged in three distinct groups. The first pertain to New Zealand's current waste related legislation and regulatory environment. The second and third groups relate to the unique challenges and motivational factors inherent to the waste and hotel industries respectively.

The dialogue presented beneath table 6.1 provides a critique of the current legislative framework and contains specific amendment recommendations. Barriers and incentives that are inherent to the operation of hotels, including those generated by the idiosyncrasies of the waste industry are considered in the later part of the chapter.

Table 6.1: Barriers and incentives to food waste separation in large New Zealand hotels

Legislative Barriers and Incentives

	ITEM	ACTION
Barriers	Absence of organic and food waste monitoring or information targets in the national Waste Strategy.	Implement targets at national Waste Strategy level. Develop data collection, reporting & dissemination methodologies with TAs & industry to ensure consistency and buy-in. Require TAs to provide data (via WMMP). Require TAs to implement licensing by-laws. Condition of licence is data collection & reporting.
	Absence of organic and food waste diversion targets in the national Waste Strategy.	Implement commercial organic and food waste reduction targets at the national waste strategy level. Require TAs & industry to meet targets (via WMMP). Commercial targets should be developed according to a variable such as per capita, building occupancy or economic activity per year.
	Landfill levy rate ($10 NZD/tonne) too low to stimulate robust development and uptake of alternative technologies.	Increase Levy to $20NZD/tonne in 2013 and incrementally each year following to $90NZD/tonne at 2016. [178]
Drivers	Waste Minimisation Fund provides financial assistance to organic waste prevention and diversion programs.	Funds are accumulated via the Waste Levy. Respondents contributing to this research noted that funding is allocated (back) to communities based on population size. This is problematic in locations with high tourism economies and low resident populations. Tourism and hotel industries could lobby for the role of tourism generated waste to be factored into allocation decisions.

Waste Industry Barriers and Incentives

	ITEM	ACTION
Barriers	Costs of providing food waste collection & disposal services can be more expensive than landfill.	Adjust cost of landfill via Waste Levy (see legislation section above).
	Lack of coordination amongst principle stakeholders.	Implementation of targets via Waste Strategy noted above could stimulate a more coordinated approach amongst stakeholders.

[178] Recommended increases determined by Hogg, Wilson, Gibbs, Holmes, & Eve (2010). In the UK, a landfill tax escalator, which sees the levy rise at £8 per year (culminating at £80 in 2014) has been implemented (WRAP 2011b).

Barriers cont.	Contractors entering the commercial market can experience difficulty attracting enough customers to make a collection and or disposal service viable.	Research conducted in the UK (WRAP 2011a) demonstrates WMC with an existing customer database are best poised to develop a food waste collection service. The legislative changes proposed above could incentivise the development of collection services amongst such WMC. WMC contractors may need to develop household collections in order to gain sufficient quantities of material to ensure disposal systems are viable. Legislative changes proposed above would also incentivse the development of household food waste recovery.
	Contractors considering entering the market find it difficult to ascertain potential demand for food waste collection services.	Legislation designed to address information deficits could contribute to amelioration of these issues.
	Viability of food waste collection and or recovery ventures may be dependant upon flow control of food waste and or other waste streams (e.g. household food waste, GW or both).	A coordinated approach to regional waste infrastructure and planning facilitated by the respective TA could assist with this issue, however, flow control may persist as a barrier to the development of food waste collection and recovery services.
	The compost product and soil amender market is currently under developed and use of the products is not prevalent amongst agricultural industries.	Greater promotion of the benefits of compost products. Adoption of the NZ 4554 compost standard throughout soil amendment product industries.
Incentives	'Kick start programs' can stimulate activity amongst the food waste diversion market. The *Enterprising Manukau* story reviewed briefly within this thesis provides an example of how initiatives of this type can operate successfully.	TAs and central government facilitate food waste diversion 'kick start' programmes in regions without food waste collection and recovery services.

Hotel Industry Barriers and Incentives

	ITEM	ACTION
Barriers	Food waste collection and/or disposal services not provided in region.	Changes to legislation suggested above have been identified as crucial to fostering the development of alternative technologies & services. TA implement by-law requiring WMC to provide food waste collection services in regions where recovery systems exist.
	PAYT landfill bound collection unavailable in region.	TA implement by-law requiring WMC to provide a competitively priced PAYT service (allow to co-exist with other service types e.g. flat rate).
	Lack of information regarding viability of onsite recovery systems (eg: composting, vermi-composting, anaerobic digestion).	Tourism industry bodies implement education campaign and forum for information sharing.

Barriers cont.	Lack of time and or resources within hotel staffing structure to allocate to assessing environmental impact of waste practices and alternative options.	This scenario compounds across the industry. Tourism industry bodies could implement an education campaign, a forum for information sharing and fund consultants to assist hotel operators.
	Waste management costs are minor compared to other budget concerns and therefore receive little attention. Focus on improvements and changes tends to be applied in periodic bursts interspersed with large gaps (typically years).	Coordinated regional campaigns (facilitated via industry bodies) have the potential to bring multiple hotels to a consistent standard. Aggregating demand in this manner could assist with the development of food waste collection and recovery services in region.
	Space and renovation requirements to accommodate extra bins and other waste equipment.	Tourism industry bodies could implement an education campaign, a forum for information sharing and fund consultants to assist hotel operators. TA Implement by-law requiring renovations or new build above specified scale to include food waste separation facilities.
	Current training regime does not adequately address food waste related issues.	Tourism industry bodies could work with training institutions to ensure relevant food waste minimisation and management training is provided to students.
	Perception that food waste separation will slow productivity or fail due to lack of staff buy in.	This research demonstrates these perceived barriers can be overcome (in some cases very easily). Tourism industry bodies could provide education, case studies, facilitation and training.
Incentives	Demonstrable environmental standards can contribute to business competitiveness.	Respondents observed more could be done to enhance customer awareness of eco-label standards, value and meaning. Eco-labels could work with industry bodies to research, articulate and promote correlations. Eco-labels & industry bodies could facilitate communication with tourism operators to ensure the barriers and drivers to organic waste diversion are understood. Develop strategies with operators to overcome barriers and address institutionalised adverse waste management behaviours. Eco-labels and industry bodies could do more to promote the social and environmental benefits associated with food waste prevention and recovery.

Incentives cont.	Eco-labels can provide impetus for change.	Food waste practices do not typically constitute core criteria. Greater focus should be applied to the importance of food waste related issues. Food waste diversion could become core criteria in regions where services are available (this is the case for other recyclables such as glass & plastics with some eco-labels).
	WMC wishing to retain customers and market share enable long term waste management contracts to be altered.	Tourism industry should celebrate and publicise cooperation of this type. Even centrally managed contracts (i.e. across multiple properties) may be malleable.
	Low or no cost food waste collection arrangements can be made with local farmers (who use food waste as animal feed) where viable.	Tourism industry should celebrate and publicise cooperation of this type as systems can be transferable between hotels. Separation can assist advent of the waste prevention effect.
	Sources: (WRAP, 2011c; Hogg, Wilson, Gibbs, Holmes, & Eve, 2010)	

6.1. Legislative barriers and drivers

This research has revealed that New Zealand's existing waste related legislation has the potential to foster market conditions favourable to food waste diversion initiatives and technologies. In particular, the Waste Minimisation Act 2008 (WMA 2008) contains numerous mechanisms considered crucial to the development of a competitive organic waste market. However, the suite of policy instruments actuated by the current government does not provide sufficient impetus to spur comprehensive uptake, innovation or expansion of food waste diversion ventures amongst industry stakeholders or governance authorities.

Current legislation does little to incentivise food waste separation within hotels. Many operators are reliant upon third party provision of waste collection, disposal and or recovery services. The only exceptions being operators for whom onsite food waste recovery systems or arrangements with individual farmers are viable. The *2010 Waste Strategy* (2010 Strategy) is of particular importance in this regard. Failings of the *2010 Strategy* and its relationship with the Waste Minimisation and Management Plans (WMMP) of Territorial Authorities (TA) are addressed throughout the following discussion.

6.1.1. Collection services and recovery facilities

Results from the primary research emphasise the fundamental role regional waste infrastructure plays in enabling the development of disposal alternatives. Hotel operators without access to competitively priced and reliable collection services are unlikely to pursue separation programs unless a suitable onsite option can be accurately assessed and successfully implemented. The development of collection services is tightly linked with the existence of disposal (and or recovery) options and the two services are, to a large degree, mutually exclusive. [179] & [180]

6.1.2. Onsite systems & informal collection arrangements

The research demonstrates that some hotel operators, predominantly those not located in large cities, are able to utilise onsite systems (like compost or vermi-composting systems) or develop informal, low cost collection and disposal arrangements with local farmers. Further research could determine the total number of New Zealand hotels that have implemented such initiatives. Research of this type would benefit the sector if it also identified technology types best suited to the varying requirements of differing hotels.

Industry associations, governance authorities and private companies wishing to foster greater food waste diversion participation could disseminate hotel specific information relating to these options as some operators may not understand their viability. Information relating the experiences of hotel operators whom have implemented cost effective on site systems successfully could be particularly constructive.

[179] The 'tender' initiative facilitated via the Sustainable Management Fund (see section 5.1.1.3) in the Auckland region provides a successful model of a program designed to stimulate activity amongst the food waste collection and processing services market.

[180] Research conducted by Eunomia for Environment Bay of Plenty confers with this observation. The Eunomia (2010:49) report notes "where there is a commercially-viable alternative to disposal for a material, collection operators will generally provide that service".

Commercially produced on site systems have become increasingly compact, easier and more efficient to manage as technology has improved in recent years. Some inner city hotels may find systems such as vemi-compost units or anaerobic digesters can be operated successfully. Accurate assessment of waste production quantities is pivotal to the successful implementation of on site systems. The *food waste production per guest night* estimates (see section 5.3.1) determined in the course of this research could assist hotel operators and system designers to develop solutions tailored specifically to the requirements of large hotels.

6.1.3. Access to collection and disposal services

Notwithstanding the recovery options discussed above (6.1.1), the salient observation relating to the *access to services* theme is that commercial food waste collection and recovery services are slow to develop in the current New Zealand waste market. Access to food waste collection and recovery services is a fundamental prerequisite to food waste separation in hotels. Therefore the challenges faced by governance authorities and private companies wishing to establish food waste collection and recovery services should be addressed within this thesis. Comprehensive analysis is beyond the scope of this research however, as the pertinent issues which determine the viability of each type of technology are largely context dependant. Thus it is the *inhibiting factors* which limit the *development* of landfill alternatives in any given locale that are discussed below. Three such factors (which manifest as barriers to the separation of food waste in hotels) have been identified during this research.

1) Absence of organic and food waste information targets within the *2010 Strategy.*
2) Absence of organic and food waste reduction targets within the *2010 Strategy*.
3) Current waste levy ($10 per tonne) does not foster competitive pricing.

The numerous disparate variables which perpetuate these barriers are discussed in greater detail below.

6.1.4. Organic waste information

Stakeholders assessing the economic viability of food waste related ventures require information pertaining to waste flows[181], quantities, composition and clientele demand. If available information is considered inadequate for requisite appraisal of market opportunities, entrepreneurs and or existing service providers are less inclined to develop food waste collection and recovery services[182]. Industry stakeholders interviewed during this research believe the inert status of commercial food waste collection and disposal markets is due in part to imperfect information. The propensity for investment (and hence the development of food waste collection and recovery services services) would be enhanced if the collection and dissemination; quality and resolution of organic and food waste information were improved. Quality information is also beneficial to minimisation and management programs (NZAG, 2007).

The viability of collection and or recovery ventures may, in some cases, be dependant upon the acquisition of wastes from multiple sources. For example, commercially sourced organic wastes may need to be supplemented with a residential food or green waste collection contract. Arrangements of this type enable operators to ensure the optimal feedstock quantity per unit of time (eg: tonnes per week) is attained. Stakeholders assessing the viability of differing options therefore require data relating to all potential sources. This research has revealed the information deficit is perpetuated by the absence of data collection targets within current legislation, inadequate monitoring and insufficient data coordination and distribution amongst stakeholders. Whilst commercial sensitivity concerns will restrict the dissemination of some data, this research demonstrates there

[181] "To sustain the high fixed costs associated with operating sanitary landfills to the standard required by the Resource Management Act, and to provide an acceptable return on the original capital investment, it is essential for landfill operators to maintain control of an economic volume of waste by establishing 'ownership' of that waste as close as possible to its point of generation. In the waste industry, this is referred to as *flow control*" (Wilson, Middleton et al. 2009:22.1).

[182] Hogg, Wilson et al. (2010) have written extensively on the *Cost Optimisation* issue.

is scope for significant improvement in both the quantity and quality of information that could be collected and shared amongst stakeholders.

The 2002 Waste Strategy (MfE 2002a) and the 2009 Discussion Document (MfE 2009c) contained targets relating to organic waste information.[183] Food waste was not included as a definitive waste stream. Information targets sanctioned and coordinated at a national level assist the development of diversion initiatives and are fundamental to the assessment of legislative efficacy (PCE 2006). The current, *2010 Strategy* contains no targets[184]. The resolution of data relating to the organic waste market would be improved if targets designed to capture food waste composition and quantity statistics were added to the national waste strategy. Data collection of this type is expensive and therefore TAs are unlikely to focus upon such activities unless obligated. Such requirements can be sanctioned within the current legislative framework. Under the Act, TAs are required to regard the Waste Strategy when developing WMMP (s44c).

New Zealand's waste collection and transportation market is dominated by large operators significantly invested in landfill facilities. For stakeholders of this type, there is little incentive to collect or disseminate information relating to organic wastes. The national waste strategy should include a requirement for TAs to sanction the reporting of waste quantities and composition by commercial contractors operating within their jurisdiction. The *WMA 2008* provides for the imposition of such regulations. Section 56(3) enables TAs to implement bylaws that require persons whom collect

[183] Target 14 of the *2009 Discussion Document* (see sections 2.1.1 and 2.1.2) posited the development of a national reporting template (facilitated by MfE with input from TAs) through which councils would report progress upon waste management and minimisation initiatives to the MfE. Requirements would have included reporting upon the progress each TA had made against respective local targets sanctioned via Target 2.1 of the *2002 Waste Strategy*. The *2010 Waste Strategy* contains no waste minimisation targets and therefore TAs are provided with little incentive to include (or retain) minimisation or diversion targets in their WMMPs.

[184] The 2010 Waste Strategy acknowledges the need for improved statistics: "The lack of data about waste hampers our ability to plan appropriate activities to improve waste management and minimisation" (MfE 2010a:3).

or transport waste to obtain a licence. Licence conditions can include regular reporting upon waste quantities and composition[185].

6.1.5. Commercial organic waste diversion

The 2002 Strategy and the 2009 Discussion Document contained minimisation and diversion targets which directly targeted organic wastes[186]. The current strategy (2010) does not require TAs to set targets for the prevention or recovery of organic wastes.[187] TAs are not required to continue WMMP targets implemented under the auspices of previous strategies (those targets were non binding).

In most New Zealand towns and cities, the collection of wastes from commercial premises is typically conducted by private operators and TAs tend to focus upon residential collections. In such scenarios, TA's have little influence over commercial waste streams. Private companies providing both collection and disposal services (landfill) experience minimal incentive to divert organic wastes. The WMA 2008 provides TAs with the ability to ensure commercial operators provide diversion services. Section 56(3) enables TAs to impose bylaws that require commercial operators wishing to obtain (or retain) a license to provide a food waste collection service. [188]

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[185] Three Auckland Region TAs (prior to council amalgamation) implemented bylaws of this type. Rodney District, North Shore City and Waitakere City all require licensed collectors to report regularly on waste quantities and types collected. (Wilson, Middleton, Purchas, & Crowcroft, 2009). A similar regulation, the *Waste Handling Facilities Bylaw* has been implemented in Christchurch (PCE, 2006; NZAG, 2007).

[186] Discussed at sections 2.1.1 and 2.1.2.

[187] The current strategy's focus upon risk (and hazardous wastes in particular) diminishes the importance of the environmental impacts associated with food waste. "Decomposing organic waste" is provided as an example of a waste type with the potential to generate GHG and therefore create an "other form of harm". In this regard, the strategy misses the importance of organic waste as the largest waste type capable of generating GHG emissions and provides no guidance or impetus to TAs to target organic wastes.

[188] Research conducted in the UK shows operators currently providing commercial collection services (for any waste type) are best placed to provide food waste services as they have an existing customer database (WRAP 2011b). In the New Zealand context, commercial waste collection services are typically provided by private companies. Whilst privately owned waste management companies with investments in landfill operations may see little financial gain in providing food waste orientated services (except to diversify the suite of services provided in order to satisfy clients demanding food

6.1.6. Flow Control

Collection providers and or disposal facility operators may require food waste quantities of a scale that cannot be provided solely by the food waste output of the commercial sector in that region. In such a scenario, residential food waste collection could be required to create a waste stream of a viable scale. Furthermore, food waste utilisation technologies may require consistent supply of green waste[189].

This example demonstrates the complexity inherent to municipal waste management and emphasises the importance of multi agency cooperation in solutions development. Moreover, the complexity of the example demonstrates the importance of multiple agencies sharing a common vision for sustainability improvements and working towards such aspirations in a coordinated and methodological manner. This aspect is discussed in greater depth in the concluding chapter.

The importance of flow control to the development of food waste collection and recovery services is exemplified by the contrast in demographic information presented in table 6.2 below.

Queenstown Lakes District and Wellington City both support the same number of hotels. Despite the fact Queenstown experiences a far greater number of total guest nights (across all accommodation types) than Wellington each year[190], no commercial food waste collection and recovery services have evolved there. In contrast, two commercial food waste collection services and one recovery facility operate in Wellington City.

Residential collection services for food waste or GW are not provided in either region however residents can drop GW off at specific facilities. It is assumed that the volume of green waste generated by the comparatively large residential population in Wellington, combined with the high number

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waste collection) the implementation of licensing by laws with service provision conditions (discussed at 6.1.4) and changes to the waste levy (proposed at 6.1.7) may shift incentives.

[189] Hogg, Wilson et al. (2010) performed an analysis of this issue in regard to household collections.

[190] Only 2010 Guest Nights (GN) are represented in the table however Queenstown Lakes District's total GN are consistently much higher than Wellington City's.

of post consumer food waste producing businesses has provided the impetus for the development of food waste collection and recovery services in that region.

Table 6.2: Guest Nights and Population – a contrast between Queenstown and Wellington

Location	Population*	Total Guest Nights (all accom types – year ended Dec 2010)	No. of Hotels	Food & Beverage Services, Supermarket and Grocery Stores (2010).**	Food waste collection service providers	Food waste recovery facilities
Wellington City	200,100	1,975,386	31	1,021	2	1
Queenstown Lakes District	28,700	2,514,784	31	250	0	0

*Sub national population estimates, 30 June 2011. Statistics NZ, accessed online 22 November 2011

**Food and Beverage Services (includes H451 Cafes, Restaurants and Takeaway Food Services; H452 Pubs, Taverns and Bars; H453 Clubs – Hospitality) and G411 Supermarket and Grocery Stores and G412200 Fruit and Vegetable Retailing. Numbers represent ANZSIC classification Codes.

Note: A report commissioned by Queenstown Lakes District Council (MWH, 2011:26) acknowledges the region's hospitality businesses generate large quantities of organic waste. The report notes that, relative to the residential populations of other districts, Queenstown's waste production rate per capita is aggrandized by the tourism sector.

6.1.7. Market Structure

Collection, transfer and disposal infrastructure is typically owned and operated by either the local TA or by private interests. Partnerships and long term contracting are common. Retaining ownership of waste infrastructure enables governance authorities to adjust arrangements to meet the changing needs and priorities of the community.

At the current time, Auckland is the only region in which the local authority is not heavily involved in waste infrastructure ownership[191] (Wilson, et al., 2009). Interview respondents observed the ownership scenario in Auckland has contributed to the stifling of landfill alternatives. Private companies

[191] In Auckland the council only influences 17% of the waste stream. Muncipal solid waste is received at three major landfills in the Auckland region. Redvale (owned by TPI) at Albany in the north, Hampton Downs (owned by EnviroWaste) in the Waikato and Whitford at Manukau in the south east. Whitford Landfill (and the East Tamaki Transfer Station) is a joint venture between Manukau City Council and Waste Management. In addition to the major three is the small Claris Landfill (on Great Barrier Island) which is owned by the Auckland Council (Wilson, D., B. Middleton, et al. 2009:21).

control the regions waste flows and experience little incentive to investigate or implement landfill alternatives. Consequently, service providers possess little knowledge of food waste quantities and can be unaware of the demand for alternative services.

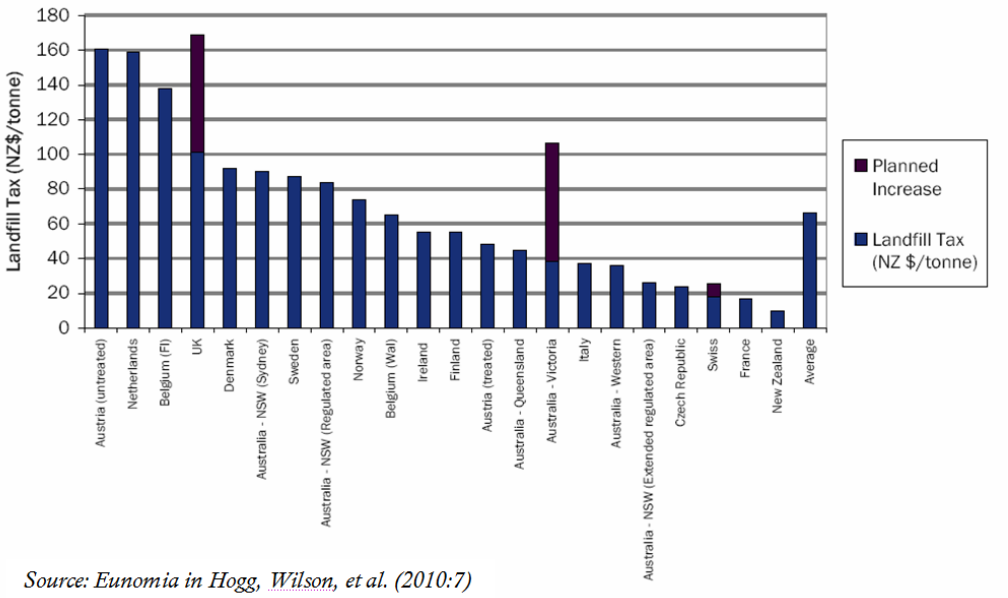
6.1.8. The Waste Levy

Disposal costs are known to motivate the collection and/or recovery preferences of waste producers (Hogg, et al., 2010) such as hotels. The economic viability of landfill alternatives is largely determined through comparability with the cost of landfill disposal as pricing must be competitive. Thus the implementation of a tax or levy upon landfill deposition, at a rate which incentivises alternatives is pivotal to the success of diversion initiatives.

The New Zealand *waste disposal levy*[192] represents an acknowledgement that waste disposal imposes costs on the environment, society and the economy (New Zealand Parliament, 2008:s25). Critics argue however that at the current rate "the cost of landfill (in New Zealand generically speaking) does not...reflect the true environmental costs of disposal" (Hogg, et al., 2010:6.9). Hogg, Wilson et al. (2010) argue New Zealand's current levy is lower than any in the EU or Australia and provides weak impetus for change in WM practices. Comparable levies (reproduced verbatim from Hogg, Wilson et al) are presented below.

[192] Introduced via the Waste Minimisation Act 2008. See section 2.1.4.

Figure 6.1: Landfill Levies in the EU and Australasia (NZ $ per tonne)



Source: Eunomia in Hogg, Wilson, et al. (2010:7)

Hogg, Wilson et al. (2010) argue the New Zealand landfill levy should increase to $20NZD/tonne in 2012 and incrementally each year following until it reaches $90NZD/tonne at 2016.[193] These increases would make the levy "comparable with some of the moderate levies" in Europe. This sentiment was also expressed by all interview respondents whom chose to comment on the levy (and was repudiated by none) although no specific values or timeframes were suggested[194].

Determining a levy rate that would:

a) stimulate the development of landfill alternatives thereby providing hotel operators with sufficient diversion options within their locale, and

b) generate a fiscal incentive for hotel operators to implement food waste separation programmes, and

[193] The study by Hogg, Wilson et al. (2010) was the only research found which posited actual levy rates for New Zealand. Under section 39 of the WMA 2008, the minister must review the effectiveness of the levy at least every 3 years.

[194] The WMA 2008 includes a review mechanism for the Levy.

c) provide stakeholders assessing the viability of food waste collection and processing services with some certainty in regards to competitive pricing

is beyond the scope of this thesis. Further research could examine these variables in a hotel and or hospitality industry context. Studies which determined the competitive pricing required in locations with no existing commercial food waste collection would be particularly beneficial. Any such study would need to assess market structure, infrastructure ownership, waste flow and myriad other idiosyncratic variables unique to a given locale.

6.2. Hotel Inherent Barriers

Hotel inherent barriers and drivers can be separated into two distinct groups. In the first group are barriers with causal links to the conditions imposed by the waste industry. The second group relate to problematic consumption and the sustainable tourism paradigm within which hotels operate. [195]

6.2.1. Waste industry imposed barriers and drivers: PAYT vs flat-rate pricing.

Waste collection contracts are billed at either a flat rate or on a pay as you throw (PAYT) basis. The PAYT model sees hotel operators charged per unit of waste disposed. Under most PAYT systems, waste is collected in containers such as bags or wheelie bins. It is typical for staff to place the containers out for collection only when they are full. Waste contractors charge per unit collected (typically per container, litre or kg). Less waste equals less units and therefore waste reductions or diversions are directly reflected in the bill at the end of each month. Under this system, hotel operators experience a direct incentive to reduce waste destined for collection.

Alternatively, a *flat rate* is charged for the collection of waste (usually in large $3m^3$ or $4.5m^3$ skip bins) at a regular frequency (ie. number of pick ups per week or month). Collection occurs regardless of the quantity of waste

[195] Refer to sections 4.5. and 4.6 for an overview of these concepts.

produced. Even if a bin contains only a small amount of waste (40% of a bins capacity for example) it is still collected and the hotel is charged.

Flat rate contracts are criticised by waste minimisation advocates because waste prevention efforts are usually not reflected in the hotels collection costs unless the collection frequency can be reduced. Because systems typically only involve a single, large bin, or because operational standards require rubbish to be removed daily, hotel operators are often reluctant to reduce the collection frequency. Doing so would reduce the spare capacity required to deal with unexpected levels of waste generation.

Because food waste constitutes a significant portion of typical, total hotel non-recyclable waste, operators are more likely to be able to cope with fluxes in landfill bound waste flows once a food waste separation process is in place. Thus, the availability of PAYT services for landfill bound waste can act as a driver for food waste separation initiatives.
With a PAYT system for both food waste and landfill waste, operators can gain complete control of waste management costs. However, some WMC may only offer flat rate systems for landfill bound wastes. In such scenarios, food waste collection costs will increase total waste collection costs, even if food waste collection is cheaper per unit. [196]

This research demonstrates that hotel staff utilising PAYT systems experience the *waste prevention effect*.[197] These observations emphasise the positive effects management initiatives can create at various levels within the Waste Hierarchy, particularly at the prevention tier[198].

[196] Observations regarding PAYT and flat rate systems are presented at section 4.9.10, 5.3.6 & 5.3.6.6.

[197] Waste prevention effect: Improved awareness of waste dynamics initiates further waste reductions (Ball & Abou Taleb, 2010; Hogg, et al., 2010).

[198] The Waste Hierarchy is reviewed at 4.1.1

6.2.2. Changing food waste management systems: A rare occurrence

Hotel managers possess significant autonomy over waste systems but are unlikely to compare differing options on a periodic basis. Once a system is in place, it is generally left alone and any practices associated with it become institutionalised. Thus, if hotel operators make changes to collection and disposal arrangements once, they are unlikely to go through the motions of exploring new alternatives again, unless a significant financial benefit or compounding reason for change can be demonstrated.

The scenario appears to be compounded by a lack of information. Waste quantity monitoring has been uncommon amongst hotels historically. Thus, neither hotel operators nor WMC are likely to have had access to waste stream data with resolution of sufficient detail to produce accurate cost comparisons. Waste audits can provide appropriate information however they are considered expensive by hotel operators. Interviews revealed that hotel operators are more willing to make changes based on experience and 'everyday' observation.

6.2.3. Competitiveness and legitimation

This research demonstrates environmental concern (and thus ecological responsibility)[199] is not a principal driver of food waste related behaviour change. However, competitiveness and legitimation feature strongly amongst the motivations of respondents, a trend strongly reinforced by the findings of the literature review. Neither hotel size nor consortium affiliation were considered to bear significant influence upon food waste management practices. The importance of leadership and the ability of senior managers to alter waste management practices was recognised during the literature review and borne out by the observations of respondents. These findings, combined with the observation that food waste costs constitute a minor component of total operating costs, lend weight to the conclusion that an

[199] See section 4.7

impetus for change should be led by industry bodies. This theme is explored in greater depth at the following chapter.

The investment incentive problem discussed at section 4.5.4 appears to bear some influence upon hotel food waste management practices. Whilst respondents observed that staff in management positions had the autonomy to alter systems, it was also acknowledged that where significant investment (to implement renovations for example) was required, changes were considered too ambitious and deemed unnecessary. Decision criteria can be conceptualised in an ecological responsiveness context (see section 4.6.1). If competitiveness is not enhanced by major changes (i.e. alterations to kitchens, as opposed to simply changing collection arrangements, adding extra bins and implementing a separation food waste regime) then practices will persist until such time as either legitimation or ecological responsibility spurs the perceived requirement for adaptation.

Most interview respondents considered eco initiatives to be more important to corporate clients rather than individual 'leisure guests'. This indicates environmental initiatives which increase operating costs (or require capital outlay for implementation) may not be favoured by the motel, hostel or home stay sectors as those sub sectors do not typically attract a corporate clientele. Amongst these sub sectors, industry associations may also be required to lead the way in fostering the adoption of sustainability initiatives.

6.2.4. Training Issues

The wide range in food waste production rates demonstrated at section 5.3.1, combined with the responses of interviewees demonstrates that food waste production quantities are largely dependent upon the attention applied to waste *prevention* by staff. Interview respondents emphasised a noticeable difference between European and New Zealand trained chefs in regard to training and believed educational institutions should place greater emphasis upon food waste related issues and prevention strategies.

Respondent's observations that separating food waste caused a waste prevention effect amongst staff are synonymous with the findings of the literature review (see section 4.4.2). These results demonstrate that New Zealand trained staff have little experience with food waste separation protocols upon graduation. The challenge therefore, is to facilitate the advent of the waste prevention effect during tuition.

6.2.5. Normalisation of food waste separation practices

The trend for legitimation amongst hotel operators (in regards to environmental friendly practices) identified within this research indicates food waste separation could become a 'norm' amongst hotels (and other hospitality sectors) over time. However, the availability of collection and disposal facilities constitutes an important prerequisite. The addition of food waste training within institutions discussed above would also contribute to the normalisation of food waste diversion practices.

The collaborative approach advocated within the *Tourism Strategy 2015* provides some scope for tourism agencies to become actively involved in the facilitation of food waste initiatives. The value of 'kick starter' programmes is demonstrated by the *Sustainable Management Fund* story reviewed briefly within this thesis (section 5.2.1.3). Tourism charters and or RTOs could conduct similar research in regions currently lacking food waste collection and recovery services.

The corporate sustainability development model (see section 4.6.4) provided by Benn, Dunphy and Griffiths (2006) provides a useful spectrum via which the progress of individual hotels and the hotel, tourism and waste sectors towards practices consistent with positive sustainability[200] can be gauged. This research demonstrates that the approach actuated by hotel operators in New Zealand ranges between *efficiency* (stage four) and *sustaining* (stage

[200] To achieve positive sustainability is to "deliver sustained high performance, provide for just and equitable conditions in the workplace, contribute to social equity, and assist in renewing the biosphere" (Benn, et al., 2006:156).

six).[201] The hotel and tourism sectors occupy similar bounds (of the spectrum) however the waste sector tends to exhibit traits commensurate with stage three, *compliance*. Criticisms held within the literature in this regard extend to the overarching, national level waste policies which assist the institutionalisation of waste management practices (Hogg, et al., 2010; NZAG, 2007; PCE, 2006).

Thus a discrepancy exists. Whilst the tourism sector appears to understand the necessity of adopting an environment led (Hunter, 1997) approach to tourism in New Zealand (Ministry of Tourism, 2007; TIANZ, 2011), waste policy (combined with other government policies that have detrimental environmental effects) contributes to the ensnarement of tourism within the product led *(ibid)* paradigm.[202]

6.2.6. Eco labels

Food waste diversion is not a core requirement of either of the eco-labels which dominant the New Zealand hotel market.[203] However, it could be made mandatory in regions where services are available. Compulsory reporting would improve data quality relating to the waste management characteristics of hotels. Analysis of such information could assist local authorities, waste, hotel, hospitality and tourism industry organisations to improve food waste CPS. [204]

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[201] See section 4.6.4.

[202] These concepts are reviewed at section 4.5.3.

Product-led: Common in areas where tourism is well established. Environmental concerns are secondary to that of the tourism industry and actions are taken on the basis of maintaining the viability and growth potential of the tourism product.

Environment-led: Environmental concern is paramount. Tourism development is limited to the carrying capacity or sustainable yield of the natural environment and does not compete to the detriment of other economic sectors in the locality.

[203] Qualmark's *Responsible Tourism* and EC3's *Earthcheck*.

[204] Privacy and intellectual property rights issues would need to be addressed.

Eco-labels could also advise and assist hotel operators to implement separation systems. Currently, few eco-labels or WMC provide advocacy or consultancy services. [205] Hotel operators wishing to alter waste practices may find a lack of experience with such activities a barrier. This is particularly pertinent in small centres where hotel operators may be considering self disposal options (as collection and disposal services do not exist). Composting and vermi composting systems (for example) require maintenance and therefore training is required. Hotel staff may not feel confident with installing systems of this type at the scale required to manage food waste quantities produced by their kitchens. Eco-labels are also well poised to facilitate communication relating to other experiences such as bin contamination, contract alterations and effects upon productivity.

Eco-labels could partner with tourism organisations to quantify, articulate and promote the relationship between demonstrable environmental standards and businesses competitiveness.

Eco-labels have the potential to drive the improvement of environmental practices within the hotel industry. Adjusting certification criteria to reflect developments amongst member hotels, the industry at large, state of the art technologies and service sector developments (such as food waste collection and disposal services) will enable eco-labels to propel industry standards. Eco labels can generate flow on effects throughout supply and procurement chains (Gallastegui, 2002). Without an impetus for continual enhancement, the positive environmental benefits generated via eco-labels could reach a state of inertia (Houe & Grabot, 2009).

[205] Eco-labels could be more pro-active in regards to assessing, developing, promoting and implementing technologies which reduce the environmental impacts associated with hotel operations. Many eco-labels require hotel operators to record resource consumption rates (such as natural gas and electricity consumption) as a core monitoring requirement. Data of this type could be applied to technology viability assessments. For example knowing natural gas consumption and organic waste production levels could help when running a cost benefit analysis of onsite AD systems.

7
CONCLUSION

The intent of this research was to identify the barriers and drivers to food waste separation in hotels. Put simply, the most important barrier is actually a lack of drivers. Stakeholders throughout the waste cycle experience little incentive to divert food waste from landfill. Hotel managers, waste management contractors and disposal facility operators function within a legislative environment devoid of definitive targets or aspirations. Governance authorities and industry associations lack impetus and direction despite the potential for policy coordination contained within the Waste Minimisation Act 2008. Lax regulations enable landfills to retain a competitive advantage over alternative recovery technologies. The sum result is the perpetuation of a wasteful culture in which the mismanagement of a useful resource generates ongoing social and environmental consequences.

Hotel operators are more likely to implement separation systems where such activity reduces costs and increases convenience. Scenarios of this type prevail within regions where onsite solutions or low/no cost arrangements with local farmers are viable. Hotel operators unable to make such arrangements are reliant upon commercial collection and recovery services. In some regions such services are not available and therefore it is unlikely that hotel operators will separate food waste. In regions where food waste collection and recovery services are available, food waste collection is typically more expensive than landfill bound collection (on a litre for litre or kg for kg basis).

The competitive advantage that landfill disposal holds over alternative technologies restricts the development of the food waste diversion sector throughout New Zealand. This scenario is perpetuated by the oligopolistic structure of the current waste industry in some locales. In regions where the organic waste diversion market is currently inadequate, policy designed to stimulate the development of these services (to a sufficient scale whereby alternatives are competitively priced) is required.

Demand idiosyncrasies specific to the hotel market provide some motivation for food waste diversion amongst hotel operators. Demonstrating engagement in sustainability orientated activities is believed to enhance a hotels competitive advantage. It is typical for hotel operators to introduce food waste separation in conjunction with other initiatives designed to improve the social and environmental status of an organisation. Eco-labels provide hotel operators with a vehicle through which to promote such actions. Food waste separation is not a fundamental requirement of the eco-labels which currently dominate the hotel market in New Zealand.[206]

In New Zealand, the principle *background elements* of the tourism industry are the same variables upon which the country's *clean green* image, *100% Pure* and *100% Pure You* brands are founded. In this regard, New Zealand's natural environment and the marketing derived from it can be considered a common pool resource. The environments capacity to assimilate waste can also be conceptualised as a common pool resource (Brown & Cameron, 2000). Any actions which have a detrimental effect upon the natural environment adversely affect the *tourism commons*.

The tourism industry has acknowledged the importance of New Zealand's "overall sustainability" to the successful marketing of the tourism product internationally (Ministry of Tourism, 2007:12). The industry has recognised waste management as an important aspect of the country's sustainability credentials and has expressed a commitment to "take active steps to reduce

[206] Qualmark's *Responsible Tourism* and EC3's *Earthcheck*.

and manage waste, encourage other sectors to do the same, and engage with the local, regional, and national agencies that provide waste–management standards and facilities" (Ministry of Tourism, 2007:6).

The need for collaboration that is recognised in the *Tourism Strategy 2015* is also borne out by this research. At section 4.5, the work of Dietz, Ostrom et al. (2006:142.5) was drawn upon to demonstrate the need for adaptability and compromise amongst stakeholders. Dietz, Ostrom et al. (2006) posit conditions that can enable effective commons governance. Whilst Dietz, Ostrom et al. (2006) observe that manifestation of all these conditions is rare, this research demonstrates that in the New Zealand hotel food waste context, an opportunity exists as most conditions are currently viable.

The tourism industry is well poised to play a central role in facilitating the development of food waste diversion initiatives amongst hotels. Sustained consultation and advocacy for the development of a national waste policy that incorporates the principles of strong sustainability[207] are key.[208]

New Zealand's waste related legislation and governance framework can enable the development of effective monitoring, interpretation of waste related data and regulation enforcement (PCE, 2006).[209] The propensity for effective networking and communication is favoured by the scale of the governance, tourism, hospitality and waste sectors in New Zealand.

[207] Defined at section 3.2.5.

[208] These sentiments are reflected in the list of barriers, drivers and potential actions presented at table 6.1 in the previous chapter.

[209] New entrants to the industry will be subject to these regulations (NZAG, 2007).

7.1. Recommendations for further research

Food waste is a multi faceted and complex environmental issue, many aspects of which lay beyond the bounds of this masters thesis. Recommendations for further research are presented in table 7.1 below.

Table 7.1: Recommendations for further research
Identify the best method for setting commercial food waste reduction targets (relates to legislative recommendations at table 6.1). Selection of an apposite reference variable is critical. Options could include per capita, economic activity per year or building occupancy.
TAs and or private companies encounter numerous challenges when assessing or developing food waste collection and disposal services (including logistics, costs, growth potential, flow control and other myriad variables). These factors inform the multifarious pricing scenarios that could develop within the market. Investigation of the impact differing cost arrangements would have (relative to the price of landfill) upon the waste management practices of food waste producing sectors throughout New Zealand would be beneficial.[210] Such work could include analysis of combining household and commercial food waste recovery operations.
Examine in detail the impact private ownership of waste infrastructure has upon the development of organic waste diversion initiatives in New Zealand.
The role and value of TA funded food waste collection and recovery services schemes require further research. Such programs have the potential to stimulate competitive pricing. The Wellington City Councils *Kai to Compost* program is the only initiative of this type represented within this research. It is unclear to what degree this ratepayer subsidised program has fostered competition whilst meeting the objectives of the councils WMMP.
The role of the Resource Management Act 1991 (RMA) was not adequately addressed in this research (due to the constraints of a masters thesis). The resource consent process has been associated with negative affects upon certainty in regards to developing disposal services for post consumer wastes (Wilson, et al., 2009). Further research could explicate issues of this type and assist the development of diversion services.

[210] Analysis of this type has been performed by WRAP in the United Kingdom. WRAP (2011c:40.4) observe that the "typical cost per tonne of disposing of food waste to landfill is £78, including gate fee and landfill tax, while diversion to AD is currently £57 per tonne. Food waste recovery via AD may therefore save around £21 per tonne. The on-going increases in landfill will make the difference between these two options more extreme as time goes on".

Wasted food represents wasted resources. Analysis could examine the costs food waste imposes upon society and the environment at differing stages throughout the food production and waste cycles. Such work could also attempt to quantify the financial losses associated with hotel food waste.
Analyse the costs and environmental impacts associated with the transportation of food waste and identify optimal collection scenarios.
Investigate the role food packaging plays in preventing or enhancing the utilisation of food wastes.
Anaerobic Digestion provides many environmental benefits including offsetting the use of synthetic fertilisers and fossil fuel generated energy production. Potential benefits could be quantified in a New Zealand context. Further research could examine the applicability of such products within New Zealand's agricultural sector. A life cycle assessment (LCA) designed to ascertain the environmental sustainability of differing outcomes, products and co-benefits amongst the myriad of potential applications would be particularly beneficial. Research of this type, including analysis of the market potential of soil amendment products could enhance the development of food waste collection and recovery services.
The primary research conducted for this thesis sought to establish a range for the quantity of food waste produced per guest night (objective 1). Acquiring data for such an analysis was problematic and therefore the results presented are rudimentary at best. Future research could build on the work done within this thesis and bolster the case studies presented herein with data derived from audits performed amongst a representative number of hotels. The extrapolations performed with the food waste per guest night range (objectives 2 and 3) inherit the limitations of the food waste per guest night data set. Furthermore, deriving coefficients with greater applicability, such as food waste generated per meal served would enable estimations to be extrapolated across the hospitality sector with greater accuracy. [211]
This research has addressed some aspects of food waste prevention, however the core focus of the work relates to dealing with food waste once it has been disposed of by hotels. Further research could focus on the potential for waste prevention within the hospitality context. Data relating to the ratio of avoidable to non-avoidable food waste could be beneficial to the sector.
Investigate the relationships between differing star ratings, pricing structures and or locations of hotels and the propensity of owners to implement food waste separation programs.

[211] WRAP (2011c) have performed analysis of this type in the United Kingdom.

Explore the influence variables including residential population size, business composition and Gross Domestic Product (GDP) per year have on regional food waste productions rates.
Conduct a survey which correlates the waste management practices of hotels with the collection and disposal or recovery services available in each respective region. Survey could provide valuable market information to entrepreneurs and enable stakeholders to monitor change.
Explore the influence of business and corporate clientele upon the environmental management practices of hotels. It is acknowledged that this thesis is very tourism centric and that, had the scope provided in a masters thesis been wider, greater emphasis could have been applied to this aspect.

7.2. Utilising the food waste resource

This study aimed to provide stakeholders with sound research from which to develop effective waste management policies. Each of the objectives outlined at section 1.3 were achieved. The results demonstrate the New Zealand hotel sector produces a significant amount of food waste with the potential to generate GHG emissions if landfilled. Moreover, the food waste produced represents a substantive resource which could be utilised as animal feed or via other recovery technologies such as composting and anaerobic digestion.

Unfortunately, many regions do not possess food waste recovery facilities and as a consequence, commercial collection systems are not available. Despite the finding that in some circumstances local farmers collect hotel food waste as animal feed (often on a low or no cost basis), it can be concluded that a large amount of hotel food waste is landfilled every day.
As discussed at section 3.2.3, I consider myself an environmental pragmatist willing to incorporate multiple perspectives when seeking solutions to environmental problems. This approach informs the recommendations presented in chapter six which are designed to promote environmental sustainability in the absence of definitive solutions (Brown & Cameron,

2000:30).[212] Some recommendations relate to national level legislative and policy changes, whilst others are concerned with re-orientating the institutionalised values and beliefs that enable environmentally detrimental food waste management practices to persist.[213 & 214]

The observations, recommendations and conclusions reached within this thesis are permeated by an acknowledgment of the importance political participation plays in effecting social change (Maniates, 2002). This theme is particularly pertinent to environmental management policies that impact the New Zealand tourism commons. Governance systems that prioritise strong sustainability can assist tourism and waste stakeholders to reduce the environmental externalities[215] associated with consigning food waste to landfill.[216] Food waste diversion practices will contribute towards justification of the *100% Pure NZ* and *Pure You* brands, an association many New Zealand export businesses trade upon and identify with (TIANZ, 2011). Environmental protection activities can only be achieved in the medium or long term (Álvarez Gil, et al., 2001), therefore, tourism industry stakeholders, arguably all New Zealand citizens, are wise to advocate for the diversion of food waste from landfill.

[212] The moral pluralism inherent to environmental pragmatism enables conclusions borne via an ecological conception of economic activity (Princen, Maniates, & Conca, 2002) to be considered within a neo liberal paradigm. This theme is explored at section 3.2. Philosophical assumptions.

[213] This thesis is intended to assist in the development of "social values and a belief system that incorporates and promotes behaviours that will lead to ecological sustainability and environmental preservation" (Brown & Cameron 2000:34.4).

[214] Section 4.7.3 demonstrates how the *individualisation of responsibility* erodes public participation and does little to adjust the underlying social structures which perpetuate adverse environmental behaviours. In the hotel food waste context for example, those operators able to divert food waste from landfill easily (via on site systems, no/low cost arrangements with farmers or competitively priced collection systems) will do so. However, if the overarching policy which drives waste management protocol goes unchanged, institutionalised practices will continue in other jurisdictions.

[215] Externalities are currently borne by contemporary society. Future generations will be forced to address issues relating to the effects of climate change.

[216] Diverting food waste from landfill internalises the externalities associated with landfilling (Hogg, Wilson, Gibbs, Holmes, & Eve, 2010).

APPENDIX ONE

A-1.1. Disposal processes and associated environmental issues

The collection, treatment and disposal of food waste can generate numerous environmental impacts and benefits (Zhang, et al., 2011). Primary end of cycle disposal processes include landfilling, anaerobic digestion (AD), incineration, use as stock feed and aerobic composting (Ayalon, et al., 2000; Zhang, et al., 2011). Landfilling and incineration are common amongst both developed and developing countries and are therefore considered as conventional within this thesis. Residues and gases produced during primary processes can be utilised and/or destroyed via waste to energy systems, flaring or secondary processing technologies such as gasification, carbonization and prylosis.

Environmental issues associated with collection relate primarily to transportation, waste flight[217] and fly dumping[218]. It is common for food waste to be collected and processed with other waste types thereby constituting part of typical municipal solid waste (MSW). In the summary analysis presented below, processing technologies and environmental issues are discussed in relation to food waste as both a single, separate waste stream and as a fraction of MSW.

Positive, negative and negligible environmental associations can be attributed to each of the systems mentioned above. Circumstances at disposal or recycling facilities (for example weather and properties affecting waste composition), the processing techniques used, the interpretation of

[217] Waste Flight: When waste is deposited at a facility alternative to that originally intended or best suited to purpose. Waste flight can also be considered in a fiscal sense whereby a disposal facility operator loses anticipated revenue on account of waste being deposited at an alternative facility (Tchobanoglous 2002).

[218] Fly dumping: Illegal and or uncontrolled disposal of waste in areas not designed for refuse collection like public places or farms (Tchobanoglous 2002).

environmental impact and impact displacement, technology performance and assumptions applied in analysis inform such associations.

A-1.2. Greenhouse Gas Emissions (GHG)

The degradable organic carbon (DOC) within food waste provides the potential for the generation of CH_4 (methane). Agreed to be 15% of the mass of typical 'wet', or 'as received from source' food waste, DOC is accessible to biochemical decomposition and will degrade to CH_4 (methane) amidst anaerobic conditions (Bingemer & Crutzen, 1987; Christensen, Simion, et al., 2009; IPCC 2006) at a decay rate of 0.231 (UNFCCC 2006).

Such conditions can manifest amongst any of the 'end of cycle' disposal processes listed at section 4.1 and are often manipulated to do so deliberately as the CH_4 is captured and utilised for energy generation, or is intentionally destroyed. Techniques such as composting are designed to affect decomposition amongst aerobic conditions however these systems can become anaerobic if managed incorrectly.

CH_4 is a green house gas (GHG) with a global warming potential (GWP) 25 times greater than that of CO2 when considered across a 100 year time horizon (Forster, et al., 2007). Food waste is considered to decompose rapidly, within 3 months to 5 years (Tchobanoglous & Kreith, 2002).

A-1.3. Air Quality issues associated with disposal practices

Volatile organic compounds, pollutants and trace constituents emitted to air from waste disposal systems (including the off-gases from treatment and energy recovery facilities and the incineration of waste) can adversely affect human health and surrounding environments (Tchobanoglous & Kreith, 2002). Food waste is unlikely to emit dangerous pollutants however, its interment in landfill creates methane which can transport non-methane

organic compounds. Food waste disposal and recovery facilities can also emit offensive odours.[219]

A-1.4. Solid waste landfills

Solid waste landfills (landfills) are commonplace throughout the world (Ayalon, et al., 2000). Food waste is rarely separated from MSW and is commonly interred with inorganic wastes.

A-1.5. GHG emissions from food waste in landfills

Landfills are the worlds second largest source of anthropogenic methane (Cruz & Barlaz, 2010) producing an estimated 13% of global anthropogenic methane emissions (Themelis & Ulloa, 2007)[220 & 221].

It can be assumed that, for one tonne of an organic substance decomposing amidst the anaerobic conditions typical of landfills, 50% of the material will convert to CO_2 and 50% to CH_4 (Ayalon, et al., 2000; Bingemer & Crutzen, 1987).[222]

Statistics attributing landfill generated GHG emissions with food waste at a global scale do not exist in the literature presumably because the food waste portion of MSW differs markedly with context (population demographics and season for example) and are rarely measured due to the high monitoring costs (or impossibility of such a task) involved.[223]

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[219] The Volatile Organic Compounds (VOC) within landfill gas (LFG) can be removed via scrubbers if landfill gas (LFG) destruction equipment is installed. The combustion process, however, does result in the increased emission of criteria air pollutants such as sulfur oxides (SOx), nitrogen oxides (NOx), carbon monoxide (CO) and particulate matter (PM) from landfills (Tchobanoglous 2002).

[220] The total contribution to the global warming problem directly attributable to Municipal Solid Waste Landfills is less than 2%. Landfills are the 5th largest contributor following rice production, domestic animals, fossil fuel production and biomass burning (Tchobanoglous 2002).

[221] 3% of total EU greenhouse gas emissions in 1995 (15 member countries) is attributed to methane generated by biowastes in landfills (European Union 2010).

[222] Landfill gas may contain less CO_2 because part of the CO_2 becomes dissolved in the landfill water (Tabasaran 1982; Gunnerson and Stuckey 1986 in Bingemer and Crutzen 1987).

[223] A study by Deublein and Steinhauser (2008) demonstrated that approximately "12 – 300 m³ of landfill gas" is produced per Mg of residual waste (waste generated by households also termed MSW).

Landfill gas (LFG)[224] can be captured from landfills and CH_4 either flared or utilised (commonly for electricity generation) once deposited material is capped with an appropriate cover (clay soil is commonly used). LFG capture rates vary between facilities and determining precise capture rates is problematic. Estimates range between 20% and 70% (Hogg, et al., 2010).

Food waste will begin generating GHG emissions immediately following deposition (the process can begin before this time) amongst anaerobic conditions.[225] It is typical for operators of sanitary landfills in industrialized countries to fill designated areas (landfill 'cells') with waste over relatively longer periods of time, placing primary and intermediate cover material atop the waste pile before applying the final cap. These covers are added gradually with each significant deposition event (for example at the end of each day or week) to manage odours, the displacement of waste by wind (littering), vermin, insect and disease vectors, infiltration of water and other considerations (Tchobanoglous & Kreith, 2002).

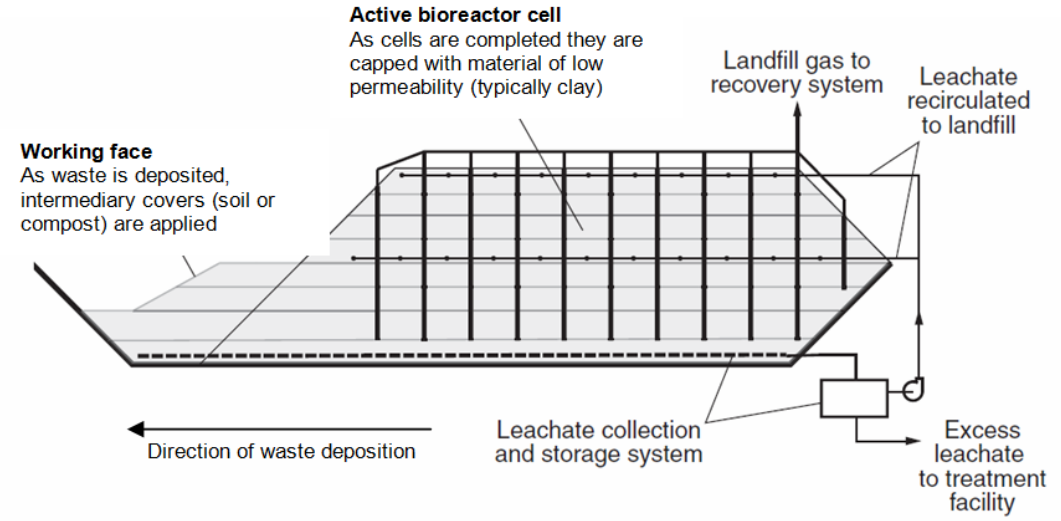
Intermediary covers are the principal source of both the aerobic and the anaerobic organisms responsible for organic waste decomposition. They are more permeable than cap material and therefore trap methane less effectively. Thus, even in facilities with capture technologies installed prior to waste deposition, some methane generated by decomposing food waste may escape to atmosphere before it can be captured.

[224] Landfill Gas (LFG) is an umbrella term used to describe all gas emissions from a landfill. Principal gases include carbon dioxide (CO_2), methane (CH_4), ammonia (NH_3), carbon monoxide (CO), hydrogen (H_2), hydrogen sulfide (H_2S), nitrogen (N_2) and oxygen (O_2). The presence of trace gases varies according to waste composition. In some landfills volatile organic compounds (VOC) can present amongst trace gases (Tchobanoglous 2002).

[225] Rovers et al. (1977 in Bingemer and Crutzen 1987) argue complete deposition of food and garden wastes occurs within 1-5 years.

Figure A-2.1: Cross section of a bioreactor landfill with leachate recirculation and landfill gas recovery systems installed.

Adapted from Tchobanoglous, G. and F. Kreith (2002:14.7)[226].



Despite advances in LFG capture technologies, many landfills do not possess comprehensive and efficient collection systems, or have not installed systems at all.

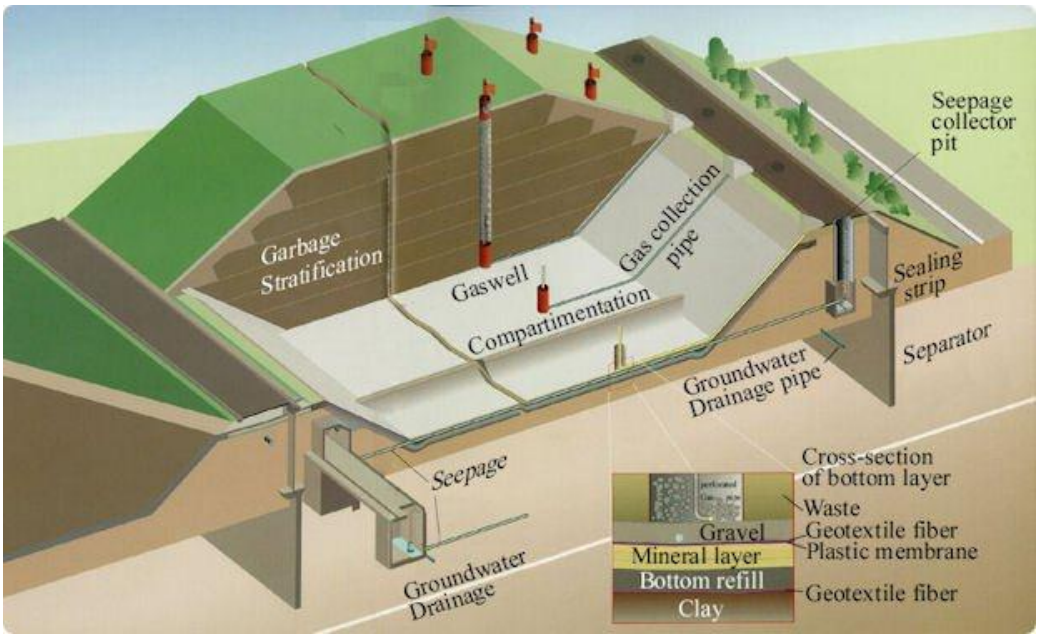
Meadows et al (1997 in Ayalon et al., 2000:540) estimated that only 40 to 50% of LFG would be collected in North America, Western Europe and Oceania before 2025. Estimates for the developing world are much lower at just 10%.

Landfill gases can migrate laterally underground and cause explosions or kill vegetation. Landfill liner and gas collection systems can minimise such risks (Boltze & de Freitas, 1997; Tchobanoglous & Kreith, 2002).

[226] Diagram in Tchobanoglous, G. and F. Kreith (2002) adapted from Solid and Hazardous Waste Education Center, University of Wisconsin–Madison, 2000.

Figure A-2.1: Cross section of a typical modern landfill containing LFG and leachate collection equipment.

Source: Cenergy 2012



A-1.6. Pre Composting of MSW

Pre-composting organic waste is known to prolong landfill life by reducing input volumes (Slater, 2001) and enhancing the materials energy generating potential (Norbu, 2005).

MSW can be partially screened and the fine, organic rich material composted. The resulting product, although contaminated with glass, plastics, metals and potentially toxic elements can be suitable as cover material. The process reduces the LFG generation potential of the waste and, if used as cover, may not be considered as biological MSW thereby enabling DFO's subject to legally binding organic waste deposition restrictions to utilise the material in the landfill operation (Burnley, 2001).

Mechanical and biological treatment (MBT) is a similar process however pre screening is minimal. Raw MSW is composted in order to reduce the organic carbon content and the resulting product is landfilled (Burnley, 2001).

A-1.7. Landfill leachate

Leachate, the watery substance emitted from the bottom of landfills can cause environmental problems including the pollution of surrounding waterways and underground aquifers. Modern landfill construction techniques minimize the production of leachate by restricting the entrance of external water, and leachate that is produced can be collected and processed, thus reducing or eliminating leachate escape. Composite liners, which can include both a geomembrane and a layer of clay, are typically used for this purpose. Common processing practices include discharging collected leachate to local waste water systems or recirculation through the waste pile[227]. Landfills in developing countries may lack such facilities. Leachate generation and escape is of significant concern in such locales. (Tchobanoglous & Kreith, 2002).

If landfilled in a 'raw' state (with no pre processing in a dryer or centrifuge for example) the high moisture content of food waste can contribute significantly to leachate generation. The toxicity of leachate however is attributable to the multiple waste types present in MSW. Reducing moisture content in the waste pile reduces the volume of leachate generated.

A-1.8. Landfills: Vadose Zone and Groundwater Quality

The Vadose or unsaturated zone is the portion of the subsurface above the ground water table. Leachate that escapes, and gases that migrate laterally underground can contaminate the vadose zone and groundwater diminishing quality, adversely affecting adjacent environments and endangering human health (Tchobanoglous & Kreith, 2002).

[227] A process applied in 'bioreactor' landfills, recirculation accelerates the decomposition and stabilization of solid waste (Hossain 2009).

A-1.9. Landfill Space and Legacy

Landfills are large scale engineering projects that typically occupy large areas of land. Landfills must be managed for years following the cessation of waste deposition. Food waste contributes significantly to the space requirements of modern landfills. Jurisdictions with low population densities are more likely to experience a greater availability of land and lower land related costs than those with high densities (Barrett & Lawlor, 1997). Barret and Lawlor (1997) present evidence which demonstrate fiscal savings can be made by constructing fewer, large scale landfills.

A-1.10. Controlled Anaerobic Digestion

Anaerobic Digestion (AD) is the decomposition of organic waste in the absence of oxygen. If decomposing under controlled conditions, the methane produced during AD can be captured and utilised as an energy source (Forster-Carneiro, Pérez, & Romero, 2008). The economic viability of such practices increases when costs associated with both energy production and waste disposal rise (Deublein & Steinhauser, 2008; R. Zhang, et al., 2007). If not captured, gases are allowed to escape to atmosphere where they can contribute to climate change or cause air quality issues.

Food waste is particularly desirable as an AD feedstock because the moisture and nutrient content, the ratio of volatile solids, the particle size and biodegradability of the material is favourable to the type of anaerobic, microrganismal activity that provides methane yields satisfactory for energy production (Zhang, et al., 2011; Zhang, et al., 2007). Studies show that yields are improved if differing organic waste types, such as piggery wastewater and food waste are combined in AD systems (Zhang, et al., 2011). It is typical for MSW to be mixed with bio solids (sewage), or for differing combinations of organic waste types to be combined and subjected to AD.

A-1.11. AD Residues

Following anaerobic decomposition a residue remains. The residue can be further processed via Advanced Thermal Technologies (ATT), composted, used as an agricultural input, landfilled or incinerated.

A-1.12. AD residues and composting

AD residues derived solely from food waste are generally considered unsuitable as composting inputs as they have little fibre and a high moisture content. However, if mixed with sufficient fibrous material such as garden waste, a satisfactory compost product can be produced (Deublein & Steinhauser, 2008).

A-1.13. Use of AD residues as agricultural inputs

AD residues (digestates) are known to present a strongly differing nitrogen reaction dynamic to aerobically produced compost and can contain elevated levels of nutrients, salt and ammonia. Although considered slightly inferior to compost, digestates can be applied to soils as fertiliser following any further decomposition, sanitization or moisture reduction (including dehydration) considered necessary (Deublein & Steinhauser, 2008).

A number of countries have developed standards (mandatory or voluntary) for agricultural products derived from AD, the objective being to minimise risks posed by animal by-products, nutrient loading, weeds, organic contaminants, heavy metals and other potentially toxic elements (PTE). Standards also serve to foster consumer confidence in such products (Hogg, et al., 2009).[228]

[228] A voluntary standard, NZS 4454:2005 has been implemented in New Zealand and is facilitated by Standards New Zealand.

A-1.14. Landfilling AD residues

If landfilled AD residues are subject to the issues discussed above at section A-1.1.3.

A-1.15. AD Wastewater

Wastewater generated during AD can be disposed to sewerage treatments plants or used beneficially as a fertiliser and sprayed onto agricultural land following appropriate decontamination procedures. Wastewater will contain high levels of nutrients and therefore runoff to waterways must be minimised during application to farmland (Deublein & Steinhauser, 2008).

A-1.16. Advanced Thermal Technologies

Advanced Thermal Technologies[229] (ATT) include gasification, carbonization, pryolysis and plasma arcing[230]. All ATT subject the residues of primary processes or raw wastes to extreme temperatures within a reactor either devoid of, or containing minimal levels of oxygen[231] and the material converts to a charcoal like substance commonly known as bio char.

Syngas generated during these processes can be utilised for energy generation or as a feedstock in the petrochemical and refining industries. Composition is determined by the parent material and is typically a mix of carbon monoxide and hydrogen (approximately 85 per cent) with smaller quantities of carbon dioxide, nitrogen, methane and various other hydrocarbons (Friends of the Earth, 2009). Syngas, or the emissions generated following the combustion of syngas are typically 'cleaned' via

[229] Also known as Alternative Conversion Technologies.

[230] Temperatures used vary around 750°C expect for plasma arching whereby material is heated to between 6,000º and 10,000ºC (Friends of the Earth 2009).

[231] These three processes are similar but employ differing temperatures and retention times (Deublein and Steinhauser 2008). All are classified as incineration and are required to meet the mandatory emissions limits set out in the European Union Waste Incineration Directive (Friends of the Earth (2009).

scrubbers and other technologies before emission to atmosphere. Emissions can contain "acid gases, dioxins and furans, nitrogen oxides, sulphur dioxide, particulates, cadmium, mercury, lead and hydrogen sulphide" (Friends of the Earth, 2009).

Wastewater created during ATT procedures poses environmental and human health risks. Biomass and gasified biomass can be used in coal fired power stations substituting the use of fossil fuels (Hogg, 2006).

A-1.17. Incineration

The incineration of municipal solid waste (MSW) is common throughout the world. Incineration plants use a heat source such as natural gas, coal or combustible waste to degrade MSW to a nonputrescible form. Some facilities simply incinerate waste however many utilise the heat energy created during combustion and are therefore known as waste to energy facilities, a term also applied to facilities which utilise the energy potential of gases created during landfilling and anaerobic digestion.

When present amongst MSW (of which it typically constitutes 15%)[232] incineration of food waste occurs satisfactorily. It is unusual for food waste as a single, separated waste stream to be incinerated as the high moisture content (Zhang, et al., 2007), which can range between 50 and 80%, with 70% being typical, requires more fuel for satisfactory incineration than a waste type with a low moisture content such as wood at 20% and textiles at 10% (Brunner and Schwarz, 1983 in Tchobanoglous & Kreith, 2002).

The heating value of food waste, measured as Btu/lb expresses the energy content of the waste type.[233] This value determines the efficiency with which a waste type can be incinerated. Food waste rates comparatively poorly, ranging between 1500-3000 Btu/lb with 2000 as the typical value whilst

[232] 10% in USA (Westendorf 2000).

[233] Btu/lb: British thermal units per pound. A Btu is equal to approximately 1,055.05585 joules.

wood and textiles are typically 8000 and 7500 respectively *(ibid)*. Thus if food waste is presented as a segregated waste stream, incineration is not the most efficient disposal process. Moreover, if food waste is removed from typical MSW, incineration is more efficient.

All incineration processes (multiple methods exist, from open burning to firing in specially designed cylinders) produce emissions which can contribute to climate change and ash residues which require careful management (Christensen, Simion, et al., 2009).

A-1.18. Ash residue from incineration of MSW

Ash residue (typically 25% of the mass of the original MSW) is most commonly landfilled, interred in dedicated ashfills or used as a construction resource. Residues can contain toxic metals and must be managed appropriately (Hahn et al., 1990 in Tchobanoglous & Kreith, 2002).

A-1.19. Emissions generated by incineration of MSW

Combustion of MSW generates gaseous and particulate emissions with the potential to adversely affect human health and the environment. Critical pollutants include PM, SO2, HCl, NOx, metals, and organics. Emissions control technologies can reduce the discharge of dangerous pollutants in accordance with regulatory standards determined by governance authorities (Hasselriis in Tchobanoglous & Kreith, 2002). Biogenic CO_2 emissions generated during the incineration of organic wastes are not included in GHG emissions inventories prepared according to IPCC guidelines (Hogg, 2006).

A-1.20. Animal (stock) feed

The nutrients, protein and fats inherent to food make this waste type a viable animal feed. Quantities, nutrient levels, moisture content and consistency can vary greatly amongst food waste sourced from hospitality businesses (whereas food manufacturers for example, can provide uniform quantities and compositions). Hotel food waste is considered to be of good quality compared with other types such as *fast foods* which tend to exhibit lower nutrient content. Material sourced from hotels is typically fed to stock in its wet form (Westendorf, 2000).

Animal health regulations or stock feeding preferences determine which types of foods are accepted for use as stock feeds (Westendorf, 2000). Most regulations relate to the prohibition of specific animal products from stock feeds. Separating animal products from post consumer waste is more labour intensive than separation performed during the preparation and pre consumer phases.

A-1.21. Aerobic Composting

Aerobic composting generates minimal CH_4 and produces biogenic CO_2 assumed to be commensurate with what was sequestered via microbial activity and the growing phase of the biomass used as compost feedstock (Bogner, et al., 2008; Christensen, Simion, et al., 2009). Consequently, CO_2 produced by composting operations is not included in IPCC authorised GHG inventories. Organic waste is typically composted in windrows or large vessels and must be managed appropriately as conditions can become anaerobic (Eldridge, et al., 2010).

Compost can be used as an agricultural input (MfE 2009c) and has positive effects on the chemical and biochemical properties of soil when applied in appropriate volumes (Ayalon, et al., 2000; Gabrielle, et al., 2005; Hogg, et al., 2009; Lima, 2004; Madejon, 2003; Suthar, 2009; Yhdego, 1994). It can increase moisture retention, soil fertility, density and nutrient content whilst

balancing pH and improving erosion resistance, soil microrganism activity and cation exchange properties (Amlinger, et al., 2007; Déportes, 1995).

Compost derived from food waste (or more typically from the organic fraction of MSW containing food waste) can contain heavy metals and or other potentially toxic elements (PTE) and may contribute to the accumulation of organic contaminants and or nutrient loading in soils. Many countries have introduced compost standards to address these concerns (Hogg, et al., 2009).

Compost can substitute the use of synthetic fertilisers (Christensen, Gentil, et al., 2009:707). Hogg, Wilson et al. (2010:70) note there is a "low level of demand from agricultural and horticultural markets for compost product" in New Zealand.

A-1.22. Comparing end of cycle disposal processes

Literature that compares and contrasts the various processes discussed above is vast, presumably because the benefits and disadvantages of each technology are strongly context dependant. No comparative studies with a focus upon hotel (or hospitality) food waste were found however, there is consensus amongst the literature that, in regards to food waste, AD provides greater environmental benefit than landfill, incineration, ATT, composting, vermi-composting or use as animal feed (Bakas & Herczeg, 2010; DEFRA, 2011; Hogg, et al., 2010; WRAP, 2010b).[234]

Research conducted in the United Kingdom demonstrates that 0.5 tonnes of CO_2-e emissions are generated for every tonne of food waste sent for disposal (WRAP, 2011c).[235] Amongst the technologies listed above (and at table 4.1), only AD offers the combined benefits of a significant energy yield

[234] Refer to section 4.1

[235] This research thesis assumes the composition of food waste produced in the New Zealand hospitality sector is similar to that of the United Kingdom.

coupled with the creation of a useful by-product and complete capture of all GHG. Other technologies can however offer a more cost effective solution whilst minimising the environmental impacts associated with landfills.[236]

A-1.23. Waste collection

The efficacy of differing recovery and disposal technologies is largely dependant upon collection methods. AD and composting require the separation of food waste from inorganic material. In some scenarios, separating food waste from all other waste types (garden waste for example) can enhance the performance of the system in question. Conversely, the efficient performance of other systems is dependant upon, or is unaffected by the inclusion of food waste (DEFRA, 2011).

A-1.24. Summary

In this section, the environmental impacts and benefits of differing end of cycle food waste disposal processes were reviewed. For some technologies, particularly those designed to affect the disposal of mixed waste types[237] (typically MSW), identifying the specific contribution of food waste to adverse environmental affects is problematic.

Nonetheless, the review demonstrates adverse affects associated with differing technologies can be reduced via minimisation of the food waste content in the total waste stream. Furthermore, technologies designed to process solely organic materials[238] can generate environmental benefits. Thus, this section provides a rationale, developed from an environmental standpoint, for the source separation of food waste.

[236] The environmental impacts associated with transportation of food waste should be considered amongst any analysis of differing treatment options. Such consideration is however beyond the scope of this thesis.

[237] Landfill, Advanced Thermal Technologies and Incineration.

[238] Anaerobic Digestion, Stock Feed and Aerobic Composting.

APPENDIX TWO

The methodology employed to meet the quantitative objectives of this thesis is detailed within this chapter.

The quantitative objectives are:

> **Objective 3)** Estimate the quantity of food waste typically produced by large hotels with restaurant facilities in the context of a meaningful variable such as guest nights (result is likely to be a range rather than a definitive quantity).
>
> **Objective 4)** Extrapolate the *food waste per hotel guest night* estimate (objective 3) with Commercial Accommodation Monitor (CAM) data and produce *estimated RTO (Regional Tourism Organisation areas) and national hotel food waste production ranges.*
>
> **Objective 5)** Estimate the green house gas (GHG) emission generating potential of the *estimated RTO and national hotel food waste production estimates* (produced at objective 4) in the context of landfilling.

Calculation of these variables required establishing:

1) The weight (kg) of 1 litre of food waste.

2) A method for calculating the quantity of CH_4 generated by 1 kg of food waste.

3) A method for calculating 'hotel guest nights'. This computation generates an ***Activity Measure*** that is indicative of the level of economic activity occurring in a hotel (see section A-2.4.3)
   The formula used should be consistent amongst all the hotels contributing waste data and with the Commercial Accommodation Monitor (CAM).

A-2.1. Bulk Density: What does 1 litre of food waste weigh?

Food wastes vary in weight according to density and water content. Providing a definitive weight for a single litre of food waste is therefore problematic. Estimations performed by various sources that have contributed data to this research are presented below and a single *density variable* identified for use within this thesis.

Hotel 1: In a personal communication (10 Jan 2012), the engineer from Hotel 1 stated that each 140L bin of un-compacted food waste weighed approx 90kg. Thus, 0.64kg is the weight of one litre of food waste.

WMC 1b: During an interview with WMC 1b, the respondent noted "food waste turned out to weigh less than had originally been expected." "When we began the collection service we priced the bins according to an average weight of 60kg but we ended up finding they were more like 35 to 50 kg".

WMC 3: WMC 3 collect separated food waste from numerous businesses including hotels. Waste weight audits are conducted every four months. During an audit, bins are weighed each day for one week. Using this data, a mean weight is derived for a calendar year. Two annual means were provided to the researcher:

> The mean weight established for a 120L bin of un-compacted food waste in 2010 was 35kg and in 2011 was 46kg. The mean of these two figures is 40.5kg, which, when divided by 120L = .34 kg per litre.

Researcher: Single litres of un-compacted food waste were weighed by the researcher and it was found that 0.40kg is the weight of one litre of food waste.

EC3: The conversion formula used by EC3 for a single litre of un-compacted landfill waste (which would typically contain food waste) is 0.3. Thus 1 litre of un-compacted 'general waste' is considered to weigh 0.30 kg.

Density variable applied to this research:

Any weight estimations used within this thesis are based upon the figure derived from data provided by WMC3: **Density of food waste (FW) = 0.34 kg / litre**

Which = 0.00034 t per / 0.001 m3

The WMC3 data is considered the best data set from which to derive an average weight for food waste as it has been collected over the longest time period, from the greatest variety of sources and subjected to the most thorough testing (compared to other data sets). The WMC 3 figure aligns well with both the researchers own result and the EC3 figure for 'general waste that typically contains food waste'. [239]

The researcher notes that not all of the bins from which the density variable is derived would have been exactly 100% full when weighed. This is because hotel staff may have placed them out for collection when they were 'almost' full. Hotel staff who prepare bins for collection were contacted and asked to provide details regarding the typical capacity of bins at collection time. A capacity factor was applied to the food waste data of each respective hotel. Details are provided at Appendix A-2.4.2.

The density variable can be expressed as:

A_1 = 1 litre of food waste [ℓFW]

A_2 = 0.34/1ℓ = Food waste density variable = [40.5kg/120ℓFW]

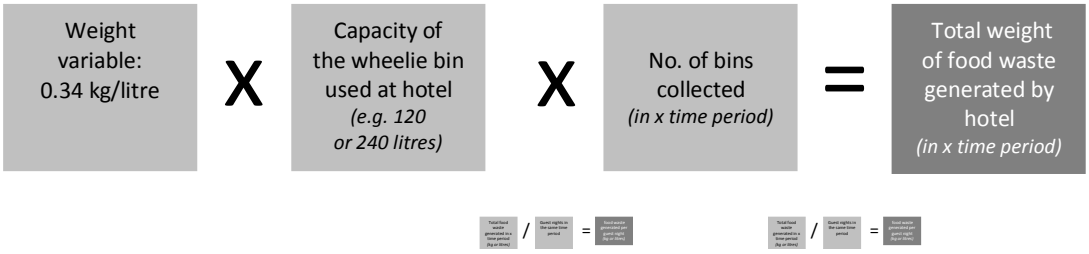
[239] The observations of Hotel 1 and WMC1b were related to the researcher in an off hand manner during an interview, 'from memory' and without reference to any actual data. They are therefore considered anecdotal.

WRAP (2011c) observe that container size affects bulk density. Compaction is a product of weight and therefore bulk density increases in step with increases in bin size (the larger the container the greater the weight, thus increased compaction results in a greater bulk density at the time of sampling). This thesis assumes that the use of 140 and 240 litre wheelie bins is typical throughout New Zealand hotels and that the difference in bulk density between these two bin sizes is negligible.

A-2.2. Calculating a hotels total food waste output

The weight variable established via the process and equation described in the previous section is applied to this research in the following way:

1) Hotel staff place wheelie bins out for collection only when they are completely full.
2) The number of bins collected is recorded by the collection contractor and this data is supplied to the hotel operator, and consequently this researcher.
3) The weight variable is multiplied by the volume of the bin and the number of bins collected in a specified time period.



This process used to calculate a hotel's total food waste output can be expressed as:

$$TFW\ell \sum_{n=1}^{12} x\ \ell \qquad TFWkg \sum_{n=1}^{12} x\ \ell \quad (A_2)$$

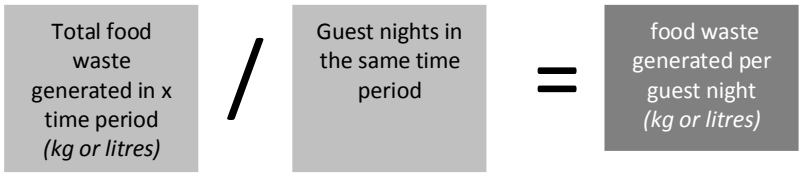
OR

where TFW = Total food waste
n = months

A-2.3. Hotel Guest Night Data (used to meet objective 3)

Achieving objective 3 required establishing a variable that would render the total volume of food waste generated by one hotel comparable with that generated by another.

The variable chosen was *guest nights* (the calculations used to determine guest nights is explained in the following section). Knowing the number of guest nights for each hotel enabled the following calculation to be performed:



The food waste per guest night variable (A) can be expressed as:

$A_{\ell} = TFW_{\ell}/GN$ OR $A_{kg} = TFW_{kg}/GN$

A-2.3.1. Calculating the Guest Night Variable

The following factors were considered when formulating the **Guest Night** variable:

Overnight guests: This is the number of overnight stays at the hotel. If one person stays for two nights, this is recorded as two *guest nights*. Overnight stays are recorded via room billing software and can therefore be considered accurate. Each hotel used a similar system to calculate this data type.

Day Guests: This category includes people who use the hotel facilities during the day but do not stay overnight. It includes people attending functions and conferences, eating a meal at the hotel restaurant and or

engaging in other activities such as using a pool, gym or spa. It is difficult to record this variable accurately. Attendance to functions and conferences can be unpredictable and actual attendance is rarely recorded by the hotel operator. [240]

Restaurant Patrons: This thesis is focused on food waste. Therefore, the number of people eating in the hotel restaurant is important. After all, hotel restaurants and room service generate the vast majority of hotel food waste, not people sleeping in hotel beds. However, obtaining data relating to the number of people consuming a meal (referred to as *covers*), that is differentiated from overnight stays and casual guests proved to be problematic.

When dining in the restaurant, most patrons who are also staying the night at the hotel charge their meals to their room account and simply pay a single bill when they check out. In this regard, restaurant patrons whom are staying the night at the hotel are supposedly eliminated from any *casual restaurant patron* variable that may be recorded.

However the hotels contributing data for this thesis do not make a specific differentiation between day guest and casual restaurant patron data. Restaurant staff record the total number of covers sold for their own records. The number of in-house covers (meals brought by people staying overnight) can be simply subtracted from this total and a record of casual restaurant patrons obtained. However, such a method does not ensure that day guests, recorded elsewhere, (attending functions, conferences or using hotel facilities for example) are not counted twice.

This is mainly because such a segregation is impossible, or too time consuming or too potentially annoying for guests, as it would involve asking every restaurant patron exactly why they were at the hotel and then

[240] People attending a conference may choose to eat at the hotel restaurant, or might dine elsewhere. Whilst hotel operators will book a function or conference based on a specified number of guests, actual attendance usually varies.
The eco-label *EC3 Earthcheck* asks its member hotels to record day guests (as best as is possible, over the course of 12 months) and then to divide that number by 3. The result of this calculation is then added to the number of overnight stays (for the same year) and a final guest night figure is obtained. For reasons explained below, that method is not replicated in this study.

recording that data. Moreover, hotel operators do not need to record such data accurately as the focus of data collection has traditionally been (and continues to be) on sales, not resource or service consumption.

The situation is compounded by some overnight guests paying for meals with cash, credit or eftpos cards (i.e. not charging it to their room). Furthermore, some lucky casual patrons might be shouted a meal by an overnight guest who charges the entire restaurant bill to their room account. Thus a large margin of error should be applied to a *restaurant patron variable.* [241]

A-2.3.2. Formula Used

In this research, Hotel Guest Night refers only to people staying overnight at a hotel.

Day guests and casual restaurant patron figures were not included because:

1) The data collection issues outlined above mean that the potential for inaccuracy of day guest and casual restaurant patron data is high. Two hotels provided data of this type, however the potential for data collection inconsistencies between them was considered too high.

2) Two of the three hotels contributing data could only provide overnight stay data.

3) CAM data only includes overnight stays (not day guests or restaurant patrons).

[241] Interestingly, *EC3 Earthcheck* do not include a metric of the number of casual restaurant patrons when calculating guest nights. If a hotel wishes to calculate the impact of casual restaurant patrons, then the restaurant operation must be certified and examined in isolation to the hotel. This means the waste produced, energy and water consumed *by the restaurant* must all be recorded separately to that of the accommodation operation. Such a scenario is impractical in all the hotels contributing data to this thesis.

Thus, by using only the overnight stay data, data collection methods remain consistent across all four data sets used in this thesis: Hotel 1, Hotel 6, Hotel 7 and CAM.

The Guest Nights variable (GN) can be expressed as:

$$GN = \sum_{n=1}^{12} x_o$$

where o = overnighters

A-2.4. Hotel food and landfill bound waste data

(used to meet objective 3)

This section provides detailed information on the data collection methodologies of the three hotels whom provided quantitative data for this research.

A-2.4.1. Regarding Inorganic Recycling

Throughout this thesis, landfill bound waste streams are considered to contain very little or no glass, plastics, metals, paper and cardboard (inorganic recycling). The separation and recycling of those items is considered as normal and standard practice amongst large hotels of 3 stars and above in New Zealand. This is largely because recycling those items is a minimum requirement of the Qualmark star rating system[242] (in locations where recycling facilities for those items are provided).

[242] This is a minimum requirement under section 8.1, *Responsible Tourism Operations* of the Qualmark Hotel Accommodation Assessment and Grading System at August 2010. These minimum requirements contribute to the star rating and are separate to the Enviro Logo Award. The requirement states: *"In regions which offer recycling (whether kerbside or transfer stations at dumps), facilities are in place for staff and customers/guests to collect and separate waste for recycling".*

Because those items are assumed to be separated from the landfill bound waste streams typical of NZ hotels, landfill bound waste is assumed to only contain food waste and items that cannot be recycled (of course some contamination is inevitable).

Thus the data collected and presented below is solely concerned with food waste and landfill bound waste quantities. The efficacy of separation, and the quantities of so called 'inorganic recyclables' collected by the hotels whom have provided waste data for this study are considered irrelevant to the food and landfill waste figures presented in this thesis.

A-2.4.2. Data collection methodologies of study cohort hotels

The data collection methods of each hotel contributing quantitative data to this thesis are summarised in the table below, and detailed in the text that follows.

All data spans October 2010 to September 2011 (inclusive).

Table A-2.1: Hotel food and landfill waste data collection methodologies

Hotel	Guest night formula		Food waste formula		Landfill waste formula
	Overnight stays	EC3 method*	Bins only collected when full**	Bin count provided by contractor	
Hotel 1:	✓	✗	✓	✓	*No data provided*
Hotel 5:	✗	✓	✗ Bins collected whether full or not	✓	Bins placed out for collection regardless of how full. Bin count recorded by collection contractor and multiplied by standard weight.
Hotel 6:	✓	✗	✓	✓	*No data provided*
Hotel 7:	✓	✓	✓	✓	Capacity full recorded by hotel staff at collection and a standard weight applied.

**EC3 Method: All restaurant patrons / 3 + all overnight guests*.

**When food waste is contained in bins as a single, separated waste stream, it can be measured in litres. This method is considered to be accurate because the heavy and sloppy nature of food waste means bins are filled uniformly with minimal air pockets or empty spaces.

Hotel 1

Guestnights: Overnighters only.

Food waste: Food waste separation and collection began at April 2010. Food waste is collected in 140L bins that are, according to staff, only placed in the loading bay for collection once full. However, because it is unlikely the bins are actually full to the brim, the content of these bins is rated as 90% full = 126 litres. Collection contractor provides bin collection count at end of each month.

Landfill bound waste: No data provided. EC3 Benchmarking report for part of the period prior to the food waste separation program was provided, however as this aggregates all data for the year, and provides only an annual figure, it is of no use.

Hotel 5

Guestnights: EC3 method = All restaurant patrons / 3 + all overnight guests.

Food waste: food waste separation and collection began at September 2010. Food waste is collected in 240L bins that are placed in loading bay for collection daily regardless of whether or not they are full. Collection contractor provides bin collection count at end of each month. This system renders the data unusable for this study.

Landfill bound waste: Collected in 240L bins and placed in loading bay for daily collection, regardless of whether or not they are full. Collection contractor (different to food waste collector) provides bin collection count at end of each month. Hotel waste officer noted "the bill is about $272 a month, so about 26 bins a month, approx $10 a bin."[243]

[243] Hotel 5

Hotel 6

Guestnights: Overnighters only

Food Waste Data: food waste is collected in 120 or 240L bins that, according to staff, are placed in the loading bay for collection only when they are full. This hotel provided food waste data in kg's. The food waste collection contractor established an 'average weight' per 120L by conducting numerous 'bin weighs' and applied this variable to the number of bins collected per month. It is assumed that whilst bins are probably not full to the brim when placed for collection, this variation will have been incorporated within the collection contractor's weight estimation (and so is not calculated again within this research).

Hotel 7

Guestnights: Overnighters only AND
All restaurant patrons/3 + all overnight guests (EC3 method).

Food waste: Food waste separation and collection began at July 2009. Food waste is collected in 120L bins that are then emptied into 240L bins for collection. The waste officer at the hotel reported that the 240L bins "are consistently about 85% full" when placed in the loading bay for collection. Therefore, Hotel 7's bins are considered to contain 204L at each collection. The collection truck comes every day and provides a bin collection count at the end of each month.

Landfill bound waste: Landfill bound waste is placed in a $3m^3$ bin which is collected daily and invoiced against a fixed rate that includes the bin rental. Just before collection, a hotel staff member flattens out the waste with a stick and records the *capacity* to which the bin is full in increments of 10 per cent. In 2010 a value for the *'typical landfill bin weight' o*f a 100% full bin was established by recording bin weights every Saturday over 4 weeks. Thus, the

'*capacity full'* value observed by the staff member is assigned a weight value (kg) and this is what is used in reporting to EC3 and within this thesis.
This *capacity full* method is considered more accurate than estimating the litres of waste in the bin because the bulky items typical to the waste stream create air pockets and will not sit uniformly.

Data Challenges:
The data discrepancy challenges encountered during this research are not uncommon. WRAP (2011c:5 & 62 s5.4) note that their attempt "to reduce the costs of the research by making use of information held by companies rather than surveying and sampling waste" was extremely problematic and ultimately "none of the corporate records received could be used owing to the different methods of recording waste data". WRAP add "a significant investment of time and effort is required to work with large corporations to obtain and standardise waste data in order to make it useful".

A-2.5. Food waste generation per capita

To provide context, a rudimentary estimation of food waste generation rates per New Zealander were calculated. The results are presented at section 5.3.3 and were derived using the following method and sources.

Table A-2.2 Daily per capita food waste generation in New Zealand: Estimation derivation table

Value	Description	Reference
3,156,000	tonnes (t) waste disposed at NZ landfills in 2006	MfE 2009b:1
4,027,947	2006 NZ Population	Statistics NZ 2012
28%	Organic fraction of NZ total waste stream	MfE 2009b:5
883,680	t of organic waste landfilled	MfE 2009b:6
53%	Food waste fraction of organic waste landfilled	MfE 2007b:34
468,350	t food waste landfilled	
0.12	t food waste landfilled per person	
0.32	kg organic waste landfilled per person per day	
0.94	litres organic waste landfilled per person per day	Using kg to litre conversion rate established at A-2.1

A-2.6. Commercial Accommodation Monitor (CAM)

(used to meet objective 4)

The Commercial Accommodation Monitor (CAM) is a monthly census of all mainstream commercial accommodation providers facilitated by Statistics New Zealand and the Ministry of Economic Development (MED). Published monthly, the CAM provides regional data on supply and demand, guest nights, guest origin (international/domestic), number of establishments, capacity, occupancy rates and employee counts.

Survey forms are sent out monthly by Statistics New Zealand to accommodation establishments (around 4,000 in March 2008) chosen from Statistics New Zealand's Business Frame (BF). These establishments must be registered for Goods and Services tax (GST) and have a turnover of a least NZ$30,000 per annum. Whilst some small establishments (eg hosted/B&B's) that are not GST registered or earn below the threshold level are not included in the survey it is unlikely that hotels would fall into this category. It is also unlikely that hotels would be overlooked by the Business Frame as accommodation will be listed as their primary commercial activity.

Whilst the response rate amongst the different accommodation types surveyed in the CAM varies, an "overall response rate of between 76 and 80 per cent" is usually achieved and the data quality of the survey is considered to be good. "Imputed values are used where data is missing, based on the characteristics of similar establishments in the same or similar regions." "Respondent participation is compulsory as it is collected under the Statistics Act 1975" (MED 2010c).

The CAM data was accessed via the internet on the 2nd of December 2011 and the excel spreadsheet titled *CAM 1 - RTO main variables by Accommodation Type* downloaded and used. Data is up to date to, and includes September 2011. [244]

[244] Refer to bibliography entry: Ministry of Economic Development (2010).

A-2.6.1. CAM definition of hotel

Within CAM hotels are identified as 'establishments for which the principle business is to provide the public with lodging, liquor, meals and refreshments for consumption on the premises. Accommodation is arranged on a room/suite basis'. This classification includes resorts (MED 2010b).

A-2.6.1 CAM definition of Guest Night

A guest night is equivalent to one guest spending one night at an establishment. For example, a hotel with 150 guests spending two nights would report provision of 300 guest nights of accommodation.

The Regional Tourism Organisation (RTO) demarcated analysis *(CAM 1 RTO main variables - pivot table)* provides information on hotels as an individual accommodation class and so this was used. The Territorial Authority (TA) segmented CAM analysis *CAM 4 TA main Variables – pivot table* was not used because that data set does not differentiate between differing accommodation types at the sub sector level.

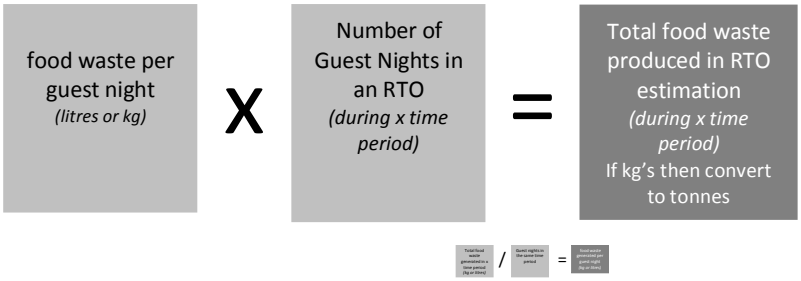
A-2.7. Extrapolating hotel data via CAM

The *food waste per hotel guest night* values can be extrapolated to an RTO scale using CAM data. This process fulfils objective 4.

The following assumptions are acknowledged:

Within this thesis the *food waste per hotel guest night* variable, which is derived from the data of participant hotels is considered to constitute a food waste generation coefficient**.**

The CAM *guest night* figures denote the level of hotel related economic activity occurring within a given RTO.
Multiplying the *food waste per hotel guest night* variable against *RTO guest nights* provides an estimation of the quantity of food waste that could have been produced in the RTO, based on the level of activity occurring within that RTO.
The value calculated is likely to be an under estimation, as the *RTO guest nights* figures would be higher if casual restaurant patrons and or day guests were included in the CAM data (see section A-2.3).



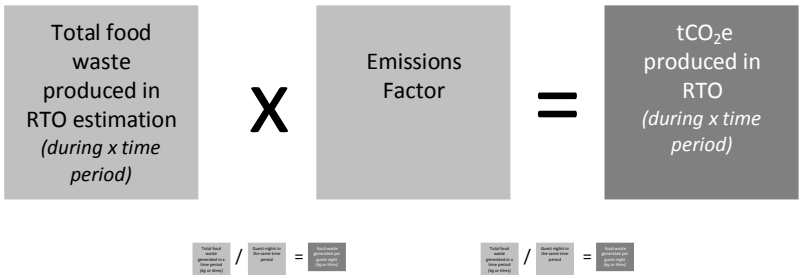
The calculation used to estimate the total food waste produced within an RTO can be expressed as:

$$R_\ell = A_\ell \sum_{n=1}^{12} x_R \qquad \text{OR} \qquad R_{kg} = A_{kg} \sum_{n=1}^{12} x_{R\,(1000)} = R_t$$

where R = RTO Guest Nights(Regional Tourism Organisation)
n = months

A-2.8 GHG emissions generation methodology

(used to meet objective 5)



GHG emissions estimates are produced by applying equation 1 (below) to the food waste quantity values.

Equation 1: EA = EF × AA

EA is the emissions in tonnes of carbon dioxide equivalent (tCO2e) for the year
EF is the emissions factor
AA is the tonnes of waste disposed to the facility in the year

The emissions factor (EF) is determined via equation 2 below:

Equation 2: DEF = (MCF × DOCf × FCH4 × 16/12 × GWP × DOC) × (1 – OX)

Where:

Methane correction factor (anaerobic managed fill)	MCF =	1
Fraction of DOC that degrades to methane	DOC_f =	0.5
Fraction of landfill gas (by volume) that is methane	F_{CH4} =	0.5
Molecular unit weight ratio of CH4 : CO2	16 / 12 =	1.3
Global warming potential of methane	GWP =	21
Adjustment for methane oxidation through capping system	(1 – OX) =	0.9
Degradable Organic Carbon Content of Food Waste	DOC =	0.15
	DEF =	**0.9450**

Equation Sources:

Tonkin and Taylor Ltd (2010) *Recommendations for methodologies for ETS landfill gas emission reporting.*

Climate Change (Unique Emissions Factors) Amendment Regulations 2010.

Climate Change (Waste) Regulations 2010.

The extrapolation used to estimate tCO_2-e attributable to hotel guest nights in an RTO or for all RTOs in NZ combined can be expressed as:

$$COR = R_t \, x \, EF$$

$$CONZ = A_\ell \sum_{n=1}^{34} x_{R_t} \, (EF)$$

where CO = tCO_2-e
R = Regional Tourism Organisation (RTO). *34 RTOs in New Zealand*
R_t = Total food waste produced in RTO, estimated in tonnes
NZ = Total food waste produced in all RTO combined, estimated in tonnes

Private waste audits are discussed in chapters one and five. Details relating to these audits remains confidential. Please contact the author for further information.

Richard Singleton
richard.singleton@ecopocket.co.nz

APPENDIX THREE

TE WHARE WĀNANGA O TE ŪPOKO O TE IKA A MĀUI
VICTORIA
UNIVERSITY OF WELLINGTON

Phone 0-4-463 5676
Fax 0-4-463 5209
Email Allison.kirkman@vuw.ac.nz

MEMORANDUM

TO	Richard Singleton
COPY TO	Jessica Hutchings
FROM	Dr Allison Kirkman, Convener, Human Ethics Committee
DATE	16 November 2010
PAGES	1
SUBJECT	**Ethics Approval: No 18099 Food waste separation in large hotels, exploring the barriers and drivers**

Thank you for your application for ethical approval, which have now been considered by the Standing Committee of the Human Ethics Committee.

Your application has been approved from the above date and this approval continues until 23 December 2011. If your data collection is not completed by this date you should apply to the Human Ethics Committee for an extension to this approval.

Best wishes with the research.

Allison Kirkman
Human Ethics Committee

TE WHARE WĀNANGA O TE ŪPOKO O TE IKA A MĀUI
VICTORIA
UNIVERSITY OF WELLINGTON

MEMORANDUM

Phone 0-4-463 5676
Fax 0-4-463 5209
Email Allison.kirkman@vuw.ac.nz

TO	Richard Singleton
COPY TO	Jessica Hutchings
FROM	Dr Allison Kirkman, Convener, Human Ethics Committee
DATE	9 December 2011
PAGES	1
SUBJECT	**Ethics Approval: 18099** **Food waste separation in large hotels, exploring the barriers and drivers**

Thank you for your request to extend your ethics approval. This has now been considered and the request granted. Your application has approval until 31 March 2012.

If your data collection is not completed by this date you should apply to the Human Ethics Committee for an extension to this approval.

Best wishes with your research.

Allison Kirkman
Human Ethics Committee

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