SORTING IT OUT

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

Tourism Research Scholarship Industry Report 26 October 2012

Richie Singleton richie.singleton@ecopocket.co.nz +64 21 740 656

RESEARCH OVERVIEW

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 disposed to landfill.

Initiatives that *prevent* food waste from occurring ensure resources are preserved and provide the best environmental outcome. However, where food is inevitably wasted, *recovery* provides a better solution than landfill *disposal*. Recovery systems, including anaerobic digestion, composting and use as animal feed enable the energy and nutrients contained within food waste to be utilised.

This research explored the barriers and incentives to implementing food waste management practices that ensure the resource potential of hotel 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.



Hotel kitchen. R Singleton

Section Page Research Overview 2 4 Introduction The Environmental Problem 4 Potential Solutions 5 Research Aims 6 Research Objectives 6 Research Cohort 7 Research Results 8 Barriers and incentives to food waste separation in large New Zealand hotels ... 10 Food waste quantities 14 Quantitative Data: Sector wide extrapolation 16 Hotel Food Waste: Greenhouse gas emission potential 18 Commercial collection pricing 19 Pay as you Throw (PAYT) vs Flat Rate pricing 19 Conclusions 21 23 References

Tables

Page

Table 1: End of cycle disposal and recovery technologies	5
Table 2: Barriers and incentives to food waste separation in large NZ hotels	10
Table 3: Food waste generation ranges per guest night	14

Figures	Page
Figure 1: Food Waste Generation Rates	15
Figure 2: NZ RTOs: Combined hotel food waste production volumes (estimate)	16
Figure 3: Study cohort RTOs: Food waste production volumes (estimate)	17
Figure 4: NZ RTOs combined tCO ₂ e generation potential attributable to hotel	
food waste production (estimate)	18

INTRODUCTION

This research, conducted as partial fulfilment of an Environmental Studies Masters degree at Victoria University was primarily focused upon the recovery¹ of food waste from large New Zealand hotels.

The observations and results demonstrate 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 recovery 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 (e.g. composting) or arrangements with individual farmers (who collect waste at low or no cost) are viable.

THE ENVIRONMENTAL PROBLEM

When decomposed in the anaerobic conditions² typical of landfills, food waste generates methane (CH₄), a green house gas (GHG) with a global warming potential 25 times greater than that of CO_2 (Forster, et al., 2007).³ Many landfills capture and destroy or utilise the CH₄ 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)*. Landfills occupy large areas of land and require specialised environmental management over extended periods of time. Food waste contributes significantly to the space requirements of modern landfills (Tchobanoglous & Kreith, 2002).

¹ Also commonly referred to as *diversion* i.e. diverted from landfill or other technologies with adverse environmental effects. Benefits associated with recovery are listed in table 1, on the next page.

² Devoid of oxygen.

³ When considered across a 100 year time horizon.

POTENTIAL SOLUTIONS

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 environmental benefit (Bakas & Herczeg, 2010; Hogg, Wilson, Gibbs, Holmes, & Eve, 2010; Waste and Resources Action Programme [WRAP] 2010). Both composting and AD systems must be operated correctly⁴ and usually 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).

Disposal and recovery technologies are listed in table 1 below. Landfill, incineration and advanced thermal technologies are used throughout the world to affect the disposal of typical Municipal Solid Waste (MSW). MSW is the everyday type of mixed waste that is produced by households and businesses such as hotels and restaurants. Food waste is known to constitute a significant portion of MSW. Landfill is the most prevalent MSW disposal system in New Zealand.

Table 1: End of cycle disposal and recovery technologies		
Disposal Technologies	Recovery Technologies	
Typically applied to mixed waste	Typically applied to food waste only (i.e. separated)	
Landfill Gases can be captured & energy produced.	Anaerobic Digestion Gases can be captured & energy produced. Digestate can be composted & the resulting product used as a soil amender with applications in agriculture.	
Incineration	Composting	
Ash residue is typically landfilled. Precautions relating	Includes aerobic, in-vessel and vermi-composting. Product can be	
to air pollution must be taken.	used as a soil amender with applications in agriculture.	
Advanced Thermal Technologies	Animal / Stock Feed	
Includes gasification, carbonization, pryolysis and	Negligible environmental effects. By laws apply, e.g. food waste	
plasma arcing.	containing meat must be boiled etc.	

⁴ For example, compost windrows can become anaerobic if managed incorrectly.

Research Aims

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.

Research Objectives

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. The stakeholder cohort studied 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.

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.

The aims and objectives presented above were all achieved. Results relating to both of the aims, and objectives 2 to 5 are summarised in this report. The outcomes of objective 1, and exhaustive analysis of all the aims and objectives is contained within the full research thesis which is available from the author upon request.

Research Cohort

Interviews were conducted in Auckland, Wellington, Rotorua and Queenstown with:

Hotel Operators(WMC)Waste Management Contractors(WMC)Disposal Facility Operators(DFO)Governance Authorities(GA)

Some hotels also provided waste data. The study was conducted in four New Zealand locales. Wellington and Auckland are considered important business and tourism centres for both domestic and international visitors.

Rotorua and Queenstown are recognised as two of New Zealand's most popular tourism destinations, attracting numerous conference and corporate events alongside high numbers of domestic and international tourists.



Auckland: 29% of national hotel guest nights. Resident population 1,486,000. Three commercial food waste collection contractors and two recovery facilities (during study period). Rotorua: 7% of national hotel guest nights. Resident population 68,900. No commercial food waste collection contractors or recovery facilities available (during study period). Wellington: 12% of national hotel guest nights. Resident population 200,100. Two commercial food waste collection contractors and one recovery facility available (during study period). Queenstown: 11% of national hotel guest nights. Resident population 28,700.

No commercial food waste collection contractors or recovery facilities available (during study period).

Occupancy data: Ministry of Tourism (2010). Population data: Statistics New Zealand (2011).

RESEARCH RESULTS

The intent of this research was to identify the barriers and incentives to food waste separation in large New Zealand hotels⁵. 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 (e.g. composting systems) or low/no cost collection 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

⁵ In the context of this study, large hotels are defined as establishments with more than 100 rooms and which contain restaurant facilities. 20% of New Zealand hotels have more than 100 rooms (Ministry of Tourism 2010).

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. If considered both practical, and financially viable, hotel operators are motivated to introduce food waste separation in conjunction with other initiatives designed to improve the social and environmental status of an organisation. Ecolabels 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.⁶ However it is encouraged.

Barriers and incentives identified during the course of this research are presented in table 2 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 policies and legislation. The second and third groups relate to the unique challenges and motivational factors inherent to the waste and hotel industries respectively.

More comprehensive analysis of the barriers and incentives identified via this research is available in the full version of the thesis. Please contact the author for more information.

⁶ Qualmark's *Responsible Tourism* and EC3's *Earthcheck*.

Table 2: Barriers and incentives to food waste separation in large

New Zealand hotels

Legislative Barriers and Incentives

	ITEM	ACTION
Legislative 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 Territorial Authorities (TA) & industry to ensure consistency and buy-in.
		Require TAs to provide data (via WWMP, Waste Minimisation and Management Plans).
		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. ⁷
Legislative Incentives	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.

Acronyms used in Table 2		
ТА	Territorial Authority.	
WWMP	Waste Minimisation and Management Plan (primarily relates to TA).	
WMC	Waste Management Contractor.	
PAYT	Pay as you throw (explained on page 19).	

 $^{^{7}}$ Recommended increases determined by Hogg, et al. (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 2011).

W_{aste} Industry Barriers and Incentives		es Table 2 continued
	ITEM	ACTION
	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.
te Industry Barriers	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.
Wa	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.
Waste Industry I Incentives	'Kick start programs' can stimulate activity amongst the food waste diversion market. The <i>Enterprising Manukau</i> story reviewed in the full version of the research thesis (available from the author) 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		S Table 2 continued
	ITEM	ACTION
	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.
	Pay as you throw (PAYT, explained on page 19) 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.
	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.
stry Barriers	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.
lotel Indu	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.

		Table 2 continued
Hotel Industry 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.
	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 already 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 (with farmers) and these types of autonomous initiatives (composting).
	Low or no cost food waste processing systems, such as composting units or worm farms can be implemented on	Systems can be transferable between hotels (what works in one can work in another), and hotels can work together to implement and maintain such systems.
	site.	The food waste separation required can assist advent of the waste prevention effect (see full research thesis).
	Sources: (WRAP, 2011b; Hogg, et al., 2010).	

FOOD WASTE QUANTITIES

Analysis of the quantitative data provided by some hotels within the research cohort enabled the development of a low, medium and high range for food waste generation per guest night.⁸ The ranges reflect the fact that, due to differing waste management practices, some hotels generate more food waste than others.

Table 3: Food waste generation ranges. Per guest night (gn).			
Range	Food Waste litres/gn	Food Waste kg/gn	
Low Range	1.0	0.3	
Medium Range	1.3	0.4	
High Range	1.9	0.6	

The results presented in table 1 (above) are supported by the findings of an Austrian case study conducted by the United Kingdom based Waste and Resources Action Programme (WRAP, 2010) which estimated a generation rate of 1.5 kg per guest night.

⁸ The data collection methodology used to establish the ranges is detailed in the full research thesis.

Data derived from New Zealand's Ministry for the Environment (MfE, 2007, 2009) and Statistics NZ (2012) publications provides some context to the ranges determined via this research. Rudimentary calculation based on figures obtained from those sources reveals the New Zealand, daily food waste generation rate per capita is 0.3 kg or 0.9 litres. Results of the aforementioned studies are compared with the data collected during this research in figure 1 below.



Quantitative Data: Sector wide extrapolation

The food waste per guest night ranges (presented in table 3 above) were applied to regional guest night statistics provided in the Commercial Accommodation Monitor (CAM).⁹ Results for all New Zealand Regional Tourism Organisations (RTO) combined are presented in figure 2 below.

Figure 2 (below) provides a comparison amongst the study cohort RTOs. The ranges presented at table 3 are static because food waste quantities are assumed not to fluctuate seasonally. Guest nights however do, and so data in figures 2 and 3 (below) 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).¹⁰



⁹ Data collection and calculation details are provided in the research thesis. Please contact the author.

¹⁰ The New Zealand 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, 2010).



Whilst figures 2 and 3 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 (Parliamentary Commissioner for the Environment, 2006; Stuart, 2009). New Zealand's tourism sector has experienced positive growth throughout the last decade (Statistics New Zealand, 2011b) and the industry anticipates this trend will continue (Tourism Industry Association New Zealand [TIANZ], 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, the resource opportunities that food waste represents will persist and potential will grow in accordance with the quantities produced by the hotel sector (Sjöström & Östblom, 2010).

HOTEL FOOD WASTE:

GREENHOUSE GAS EMISSION POTENTIAL

The principal greenhouse gas (GHG) of concern in the context of this study is CH_4 . Commonly know as methane, CH_4 can be measured and referred to in respect to it's equivalence to CO_2 (carbon dioxide). The unit used is CO_2 -e. The 'equivalence' relates to the gases global warming potential.

 CH_4 emission estimates determined in this study range from 0.32 to 0.61 kgCO₂-e per guest night.¹¹ Estimated ranges for all NZ RTOs combined are presented in figure 4 below. The results presented assume zero capture of any CH_4 . If the food waste was processed via anaerobic digestion, CH_4 emissions would be negligible as all CH_4 would be captured and utilised (WRAP, 2011b). 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).



Note: Figure 4 assumes food waste is landfilled in facilities without landfill gas capture systems in place. Food waste decomposes rapidly, emissions can escape before landfill caps and gas collection systems (which are not 100% effective) are installed.

¹¹ CH₄ emissions estimations are assumed to be consistent with organic waste production levels.

Commercial Collection Pricing

This research concludes that at the current time, commercial food waste collection services tend to be more expensive (on a litre for litre or kg for kg basis) than landfill bound collections (more detail is provided in the full thesis). The cost differential directly reflects the competitive advantage landfill facilities hold over diversion initiatives such as composting and anaerobic digestion.¹² The current cost structure associated with landfill collection acts as a disincentive to food waste separation initiatives in hotels. Nonetheless, some hotel operators are motivated by other incentives. These are summarised in table 2 (page 10).

$P_{AY\,AS\,YOU\,THROW\,vs}\,F_{LAT\,RATE}\,P_{RICING}$

Separating food waste can provide hotel operators with an opportunity to refine landfill bound waste arrangements. Hotel operators participating in this research observed that large skip bins have been the typical vessel used for collection and transportation of landfill bound waste. Waste management contractors usually charge a 'flat rate' for bins of this type, collecting or emptying the bin on a regular basis regardless of the amount of waste contained within.

The reduction in landfill bound volumes brought on by food waste separation can in some contexts, justify a switch to an alternative collection and billing system for landfill wastes. Waste minimisation advocates recommend the use of pay as you throw (PAYT) systems as they provide the user (the hotel operator) with an incentive for waste reduction. PAYT is similar to a household rubbish bag where the user only pays for the amount of waste they actually throw away (wheelie bins are typically used in the commercial context). However switching to PAYT systems, despite the reduction in landfill bound volumes brought on by food

¹² Collection for animal feed is typically cheaper than landfill collection. However farmers tend to make individual arrangements with specific hotels, only collecting what they require. Thus, it cannot be concluded that diverting hotel food waste to animal feed will serve as an adequate end of cycle solution to the hotel industry's food waste problem. Stock feed agents who collect food waste on behalf of farmers (and typically re constitute the waste as feed products) prefer food wastes that are presented distinctly. For example supermarkets can provide bakery products separate from delicatessen products.

waste separation practices may not necessarily result in a reduction of the costs a hotel operator pays for landfill disposal if the PAYT service is not priced at a cheaper rate (on a litre for litre or kg for kg basis). It is typical for waste producers (hotel operators in this context) who have switched to PAYT systems to use small compactors to squash waste and therefore reduce the number of PAYT bins placed out for collection. This research found that despite the compacting practice, total waste collection costs rose when hotel operators began separating food waste for commercial collection and switched from a single flat rate bin to a PAYT service for compacted landfill bound waste.

Waste management contractors observed that providing PAYT systems can be more cost intensive than providing flat rate systems. The practicalities associated with managing differing bin types are reflected in the prices charged to hotel operators. Similarly, the costs associated with providing specialised food waste collection services differs markedly from landfill bound collections. The latter are typically much larger in scale, linked with residential markets and encompass multiple waste streams. Commercial collection pricing is complex as each scenario is heavily context. Recommendations for further research are provided in the full research thesis.

CONCLUSIONS

This research demonstrates the New Zealand hotel sector produces a significant amount of food waste that has the potential to be utilised as a valuable resource. Recovery technologies such as composting and anaerobic digestion enable the energy and nutrient potential of food waste to realised.¹³ If correct conditions are met, the waste can be used as an animal feed. However, many hotel operators have no option but to consign food waste to landfill, as neither the commercial collection services nor the recovery facilities required to process the material exist within their regions.¹⁴ In locations where services are available, the cost (in comparison to landfill) can be prohibitively expensive. When landfilled, food waste can generate green house gas emissions which contribute to global climate change.

This research demonstrates there is potential for a pragmatic approach toward solving the food waste problem among the New Zealand hotel sector. Whilst most recommendations relate to policy change, some relate to the re-orientation of the institutionalised values and beliefs that enable environmentally detrimental food waste management practices to persist.¹⁵ The barriers and incentives summarised in table 2 (page 10) provide valuable insight to the changes that are required in order for cost competitive food waste diversion initiatives to develop throughout New Zealand. Recommendations are broad in scope. Specific alterations that are required amongst the waste and tourism industries must be

¹³ The potential for energy generation from food waste is significant, however further research is required to determine the scale at which ventures of this type are viable. Viability can require large volumes of organic waste and therefore household food waste collections may need to be incorporated. Similarly, composting operations can require vast amounts of green waste (garden waste).

¹⁴ Despite the finding that in some circumstances local farmers collect hotel food waste as animal feed (often on a low or no cost basis), or that some hotel operators utilise onsite processing systems (such as composting), it can be concluded that a large amount of hotel food waste is landfilled every day.

¹⁵ The full version of the research thesis contains a section which explains 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, where specific incentives facilitate change. However, if the overarching policy which drives waste management protocol goes unchanged, institutionalised practices will continue in other jurisdictions.

coupled with the systemic and policy orientated changes required of local and national waste governance agencies.

Governance systems that prioritise strong sustainability can assist tourism and waste stakeholders to reduce the environmental externalities associated with consigning food waste to landfill. 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). Both the environments capacity to assimilate waste, and the background elements that endow the New Zealand tourism product can be conceptualised as common pool resources.¹⁶ Hotel and tourism industry stakeholders, arguably all New Zealand citizens, are therefore wise to advocate for the diversion of food waste from landfill.



Enroute to Milford Sound, New Zealand. R Singleton

¹⁶ The environments capacity to assimilate waste (as solids, liquids and gases) can be considered a common pool resource 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, whether natural, socio cultural or manmade (Jafari, 1974) for example an outstanding natural landscape, popular festival or remarkable city, share these characteristics (Healy, 1994).¹⁶ Thus, the environment, background tourism elements 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.

REFERENCES

Bakas, I., & Herczeg, M. (2010). Food Waste. Copenhagen: Copenhagen Resource Institute.

Bingemer, H. G., & Crutzen, P. J. (1987). The Production of Methane From Solid Wastes. *Journal of Geophysical Research*, 92(D2), 2181-2187.

Blanco, E., Rey-Maquieira, J., & Lozano, J. (2009). Economic incentives for tourism firms to undertake voluntary environmental management. *Tourism Management*, 30(1), 112-122.

Briassoulis, H. (2002). Sustainable tourism and the question of the commons. *Annals of Tourism Research*, 29(4), 1065-1085.

Common, M., & Stagl, S. (2005). *Ecological Economics - An Introduction*: Cambridge University Press.

Forster, P., Ramaswamy, V., Artaxo, P., Berntsen, T., Betts, R., Fahey, D. W., et al. (2007). *Changes in Atmospheric Constituents and in Radiative Forcing. In: Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change:* Intergovernmental Panel on Climate Change.

- Healy, R. G. (1994). The "common pool" problem in tourism landscapes. *Annals of Tourism Research*, 21(3), 596-611.
- Hogg, D., Wilson, D., Gibbs, A., Holmes, A., & Eve, L. (2010). Earthcare Environmental and Envirofert Household Organic Waste Cost Benefit Analysis Report: Eunomia Research & Consulting Ltd, Greenfingers Garden Bags, Earthcare Environmental Limited and Envirofert Limited
- Jafari, J. (1974). The components and nature of tourism: The tourism market basket of goods and services. *Annals of Tourism Research*, 1(3), 73-89.
- Ministry for the Environment (2007). *Targets in the New Zealand Waste Strategy: 2006 Review of Progress*. Wellington: Ministry for the Environment.
- Ministry for the Environment (2009). Solid Waste Composition. Environmental Report Card. Wellington: Ministry for the Environment.
- Ministry of Tourism (2010). Tourism Sector Profile: Hotel Sector. Wellington: Ministry of Tourism.
- Parliamentary Commissioner for the Environment (2006). *Changing behaviour: Economic instruments in the management of waste.* Wellington: Parliamentary Commissioner for the Environment (PCE).
- Sjöström, M., & Östblom, G. (2010). Decoupling waste generation from economic growth A CGE analysis of the Swedish case. *Ecological Economics*, 69, 1545–1552.
- Statistics New Zealand (2011a). Subnational Population Estimates: At June 2011 Retrieved 22 November 2011, from

http://www.stats.govt.nz/browse_for_stats/population/estimates_and_projections/Subnational PopulationEstimates_HOTPJun11.aspx

Statistics New Zealand (2011b). Tourism Satellite Account: 2011. Wellington: Statistics New Zealand.

Statistics New Zealand (2012). QuickStats About New Zealand: Population of New Zealand, 2006 Census Retrieved 1 April, 2012, from http://www.stats.govt.nz/Census/2006CensusHomePage/QuickStats/AboutAPlace/SnapShot.a spx?id=9999999&type=region

Stuart, T. (2009). Waste: Uncovering the global food scandal. London: Penguin.

Tchobanoglous, G., & Kreith, F. (2002). *Handbook of Solid Waste Management* (2nd ed.). New York: McGraw-Hill.

- Tourism Industry Association New Zealand (2011). *Tourism Future 2011-14*. Wellington: Tourism Industry Association New Zealand (TIANZ).
- Waste and Resources Action Programme (2010). *Case Study 2: Food waste collection from SMEs -Austria: Municipality of Vienna & the Province of Vorarlberg* Oxon: Waste and Resources Action Programme (WRAP).
- Waste and Resources Action Programme (2011a). *Collecting food waste from small businesses and schools*. Banbury: Waste and Resources Action Programme (WRAP).
- Waste and Resources Action Programme (2011b). *The composition of waste disposed of by the UK Hospitality Industry*. Banbury: Waste and Resources Action Programme (WRAP).