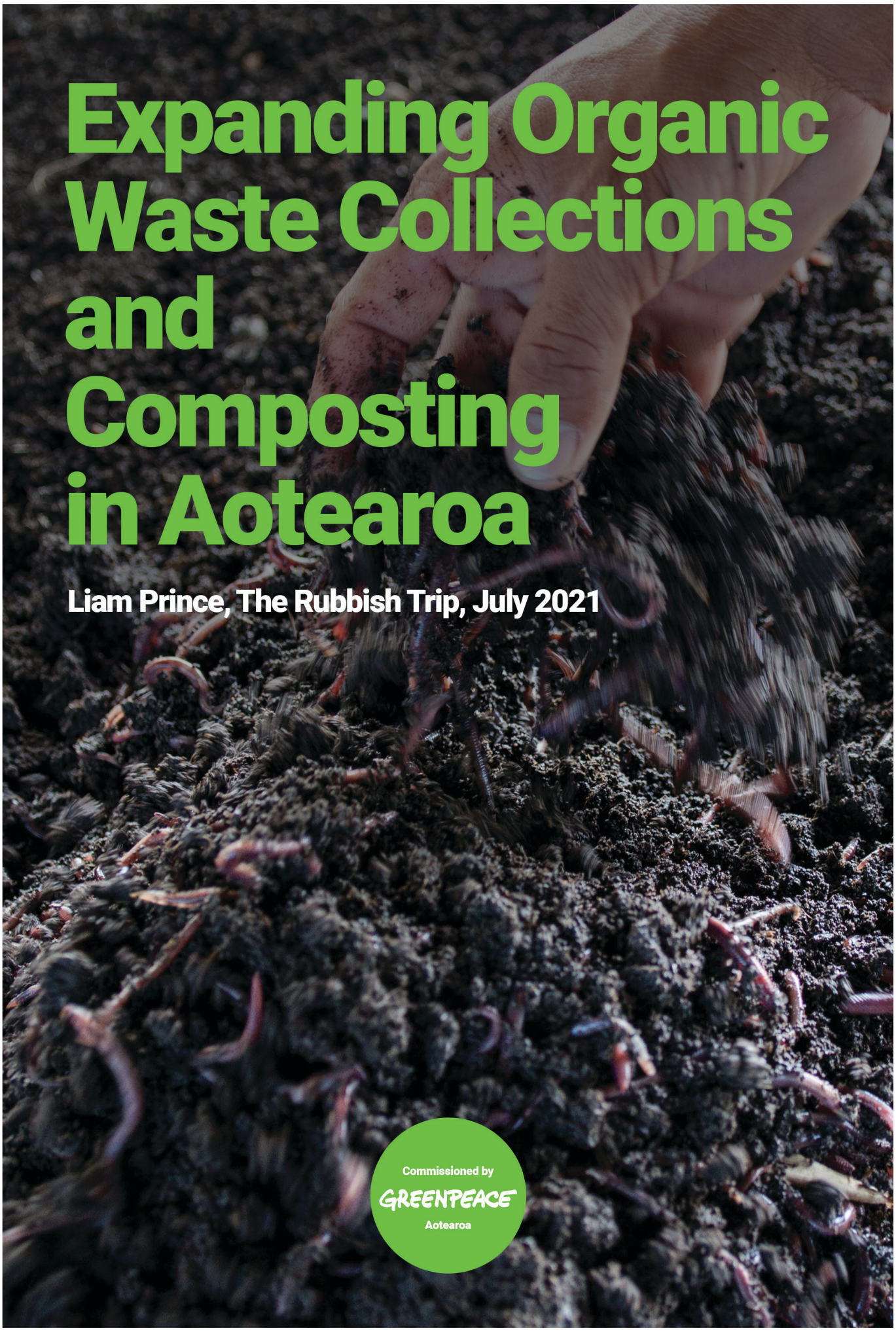

Expanding Organic Waste Collections and Composting in Aotearoa

Liam Prince, The Rubbish Trip, July 2021

Commissioned by
GREENPEACE
Aotearoa

Summary

Many negative environmental impacts produced by modern human society can be attributed to our relationship with food – how it's grown, harvested, processed, transported and disposed of. Capturing and utilising organic waste is one vital way to reduce emissions and pollution, and move towards a zero waste, circular economy. The beneficial use of organic waste is also fundamental in the shift to regenerative agriculture – enabling us to replenish organic matter, increase biodiversity and sequester carbon in soils, and thus remedy the harm caused by industrialised land-use.

Organic waste management systems come in all shapes and sizes and produce many different outcomes and outputs. Unfortunately, most organic waste policies are narrowly focused on diverting organic waste from landfill; how we might utilise these organics to create a resilient, regenerative food system is largely an afterthought. This has resulted in most organic waste collection and processing systems focusing on quantity (i.e. maximising organic waste collected and processed), at the expense of producing a quality end product and developing local food systems that grow community resilience and wellbeing.

This report examines various collecting and processing methods for organic waste, alongside key policy, legislative and investment tools to help drive development of organics infrastructure. Drawing on local and international experience and research, and with the objective of supporting regenerative and resilient food growing practices in mind, the report considers the pros and cons of:

- centralised vs decentralised systems
- various aspects of managing different types of organic waste, and
- different processing methods such as anaerobic digestion (AD), various composting processes, and more.

One key conclusion of these analyses is that various methods and scales of organics collection and processing infrastructure can and should work in tandem – the conversation is not 'either/or', but 'both, and'. To achieve a wide range of positive social and environmental outcomes beyond simply diverting organics from landfill, a complimentary ecosystem of small, medium and large-scale management approaches should be developed (including centralised kerbside collections, decentralised community-scale composting, on-farm composting, home composting and more). There will almost certainly be space for both composting and AD, though decision-making on which technology is most appropriate for any given organics streams and local circumstances must also consider the vital broader goals of soil restoration, carbon sequestration and the transition to regenerative agriculture. In particular, the system developed in Austria, in which farmers are fundamental to the entire system, is a highly successful decentralised model that could potentially work well in Aotearoa.

Summary (cont')

Aotearoa currently has comparatively little organics collection and processing infrastructure, nor many policies to incentivise its development. However, this situation is likely to change rapidly given recent climate change and waste reduction policies. The next few years present a crucial opportunity to develop an integrated and holistic organics management system. Policy and investment must carefully balance the need for large-scale diversion of organics from landfill, with the more complex objectives of producing high-quality soil improvers and supporting the transition to regenerative and resilient food systems that can provide multiple social, cultural, economic and environmental co-benefits.

To support these objectives, a **comprehensive organic waste strategy** is needed at both central and local government. This organics strategy should be integrated with broader waste, climate, circular economy, resource management and agriculture policy. This could follow, for example, the EU's Circular Economy Package, which has a wide range of waste and climate action regulations driving organics policies. In NZ, the Climate Change Commission's advice and the Government's response should provide the impetus to develop organic waste infrastructure via climate action policies, but this should be explicitly tied to the beneficial end-use of organics in agriculture for soil restoration/carbon sequestration.

Such a strategy should draw on frameworks like the waste hierarchy, the 'cascades' of biological materials in the circular economy and the circular bioeconomy, to **create and embed a rigorous and cross-sectoral organics hierarchy** to inform procurement and decision-making. This will ensure the highest and best use of organics, which produce the greatest emissions and waste reduction outcomes, across the economy.

Robust and clear provisions for organics infrastructure in resource management regulations could help increase the capacity of composting and urban farming activities. This could include developing and adapting Environmental Standards, National and Regional Policy Statements, and consenting and planning rules (such as permitted activities under District Plans). The RMA reforms potentially present an opportunity to integrate such changes.

Summary (cont')

Finally, the following key waste policy tools should be signalled in the revised New Zealand Waste Strategy and adopted in the upcoming review of the Waste Minimisation Act:

- **Mandatory separate collection and/or on-site processing of organic waste followed by an eventual ban on landfilling organics.** Phasing in these policies at an appropriate pace would ensure the development of widely distributed organic waste infrastructure while minimising the potential for perverse outcomes. Territorial Authorities also have powers to require mandatory collection and recycling of organics via waste bylaws and controls, which may be necessary if central government does not regulate/legislate (regardless, local government will ultimately design the specifics of local systems). Key stakeholders should be consulted and engaged in policy design to determine appropriate details such as a phase-in timeframe, thresholds, exemptions etc. to allow for infrastructure to develop (too short a timeframe or limited stakeholder engagement may lead to investment in problematic technological fixes).

- **Ambitious waste minimisation targets for reuse, recycling and resource recovery.** Even if targets do not explicitly mention organics, they will not be achievable without separate collection and processing of organics.

- **Ongoing increases to the Waste Disposal Levy.** The initial increase to $60/t for Class 1 landfills by 2024 is not sufficient to adequately incentivise organics diversion – this figure should continue to rise to well beyond $100/t to level the playing field for organics management.

Contents

Reference on terms found in this document:

Green waste - garden trimmings, grass clippings, flowers, weeds, leaves, branches etc. These materials are much more stable and easier to compost than food.

Food waste - mostly refers to food scraps from kitchens (home and commercial, cooked and raw), but sometimes refers to avoidable food waste such as stuff gone past its use-by date or overripe/rotting veges from markets.

Organic waste (aka bio-waste in Europe) - a term that usually encompasses all types of waste that can be composted, though usually refers to green and food waste, excluding more difficult to process types such as sewage sludge.

'Community' or 'community-scale' composting - refers primarily to scale and proximity, e.g. small-scale composting sites that service a confined geographical, urban or suburban area. This proximity can incentivise community engagement and often integrates other initiatives like urban farming or community gardens.

1. Introduction

Organic waste management is increasingly recognised as a vital part of a circular economy, climate change and zero waste policies globally. The need to build organic matter and sequester carbon in soils also makes organic waste a fundamental element in shifting agricultural practices to more regenerative systems. However, multiple methods for collecting, processing and utilising organic waste exist, and not all methods are equal when seeking best outcomes for soil health and climate action, and developing a regenerative and resilient food system.

Unfortnately, organic waste management often only adopts the singular goal of diverting organic waste from landfill without a holistic view of a sustainable food and organics system. Reducing organics in landfill does have important environmental benefits such as reductions in methane emissions, leachate, ammonia and other pollutants. While there is general support for organic waste diversion for the above reasons, some actors in the waste management sector believe that methane capture systems in landfills are the most efficient and cost-effective way of minimising the climate impacts of organic waste.

But even those who recognise the need to divert organics from landfill often only consider the beneficial end-use of organic materials, once processed, as secondary. Because of this, many large-scale organic waste processing methods do not produce good quality compost. Balancing the need for quantity (maximising amounts of organic waste collected, widespread collection) vs issues of quality (contamination, GHG emissions, nutrient value, community/social co-benefits of end-use of compost) is an important consideration. A good way of balancing these factors is to follow the waste hierarchy[1], and particularly one that is designed for organic (particularly food) waste (See Figure 1).[2] The important point is that these values are not mutually exclusive but can be complementary outcomes of a holistic system.

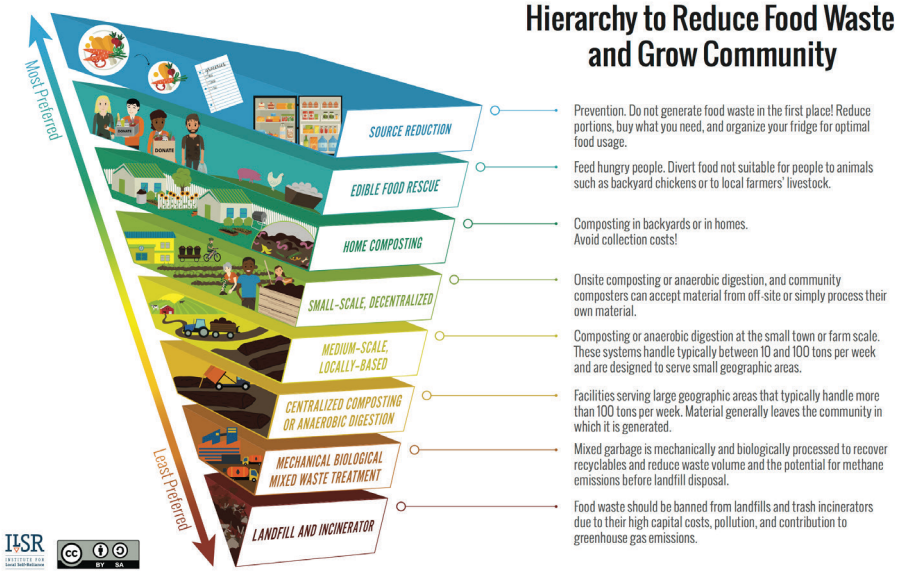

Figure 1: Food Waste Hierarchy - Institute for Local Self-Reliance[3]

[1] See Zero Waste International Alliance (2018). 'Zero Waste Hierarchy of Highest and Best Use.' Retrieved from: https://zwia.org/zwh/

[2] See also, Zero Waste Network Aotearoa (March 2021). Organic Waste: A position statement from the Zero Waste Network. Retrieved from: https://zerowaste.co.nz/assets/Organic-Waste-in-Landfill_discussion-doc-2021.pdf

[3] Brenda Platt (4 April 2017). 'Hierarchy to Reduce Food Waste & Grow Community.' Institute for Local Self-Reliance. Retrieved from: https://ilsr.org/food-waste-hierarchy/

‘This document discusses and assesses various organics management systems (as well as policy and infrastructural opportunities and barriers), examining what is currently happening in Aotearoa and around the world, and considering what systems, policies and incentives will best help drive investment and development of organics infrastructure.

2. Collecting Organic Waste

The design and implementation of a collection system fundamentally determines the quantity and quality of organic waste 'feedstock' for composting. Many experts agree that collections present the most difficult challenges to the entire organic waste management system, as the point of interface with citizens, residents and businesses/institutions with all their multifarious levels of interest, knowledge, circumstances etc. A badly designed system can result in low quantities of waste collected (low participation), high contamination and can be expensive without achieving the desired outcomes. The design must also account for interactions with food rescue activities and ensure that collections do not disincentivise food waste prevention, reduction, rescue and redistribution

This section will discuss different methods and considerations for collecting organic waste: centralised vs decentralised, what types of organic waste to collect, details around infrastructure and public incentives to participate in collections, concluding with a few case studies of different collection models in NZ and globally.

Collecting Urban Organic Waste

The biggest sources of urban organic waste are households, food businesses like supermarkets and restaurants/cafes, offices and institutions like schools, events and city green spaces. NZ has plenty of private collection services for commercial organic waste and both public and private green waste drop-off points, but residential collections are not common despite organics being on average the largest segment of household waste to landfill. Large-scale organic waste collections run by local authorities are scarce and underdeveloped in NZ compared to some other developed countries. See for a stocktake of Aotearoa's various public and (some) private organic waste services.

In 2005, MfE released a discussion paper on options for kerbside collections of household organic waste,[4] signalling a growing appetite for organic waste collection and processing. This provided a useful assessment of various approaches, considerations, and pros and cons of different methods. However, the paper only considered centralised systems run by local government, and did not consider ways that decentralised/localised, community-scale composting can be incorporated into organic waste management strategies. Since this report's release, organic waste collections in NZ have increased in number, but unsurprisingly they have all been centralised systems. However, several community-scale services have also established in recent years, and while it is a young and nascent sector, it shows a lot of promise – particularly in championing professional urban farming, food security, climate action and many other aspects of ecological and social regeneration.

Centralised vs Decentralised

The most basic distinction of organic waste collection and processing services is between centralised and decentralised models. Centralised models can be run by local authorities or private companies, and can capture commercial or residential organic waste, or both.

[4] Ministry for the Environment (MfE) (May 2005). Options for Kerbside Collection of Household Organic Wastes. Retrieved from: https://environment.govt.nz/assets/Publications/Files/kerbside-collection-organic-wastes-may05.pdf

They typically involve a kerbside (aka door-to-door) collection service by medium to large-sized vehicles, using bins of varying sizes (depending on the type and quantity of material collected). The organic waste collected is then taken to a large central composting or anaerobic digestion (AD) facility. These facilities are designed to process tens of thousands of tonnes of organic material per year (e.g. 50,000 tonnes per year processed by Living Earth in Christchurch), involving a wide range of composting and processing methods (see Section 3 for processing methods). While centralised systems can produce good results if designed, implemented and managed well, there are many variables and complexities and thus more things that can go wrong.

Advantages:	Disadvantages:
More easily able to take a wider range of food (bones, meat scraps, dairy products, cooked food)	Costly infrastructure and operational costs, fewer jobs created
Can capture high volumes of organic waste	High transport footprint
Generally best suited to high density urban areas with little green space	High risk of contamination of organics
If designed well, can drastically increase rates of organic waste collected in relatively short space of time	Requires end markets to be explored and sought for compost
	Takes a resource away from a community who may benefit from keeping and using it.

In comparison, decentralised systems aim to process and compost organic waste as close to the source of organic waste as possible. This might involve no collection system whatsoever (e.g. home composting, on-site composting at institutions or a community composting site where residents drop off organic waste), or micro-collectors on bicycles or light vehicles. Decentralised facilities are often small-scale (usually processing fewer than 200 tonnes per annum) and might service a neighbourhood, a suburb or a few suburbs, or even a small town, but can make up part of a larger network of composting sites throughout a city. Capacity and methods are vital considerations for localised composting – trying to maximise size or output volume without adequate management can easily result in negative environmental/nuisance effects (e.g. odour and leachate).[5] The strength of smaller scale composters is in producing high quality, clean and nutrient dense compost that is kept and used within a community.

There are many additional social and environmental benefits of decentralised, community-scale composting. Creating access to a good source of compost helps to grow food resilience, community engagement and participation, and has high job creation potential.

This can encourage the development of urban farming and community gardens. In Aotearoa, many community-scale composting operations are intertwined with regenerative urban farming.

[5] These cautions of course also apply to large-scale composting, but smaller-scale composting falls into grey areas within NZ's Resource Management regime, meaning it has fewer regulations (though also fewer permissions)

Decentralised composting is flexible, meaning that each composting site can be designed differently depending on the needs and circumstances of the community. NZ's community-scale composters are often run by social enterprises and community-led initiatives with minimal support from local authorities (small grants at best). However, there are some successful examples of cities in Europe and the US that use a decentralised community composting network as the primary means of collecting and processing organic waste into compost, with the support of municipal authorities (e.g. across Portugal & Spain, and in Besançon in France – see case study below). Such examples show that home and community composting can be integral to an organic waste management system but again must be managed well to avoid negative environmental outcomes.[6]

Advantages	Disadvantages
Scalable, flexible, low-cost, job-rich	Small-scale, low-volume, slow implementation without adequate investment
Compost quality can be managed much more effectively with adequate training	Regulatory barriers to community composting: e.g. no specific dispensations for small scale composting in resource consenting and planning rules.
Very low transport footprint	Harder to source carbon bulking materials (e.g. wood chips) without adequate support. Has led some decentralised composters to use compostable packaging, raising concerns around soil health and contamination
Incentivises development of urban farms and community gardens – local food resilience	Quality control difficulties: home composting is unregulated and if not managed well can result in methane emissions, contamination, nutrient leachate and more. Community-scale composting is difficult/costly to regulate, and end-use of compost does not require it meets minimum quality standards unless sold.

The following examples of decentralised composting in NZ show some of the different models possible (The UFA membership contains a good list of community composting projects and urban farms):

Kaicycle (Wellington) – residential food waste collection on e-bikes, compost made and used in their urban farm in Newtown
Community Compost (Nelson) – residential, commercial and event food waste collections in vans and on e-bikes, compost sold or donated to schools and community gardens
The Compost Co (Waiheke Island) – commercial food waste collections in small van,

[6] Ann van der Linden and Almut Reichel (2020). Bio-waste in Europe – turning challenges into opportunities. European Environment Agency, report No. 04/2020. Retrieved from: https://www.eea.europa.eu/publications/bio-waste-in-europe. P. 15

compost sold or donated
Why Waste (nationwide) – residential and commercial worm farm service on customer's property
Otago Polytechnic – composting sites on campus to collect and process the Polytech's food waste.
There are other models that do not quite fit the distinction between centralised and decentralised systems. A good example is the predominant model in Austria, where medium sized composting operations are run in direct partnership with farmers (see case study below).

Which streams to collect

There are three streams that a kerbside organics collection may service: green waste only (easiest and smallest quantity); food scraps only; or green + food waste together (aka FOGO – Food Organics and Garden Organics).

FOGO collections are more convenient and efficient from a resident's point of view which can lead to higher participation (though not necessarily – other system design features can be more influential on participation). Including green waste can also help minimise food waste odour and means that use of compostable liner bags is easier to avoid. However, collecting these material streams together makes the composting process more difficult to manage (e.g. getting good C:N ratio, aeration of piles etc).[7] Zero waste best practice demands the greatest degree of source separation possible to achieve minimal contamination and the highest quality end product — the same applies to organic waste and compost production. Some places (e.g. Austria) segregate organic waste even further – green waste into 'woody' and 'fine' (leaves and grass) materials; food waste into kitchen and market waste – to achieve best possible compost quality.

Separate food scrap collections have several environmental benefits and cost savings compared to FOGO collections.[8] They can significantly reduce carbon emissions by incentivising a reduction in edible food wastage (which also has important social outcomes) and by only needing smaller, cheaper, lower-emissions vehicles. Collecting food waste separately opens more processing options for both food and green waste. Food waste is suited both to composting (at all scales) and anaerobic digestion, while green waste can be easily processed via any scale of composting. Green waste often does not need to be collected if accessible drop-off points are available, and private collections and services can fill in the gaps.

Organic waste coming from agriculture, like manure and animal carcasses, are best processed on farm via composting. There are potential opportunities to develop support and services for farmers to adopt best practice processing of organic waste. Austria provides an exemplary model (see case study below).

[7] For a full list of pros and cons of different kerbside collection options, see section 3 from p. 11: MfE (May 2005) (footnote 3).
[8] Sarah Pritchett and Sunshine Yates (May 2020). Recommendations for standardisation of kerbside collections in Aotearoa. WasteMINZ. Retrieved from: https://environment.govt.nz/assets/Publications/Files/recommendations-for-standardisation-of-kerbside-collections-in-Aotearoa.pdf

Collection vessels

The size of bins depends on the materials collected, although there is some debate around appropriate bin size even for single-stream collections. Timaru, Selwyn and Waimakariri councils provide large 240L wheelie bins for FOGO, and Christchurch uses smaller 80L wheelie bins primarily for food waste and a small amount of green waste (residents can pay to upsize to 240L bins).

Food scraps only collections use very small bins (usually 23L), with the additional option of providing 6L kitchen caddies to residents, and the further option of provide certified compostable liner bags for the caddies. Providing a caddy obviously adds cost but can increase convenience and therefore participation in the system. Similar factors apply to compostable bag liners, but with added risks that if no bag is provided then customers may use non-compostable or non-certified compostable plastic bags instead and contaminate the organics collection. These bins and caddies are also designed to allow moisture to evaporate from food scraps, reducing weight, volume and odour (which larger FOGO bins do not). Ruapehu and Raglan provide caddies and compostable liners along with the kerbside bin; Auckland (Papakura) provides caddies with optional compostable liners for purchase; and Hamilton, New Plymouth, Kaikōura and the Wellington (Miramar) trial provide only the kerbside bin – no caddies or liners.

Community scale composting collections can also use a variety of vessel types, but typically use small 20L lidded buckets that may (e.g. Kaicycle) or may not (e.g. Community Compost) include a compostable liner.

Incentivising use of organic waste collections

Apart from broader policy measures discussed in Section 4 of this document, there are other collection design features that can incentivise and increase participation in the Apart from broader policy measures discussed in Section 4 of this document, there are other collection design features that can incentivise and increase participation in the system and thus capture more organic waste. These features include: system and thus capture more organic waste. These features include:

- Smaller residual (landfill) waste bins (larger bins can incentivise people to fill them)
- A user-pays or ‘pay-as-you-throw’ (PAYT) system for residual waste. This makes it cheaper for users to separate organic waste.
- Collecting residual waste less frequently (e.g. fortnightly) alongside weekly (minimum) organic collections.

Case studies/fact files

Christchurch:

- Rates funded FOGO collection
- Processed by Living Earth in an industrial zone in the suburb of Bromley. Food waste processed in an industrial tunnel system for 7-10 days (pasteurising), then finished maturing in windrows. 12-week processing timeframe. Green waste composted directly in windrows and later mixed with food waste
- 50,000 tonnes collected, turned into 50,000 cubic metres of compost
- Christchurch City's waste to landfill in its most recent waste audit contained 10% organics, which has been steadily decreasing since the introduction of organics collection. This is much lower than other parts of NZ.
- Issues with odour at composting site.

Timaru:

Timaru District Council (TDC) implemented a 3-bin collection service in 2006 to collect organics (FOGO), alongside recycling and residual waste. Timaru's waste to landfill reduced by 63% with the new collection service. TDC was the first council in NZ to create such a system to collect organic waste – others previously had separate organics collections in bags that were unsuccessful and discontinued. It took 7 years for the plan to get from inception to implementation. TDC owns and operates its own landfill, and projections on the lifespan of the landfill made separate collections of organic waste a viable and sensible thing to do in the long term (given pre-2006 roughly 50% of kerbside waste collections contained organic waste – which is a common statistic across NZ). Costing of different options showed that composting was cheaper at $100/T compared to landfilling at $192.50/T.[9]

TDC decided to collect FOGO in large 240 litre wheelie bins (while reducing the size of residual waste/landfill bins to 140 litres and reducing collection frequency to fortnightly to incentivise usage of organics and recycling bins). The composting site processes around 14,000 tonnes of organic waste per year using a "Gore Cover" windrow composting system. The compost is sold to farmers and residents in the region – market research was done prior to the implementation of the system to ensure farmers wanted the compost.

There was some push-back from small sections of the community when the new system was introduced – e.g. elderly community who were concerned they could not manage three large wheelie bins, rural residents who didn't see the need to have an organic waste collection, and central city businesses who didn't want numerous large bins cluttering the CBD.

TDC's 2017 Waste Assessment found that more could be done to improve separation of organic waste from residual waste. Organic waste still comprised 25% of red landfill kerbside bins, 11% of transfer station general waste and 19% of waste directly landfilled.[10]

[9] Brian Gallagher and Ruth Clarke (Nov 2013). Change for the better, Timaru kerbside organic collection & composting, 7 years on, 2006-2013: Key Learnings. Presentation at WasteMINZ Conference 2013. Transpacific Industries Group & Timaru District Council. Retrieved from: https://www.wasteminz.org.nz/pubs/timaru-kerbside-organic-collection-composting-seven-years-on-key-learnings/

International (European) case studies

Italy

Italy (among other European countries) has achieved high collection and processing rates of organic waste, largely via kerbside or door-to-door centralised collections of food scraps. Its success is largely due to strong legislative settings such as mandatory separate collections of recyclable streams that were adopted decades ago, even though this policy does not specify organics in the mandate (see policy discussion in Section 4 of this document for more details). Some municipalities in Italy have achieved separate collection rates of over 90%. Even some big, densely populated cities have good rates – in Milan, a city of 1.4 million, 800,000 daily commuters and 11 million annual tourists, their separate collections capture around 86% of all collected food scraps (the remaining 14% is in residual waste collections).[11]

Besançon, France

A city of over 100,000 in eastern France. In 2008, the regional waste management organisation, SYBERT, decided not to replace its old incinerator furnace and instead embark on an ambitious waste minimisation strategy. Instead of developing a centralised system, SYBERT decided that it would invest in and support a decentralised network of home and community-scale composting as the primary means of processing the city's organic waste. By 2016, "70% of the population under SYBERT either had a composter or was covered by a community composting site, and over 50% of the citizens were composting their food scraps at home".[12]

Besançon has different types of composting facilities. For residents with yard space, home composting receptacles can be purchased by residents at reduced cost, and local composter associations provide advice and training on good composting practice. For densely populated areas, a community composting facility is located at the foot of many residential buildings and is managed by the inhabitants (although SYBERT supports the installation and basic processes). Despite being voluntary, participation in this method of community composting is high, and many residents have developed a sense of ownership of local sites (e.g. building community gardens adjacent to the composting facility). For areas where neither home or foot-of-building composting sites are possible, SYBERT has installed larger composting houses with 20 tonne annual capacity, servicing between 100-1000 households. These composting houses are installed and managed by SYBERT.

These systems are all currently voluntary – local government subsidies, investment, incentives and overall waste strategy design have enabled this system to work. However, data on total quantities of organic waste captured are unknown. Mandatory source separation (which will be in force by 2024 across the EU) will likely drive uptake of these services even more.

---

[10] Ruth Clarke and Bruce Middleton (July 2017). Timaru District Council Waste Assessment. Timaru District Council and Waste Not Consulting. Retrieved from: https://www.timaru.govt.nz/__data/assets/pdf_file/0017/181124/1002595-PLAN-Waste-Assessment-Timaru-District-Council-2017.pdf

[11] See Enzo Favoino's presentation (57:32 - 1:19:38) in the following webinar for information on Milan as well as other parts of Europe: Zero Waste Network Aotearoa (5 Nov 2020). 'Our Zero Waste World Digital Summit – International Perspectives on Organics.' YouTube. Retrieved from: https://www.youtube.com/watch?v=4TfigXWVZ5Q

[12] Rosa, Ferran (2018). The Story of Besançon. Zero Waste Europe. https://zerowasteeurope.eu/downloads/case-study-of-besancon/ p. 4

Austria [13]

Austria's organic waste management system is unique and highly developed, having one of the highest capture rates of organic waste in Europe. It began as far back as 1986 when Vienna launched a separate organic waste collection pilot in cooperation with an organic farm owned by the city. The success of this trial led to the duplication of the system across Austria, with farmer cooperation being the core feature of Austria's system – farmers process and produce (and largely use) the compost on their land and often conduct collections too (particularly in smaller towns and rural areas). Austria now has a very high collection rate of organic waste at 70-80% of total production. Most interestingly, one of the key intentions of Austria's composting system since its early development has been to improve soil fertility and prevent desertification of soils caused by conventional agriculture.

Austria's system is decentralised but structured differently to a place like Besançon – there are over 400 composting plants for 8.6 million inhabitants (roughly one facility per 20,000 people), with the average facility processing at a medium-scale of around 3000 tonnes per year. An example of how the system works for larger cities is in Graz, population 320,000. The city has a centralised collection system which pre-processes the organic waste, which is then trucked to around 18 nearby farms who do the remainder of the composting. The most successful systems in smaller towns have organics collected and processed by local farmers, with support from local authorities.

Austria has strong compost quality assurance processes. Source separation is tightly managed – green waste is mostly gathered at drop off points (some places do separate collections of green waste alongside food waste only bins) and then divided into 'woody' and fine materials. Food waste is divided into kitchen waste (which includes cooked food) and market waste (raw produce). Strong processes are in place to ensure high participation and engagement in collections, such as education. There are also composting manager training schemes, with strict rules and guidelines for making and managing compost, and a lot of testing of the maturation process to ensure quality. Awards are given to farmers who produce the best quality compost. These processes have resulted in a very low contamination rate of around 0.2% (some European systems have as much as 5 or even 10% contamination).

[13] Most information taken from Florian Amlinger's presentation (5:08 – 27:01) in the following webinar: Zero Waste Live! (17 March 2020). 'Decentralised management of organic waste.' Zero Waste Cities, Zero Waste Europe. Retrieved from: https://zerowastecities.eu/webinar/decentralised-management-of-organic-waste/; and Florian Amlinger (Nov 2009). Biowaste Recycling in Austria: The Decentralised Solution. European Composting Network (ECN). Retrieved from: http://www.samsoluciones.es/sam/wp-content/uploads/2009/11/Estudio-CMC-Florian-Amlinger1.pdf

3. Processing methods (making compost)

Alongside collecting organic waste, determining how to process organics once collected requires careful consideration. The intended outcomes and end-use of organic waste should be clearly understood and articulated from the outset as this can determine collection design and best processing system. If soil improvement and shifting farming to more regenerative models is the focus, producing high quality compost will be important. However, there are multiple methods of composting and some are better suited to soil regeneration than others.

Whatever process is used should not disincentivise food waste reduction. Achieving the best environmental and social outcomes requires a food waste management system (excluding green waste) to ensure that as much food as possible is prevented, rescued, redistributed to people and reused/recycled into animal feed, before composting or other processing methods are considered.[14] These priorities mirror the zero waste hierarchy of preventing and reducing waste and reusing resources before recycling and disposal are considered – prioritising the highest and best use of resources.[15] Figure 2 below is an example food waste hierarchy (also Figure 1).

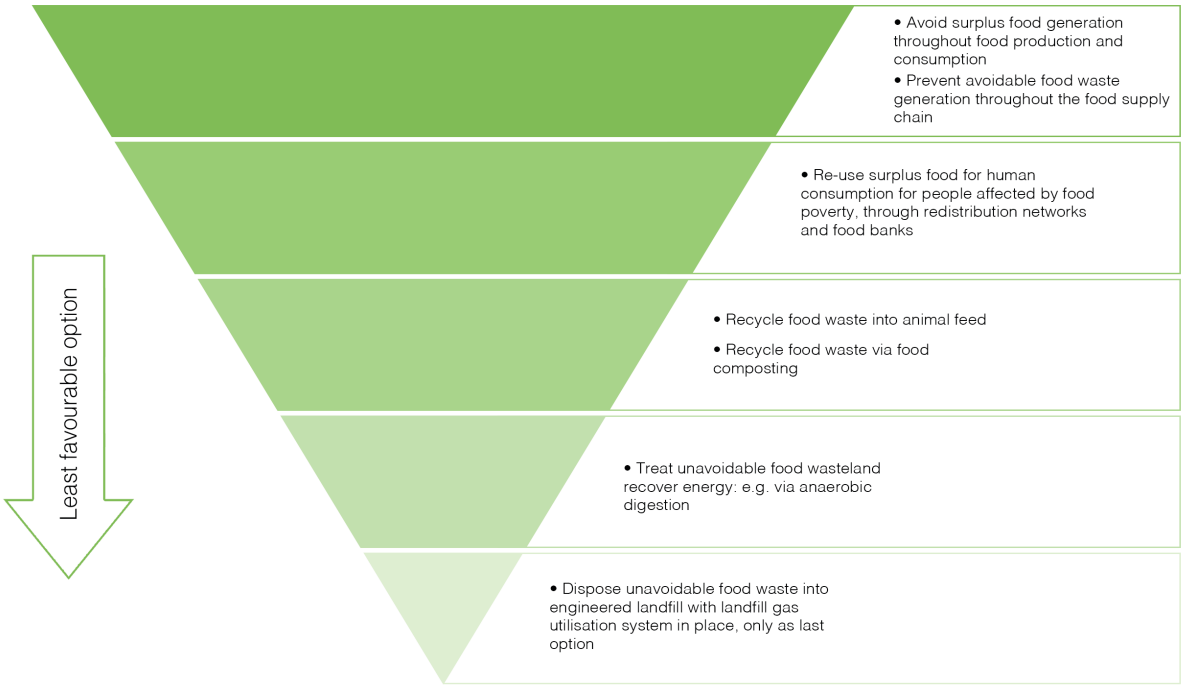

Figure 2: Food Waste Hierarchy[16]

However, once food waste has been prevented, reduced, reused and recycled as much as possible, plenty of organic waste will remain for processing. The two most common processing methods are composting and anaerobic digestion (AD). The pros and cons of both systems are hotly debated, and the issues are complex. The Zero Waste International Alliance (ZWIA) has produced a guide for deciding whether composting or AD is best for

[14] Food waste has also been described as an issue that a shift to regenerative farming should be concerned with, e.g. Tessa Vincent (27 May 2020). 'Regenerative Agriculture and Food Waste.' Nature-based Solutions, Pure Advantage. Retrieved from: https://pureadvantage.org/regenerative-agriculture-and-food-waste/

[15] See Zero Waste International Alliance (2018) (footnote 1).

[16] Effie Papargyropoulou et al. (1 Aug 2014). 'The food waste hierarchy as a framework for the management of food surplus and food waste.' Journal of Cleaner Production, Vol. 76, pp. 106-115.

a given situation.[17] The key conclusion is that composting should be prioritised over AD, and if AD is chosen, the 'digestate' should also be composted to avoid issues with excess nitrogen-use on farms.
Below is a brief overview of the key issues and considerations around AD and following that a review of various composting methods. Further research and engagement with experts in the field is needed to understand the different impacts and outputs of different systems, and to find the best practice solutions to support holistic beneficial outcomes for organics, soil and food.

Anaerobic Digestion (AD)

AD decomposes organic matter in an enclosed (no oxygen) and low heat-treated environment. It is an increasingly popular technology and often considered a favourable method of processing organic waste because it utilises 'renewable' energy from the biogas produced, and the remaining organic matter, known as 'digestate', can be used as an organic fertiliser.

AD is gaining traction in NZ as a desirable way of processing organic waste. Auckland Council recently signed a 20-year contract with Ecogas to send food scraps from its kerbside collections to a large-scale AD plant currently being built in Reporoa.[18] This is the first of its kind in NZ, but Ecogas sees potential to build up to 20 facilities around NZ in the next 10 years.[19] Many in the waste sector have expressed interest in AD, including MfE who have mentioned it as a possible area of investment in several recent public documents (e.g. Waste Levy expansion).

By-products of AD

Biogas: the AD process metabolises a large proportion of carbon from the feedstock to produce methane/CH^4 (aka biomethane or biogas, as opposed to fossil methane). This biogas is widely recognised as a renewable source of energy, being one element of the carbon cycle. It provides GHG emissions reductions if used in place of fossil fuels. However, renewable energy subsidies in Europe have resulted in a lot of AD plants built for the sole purpose of producing energy, which has led to the practice of growing crops (particularly maize) to be used as a feedstock (rather than using organic waste). This has displaced land that could be used to grow food and the farming practices are also damaging the soil.[20] There is also debate on the GHG emissions issue, particularly whether organic matter 'recycling' should attempt to retain as much carbon as possible and minimise carbon loss as either CO_2 or CH_4 – composting does emit CO_2, but AD attempts to maximise the production of CH_4.[21] There are some composting techniques that attempt to minimise carbon emissions (more below).

---

[17] Zero Waste International Alliance (Aug 2017). Composting and Anaerobic Digestion Policy. Retrieved from: https://zwia.org/composting-and-anaerobic-digestion-policy/

[18] Auckland Council (5 Dec 2019). 'Auckland Council announces world-class food scraps processing contract.' Our Auckland. Retrieved from: https://ourauckland.aucklandcouncil.govt.nz/articles/news/2019/12/auckland-council-announces-food-scraps-processing-contract/

[19] Ecogas (2 Sep 2019). Ecogas receives Provincial Growth Fund support. Retrieved from: https://www.ecogas.co.nz/news/ecogas-receives-provincial-growth-fund-support

[20] George Monbiot (17 Mar 2014). 'The Biogas Disaster.' Permaculture Research Institute. Retrieved from: https://www.permaculturenews.org/2014/03/17/biogas-disaster/

[21] This has been observed on US farms: Jessica McKenzie (3 Dec 2019). 'The misbegotten promise of anaerobic digesters.' The Counter. Retrieved from: https://thecounter.org/misbegotten-promise-anaerobic-digesters-cafo/

Fertiliser: aside from biogas, the other major output of anaerobic digestion is known as 'digestate', which is sometimes separated into its solid and liquid portions. Digestate is high in organic nutrients such as nitrogen, phosphorus, potassium and others, and thus deemed suitable for use as an agricultural fertiliser and/or soil amendment. Because digestate-derived organic fertiliser can be used to offset the use of synthetic fertiliser, it can greatly reduce agricultural emissions and is better for soil health than mineral fertiliser. However, there are multiple environmental harms that can result from using digestate fertiliser, such as nitrate run-off and NOx emissions (Nkoa 2014). Inappropriate use/overuse of digestate fertiliser results in similar damage to soil health (via loss of soil carbon, decreased organic matter and soil erosion) caused by synthetic fertilisers.[22] This is why the ZWIA recommends that digestate is composted before being used as fertiliser (and also perhaps why in Italy digestate is legally considered 'waste' unless composted). The Ecogas AD facility in Reporoa does not appear to have plans to compost the digestate, and instead claims it can be applied direct to land as fertiliser.[23]

AD may be an appropriate solution for certain organic waste streams that are difficult to compost, but the various pros and cons need to be carefully evaluated for any situation. AD is an expensive technological solution that is less scalable than composting (i.e. it is usually only appropriate for medium to large operations). Investment in AD may also result in a 'lock-in' effect which incentivises maximising its processing capacity and thus disincentivising reductions in food waste and crowding out the market for alternative methods of processing organic waste such as small- to medium-scale composting. While many consider it on par or even above composting as the preferred method of organic waste processing, others place it lower on an organic waste hierarchy as a recovery/treatment step, rather than a reuse or recycling step that composting fits into.

Composting

Composting is a way of controlling and speeding up natural biological processes of biodegradation of organic matter to produce a beneficial soil conditioner. If made well, compost has much better soil conditioning properties than other fertilisers and thus supports soil regeneration, water retention and carbon sequestration. However, if managed inappropriately, the composting process can produce excessive carbon emissions (including methane if inadequately aerated), odour, leachate (nutrient run-off) and may not get hot enough to destroy disease causing pathogens and weed seeds. Producing compost of high quality or suitable composition is important to maximise its soil regeneration potential.

A 2013 report on municipal compost use on Canterbury farms showed potential for minimising the use of synthetic fertiliser (up to 40% recommended in the trial). That this finding was not an explicit focus of the study shows that even with conventional farming practices, generating compost for agricultural use can be a vital tool in the shift towards regenerative methods.[24]

---

[22] Although the science around the impact of nitrogen rich fertilisers is disputed: e.g. Bijay Singh (April 2018). 'Are Nitrogen Fertilizers Deleterious to Soil Health?' Agronomy, Vol. 8(4). DOI: 10.3390/agronomy8040048

[23] For local perspectives on the downsides of AD, see Kate Walmsley (23 Aug 2020). 'Why industrial anaerobic digestion is not the answer to food waste.' The Spinoff. Retrieved from: https://thespinoff.co.nz/food/23-08-2020/why-industrial-anaerobic-digestion-is-not-the-answer-to-food-waste/; and Nick Morrison (Dec 9 2019). 'They've Got This Wrong – It's Not Waste To Divert It's Food For Our Soils.' Go Well Consulting. Retrieved from: https://gowellconsulting.co.nz/theyve-got-wrong/

Different composting methods often depend on scale (home, community, on-farm or large-scale composting), but also on the material available. If contamination is not well managed or captured before processing, contaminants are concentrated in the final product. Larger-scale methods often involve some form of mechanical pre-screening to identify and remove contamination, while smaller-scale methods may require manual removal of contaminants
.
Brief descriptions of different composting methods and NZ examples are listed below. Note: all the common composting methods follow the basic process of 'aerobic' composting (ensuring the process is sufficiently aerated with oxygen to encourage faster decomposition and to avoid anaerobic conditions that produce methane). However, the uncommon innovative methods below operate with semi or fully anaerobic conditions that ferment the organic waste by inoculating it with specific microbes. If done properly, this process can substantially reduce the GHG emissions of the composting process and thus retain more carbon in the organic matter.

Common methods

Bins: a highly recognisable system that is used frequently for home composting or small-scale community composting – often a 1m3 wooden box. They are best suited to small-scale composting as they can create problems if too big (e.g. difficult to aerate/turn, produce leachate), although this method is sometimes used on a slightly bigger scale on farms in large concrete bays. An example of a well-designed small-scale bin system in NZ is the CarbonCycle design which is used by several community composting sites and urban farms around Aotearoa.

Windrows: a windrow is a long open-air triangular shaped pile and is perhaps the most common and basic composting method for medium and large-scale operations. In NZ this method is used in Christchurch by Living Earth (after an 'in-vessel' first step), Timaru, Auckland, Wellington and more. It is also common overseas and is the predominant method in Austria's on-farm systems. A windrow's size and shape enable large machinery to keep the piles aerated and hydrated. Windrows can also be modified and managed in ways that help speed up the process, reduce odour and improve water retention – e.g. the Gore™ Cover system used in Timaru (which some would consider an in-vessel system).

In-Vessel Composting (IVC): involves composting organics in an entirely enclosed vessel in which the temperature and airflow are controlled. The vessel produces little to no odour, thus these systems can process materials that are more difficult/problematic to process in windrows. The process is also reliably fast. However, it does not produce quality usable compost on its own – the compost requires further maturation. Living Earth in Christchurch uses an IVC tunnel in an initial 7-10-day step that 'pasteurises' food waste before it is mixed with green waste and matured in windrows outdoors. NZ company Global Composting Solutions has designed the HotRot IVC system used by (among others) Easy Earth in Whanganui, as well as the small-scale Comet IVC that can be used for onsite composting at

[24] Abie Horrocks et al. (Jan 2013). Compost SFF Final Report (2009–12): A report prepared for SFF Project 09/152: Sustainable use of municipal compost for the agricultural sector. Plant & Food Research, SPTS No. 7870. Retrieved from: https://www.envirofert.co.nz/uploads/Final-Report-on-Trial-2009.pdf

institutions. Xtreme Zero Waste in Raglan and Ruapehu District both have a semi IVC tunnel system (it has movable lids that can open the vessel) known as a Horizontal Composting Unit. IVC requires the construction of a technical facility and thus have higher capex costs than windrow systems.

Aerated static piles: a pile arranged in such a way that no turning is needed. The pile is usually built on top of air-blowing pipes, and coarse materials like wood chips are added to ensure adequate air flow. A bio-cover is often used to reduce odour and enhance moisture retention. Envirofert in the Waikato uses this method.[25] Again, more investment is required compared to windrows, but well-built and monitored piles need little maintenance, and there are quality benefits to 'no turn' methods such as this (see more on this in the SPICE description below).

Vermicomposting: aka worm farms. Vermicomposting is highly scalable – it can be done at home or at an industrial scale. Vermicomposting also has the potential to process organic wastes that are difficult or unable to be composted using conventional methods (e.g. liquid wastes such as farm manure and effluent, food processing sludges and by-products). Why Waste provides a decentralised small-scale vermicomposting service for households and businesses in various centres around NZ. MyNoke offers large-scale vermicomposting services across NZ and currently processes as much as 250,000 tonnes of organic waste per year.

Uncommon innovative methods:

SPICE (Static Pile Innoculated Compost Extension):[26] a method developed by Australian zero waste and composting expert, Gerry Gillespie. This method is also being used in a one-year pilot community composting trial in Christchurch, called 20:20 Compost, started December 2020. Once the pile is built and inoculated (inoculum can be made from scratch following a simple recipe), it is fully covered and does not need turning,zz watering or any other maintenance until finished composting. The benefit of not turning the pile is that it encourages the growth of fungal networks that are essential for growing the soil food web and improving soil health. To maintain the integrity of the fungal networks, the compost should ideally be used on site and not transported. This method thus suits a decentralised model

BAM (Beneficial Anaerobic Microbe) Composting: uses a similar principle to SPICE composting with slight process variations (e.g. turning frequency). It is currently being trialled by Kaicycle in Wellington, with advice from Daniel Schuurman of Biologix.

Mechanical Biological Treatment (MBT)

[25] Full details of their methodology can be found here (section 2): Peter Moon and Harold Ruppert (Dec 2018). Envirofert Compost Facility Operations Plan. Prepared by 02Compost for Waikato Regional Council. Retrieved from: https://www.waikatoregion.govt.nz/assets/WRC/Community/whats-happening/have-your-say/Envirofert/Appendix-A-Operations-management-plan.pdf

[26] David Hardwick and Gerry Gillespie (n.d.). Static Pile Inoculated Compost Extension (SPICE): Making quality compost using a no-turn method. Soil Land Food and Returning Organics to Soil. Retrieved from: https://www.gerrygillespie.net/uploads/4/5/6/5/45656863/spice_compost_metric_version.pdf

After composting and AD, MBT is the next most common means of processing organic waste. MBT refers to a range of processes for treating waste not separately collected at source. Once separated from recyclables and residual waste, the organic fraction is either digested (to derive biogas or fuel), composted or dried. Due to being initially mixed with other waste streams, the organics are typically highly contaminated, and thus are too poor quality to be used as soil improvers – mostly this material is landfilled, incinerated or used for reclaiming land. This method is no good for making usable compost for agriculture.

4. Policy tools - legislation, regulation, investment

Aotearoa has relatively little organic waste management policy compared to other comparable jurisdictions where organic waste management infrastructure has been steadily developing for years. Thus, central and local government must play a key role in substantially scaling the uptake of organic waste collections and processing. Many different policy approaches are available, and different levels of government have different tools they can use. However, it is important that any proposed regulation, legislation or bylaw is carefully designed to avoid unintended outcomes. It should incentivise the production of high-quality compost for agricultural use and not exclude stakeholders such as small- to medium-scale composters in attempts to collect maximum amounts of organic waste.

Both local and central governments in NZ have largely shown a distinct and consistent lack of interest in regulating organic waste, with voluntary methods being preferred (this was also the case with many other waste streams and policies until recently). This is evident in documents such as MfE's Options for Kerbside Collection of Household Organic Wastes from 2005, which states that voluntary methods may be effective because no national legislation on organics management was (and still is not) proposed, and also because of "limits to the availability of processing systems and composting markets" (p. 9).[27] However, the document does acknowledge that nothing prevents Councils from passing bylaws to regulate organic waste – though the document also notes that a range of factors should be considered, from the range of waste management options available, perverse outcomes (residents switching to private collections) and legal implications of enforcing measures on private collections.

Similarly, the second of four key recommendations to MfE in WasteMINZ's Recommendations for standardisation of kerbside collections in Aotearoa report from May 2020 suggests a soft policy approach to organic waste management: "Incentivise local authorities to collect food waste for composting or AD to reduce kerbside residual rubbish to landfill" (p. 6; p. 33).[28] However, it does hint at partial regulation: "it is not recommended that greenwaste be collected… Other tools are seen as more effective at removing greenwaste from residual rubbish, such as bans on greenwaste to landfill through local authority bylaws" (p. 35).
This section highlights a range of policy actions that both central and local government can take, and discusses some leading international examples and some key policy considerations.

Organic waste bans & mandatory separate collection

The most wide-reaching and restrictive policies that both central and local government can set to advance organic waste services are:

- Banning organics from being dumped directly in landfill (without necessarily specifying what should happen to the organics)

[27] See footnote 3.
[28] See footnote 6.

- Mandating the separate collection of organic waste and/or ensuring it is processed/ recycled at (or as close as possible to) source.

Mandates can achieve similar outcomes as bans without risking negative outcomes such as investment in MBT, but both policies can work in tandem. Both can be implemented with a phased approach — involving minimum tonnage thresholds (policy applies to generators or collectors of minimum quantities) and distance exemptions (policy applies to those within a certain distance of a composting facility) that slowly decrease over time — allowing time for infrastructural development, or for each Territorial Authority (TA) to implement a suitable system (if policy is set by central government). Such policies can also apply only to commercial and institutional sources of organic waste (e.g. supermarkets, cafes, schools etc.), excluding household organics, or can be 'universal' (i.e. apply to all sources of organic waste).[29]

At central government level, these policies could be achieved via the Waste Minimisation Act 2008. Section 23(1)(a) enables regulations to be made on "controlling or prohibiting the disposal, or anything done for the purpose of disposing, of products or waste."[30]

Some TAs have 'controls' or regulations on green waste, e.g. the recently passed Wellington City Council Solid Waste Management and Minimisation Bylaw. Relevant controls include:

- "2.12: No more than 10% green waste shall be deposited into any Council provided waste receptacle.

- 2.19. Prior to entering the Southern Landfill, landfill users are required to separate green waste from general waste in accordance with landfill use and entry requirements.

- 2.20. Prior to entering the Southern Landfill, in accordance with landfill use and entry requirements landfill users are required to separate [among other items listed]:

- Compostable garden waste

- 2.21. In addition to the restrictions described in clauses 2.19 and 2.20 (above), the Council may also refuse to accept for disposal to the Southern Landfill any:

- a. Cleanfill.

- b. Items or material it considers, at its sole discretion, can reasonably be expected to be diverted from the waste stream."[31]

---

[29] For a thorough summary of various considerations and examples in the US context, see: Katie Sandson et al. (July 2019). Bans and Beyond: Designing and Implementing Organic Waste Bans and Mandatory Organics Recycling Laws. Prepared by Food Law and Policy Clinic at Harvard Law School, and Centre for EcoTechnology (CET). Retrieved from: https://wastedfood.cetonline.org/wp-content/uploads/2019/07/Harvard-Law-School-FLPC-Center-for-EcoTechnology-CET-Organic-Waste-Bans-Toolkit.pdf

[30] Section 23 can also provide supplementary regulations, such as setting quality standards for the compost (subsections (1)(g) and (h)), which may be important for avoiding negative environmental consequences of collections and processing, and for ensuring high quality, pathogen-free, uncontaminated and nutrient-dense compost.

[31] Wellington City Council (2021). 'Controls for the Solid Waste Management and Minimisation Bylaw 2020.' Retrieved from: https://wellington.govt.nz/your-council/plans-policies-and-bylaws/bylaws/other-bylaws/controls-for-the-solid-waste-management-and-minimisation-bylaw-2020

Councils could develop similar controls for food waste – even mandating separate collection or landfill bans – without direction from central government regulation or legislation.

While bans and mandates are effective at driving organic waste infrastructure development, they achieve best results when combined with other policies such as investment, regulations, incentives and taxes, public education and communication, technical training, data collection and enforcement (see Figure 3). Central government can support these actions (particularly investment), but TAs will largely be responsible for design and implementation details.

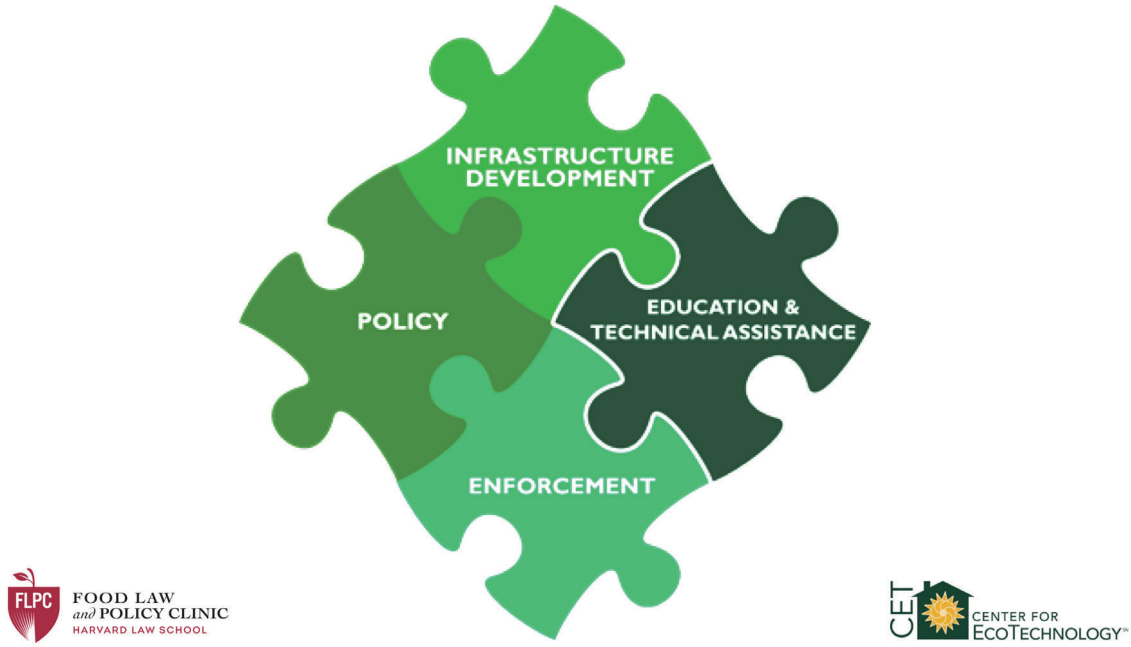

Figure 3: Comprehensive policy framework from The Composting Collaborative, 14 Feb 2019 webinar.[32]

Other waste policy options

A range of other more general measures can help develop organic waste infrastructure:

- Increasing the Waste Disposal Levy (central government). NZ's levy will increase gradually to $60 per tonne for Class 1 landfills (which take domestic rubbish) by July 2024. This is not high enough to adequately incentivise separate collection/processing of organics (will still be cheap to landfill organics). Eunomia Research & Consulting recommended NZ's waste levy should increase to $140 per tonne.[33] MfE plans to review this rate in 2023 with a view to continue increasing the levy beyond 2024.

- Mandatory reduction targets for residual waste or landfilling (central).

- Mandatory separate collection of different 'recyclable' material streams (central and local). While not necessarily explicitly including organics, it still incentivises organics management. Typically part of a broader waste strategy (e.g. Italy set the target of 65%

[32] The Composting Collaborative (14 Feb 2019). 'Organic Waste Bans: An Analysis of Existing Policies, Challenges, and Opportunities.' Webinar. Retrieved from: https://www.compostingcollaborative.org/resources/organic-waste-bans-an-analysis-of-existing-policies-challenges-and-opportunities/

[33] Duncan Wilson et al. (30 May 2017). The New Zealand Waste Disposal Levy: Potential Impacts of Adjustments to the Current Levy Rate and Structure. Eunomia Research & Consulting. Retrieved from: https://eunomia.co.nz/wp-content/uploads/2017/06/WDL-Final-Report-30-05-17.pdf

separate collection of recyclables without specific provisions for organics).

- Non-mandatory waste minimisation strategies or plans (central and local).

MfE is also currently undertaking a review of the NZ Waste Strategy and the Waste Minimisation Act, and there is scope for creating stronger targets and tools for increasing organic waste collection and processing.

The right policy mix will depend on the local context. Overseas experience shows that the more restrictive policy tools can create difficulties and unintended outcomes, particularly if organic waste management infrastructure is underdeveloped. Some European countries with organic waste bans and landfill reduction targets have seen investment in undesirable technologies such as incineration or MBT. Incineration of any organics is highly energy inefficient and loses the opportunity to recycle nutrients and carbon back into the soil via composting, and instead releases carbon as CO^2. MBT produces contaminated compost or digestate unsuitable for agriculture.

International examples International examples

The EU has recognised that mandating the separate collection of organic waste and/or processing ('recycling') at source can ensure lower contamination rates and can help to develop the infrastructure needed to collect and process organic waste to produce compost and fertiliser suitable for agricultural use. The EU's updated 2018 Waste Framework Directive mandates all Member States to ensure that organic waste (aka 'bio-waste') "is either separated and recycled at source, or is collected separately and is not mixed with other types of waste" by the end of 2023 (Article 22). Furthermore, following this date, recycling targets for municipal organic waste will be set (Article 11(6)), and by 2027, organic waste can only be considered 'recycled' if it is collected separately or separated at source, which excludes MBT systems (Article 11a(4)).[34] Organic waste management infrastructure is mature and relatively widespread across Europe, but as a whole the bloc captures only 30% of organic waste. This policy will help bring all Member States up to best practice.

Some EU Member States have even more detailed legal requirements around the management and separation of organic waste, such as Slovenia's 'decree on biodegradable kitchen waste and green garden waste,' which prohibits any kind of mixing or improper disposal of any kind of organic waste (including kitchen waste disposal units like InSinkErator).[35] The finer details around minimum standards for collection, frequency, quantities, rights, obligations etc. are set by municipal governments.

Another example is South Korea, which has very high rates of organic waste collection and processing, having developed infrastructure since the mid-90s. In 2005 the government banned organic waste from landfill, along with greater investment in organic waste

[34] Consolidated text: Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives. EUR-Lex: Access to European Union Law, Document 02008L0098-20180705. Retrieved from: https://eur-lex.europa.eu/eli/dir/2008/98/2018-07-05

[35] Decree on the management of biodegradable kitchen waste and green garden waste (17 May 2010). Official Gazette of the Republic of Slovenia, No. 39/10 [translated from Slovenian to English]. Retrieved from: http://www.pisrs.si/Pis.web/pregledPredpisa?id=URED5366

processing (composting, AD and animal feed) facilities. After issues with improper disposal of organic waste liquids into the ocean,[36] the Korean Government banned this practice and mandated separate collection of food waste in 2013.[37] However, these policies do not address the fact that Korea has one of the highest food wastage rates per capita anywhere in the world (food waste is one of the most globally significant contributors to GHG emissions), and the country now produces more compost and fertiliser than there is domestic demand for.

Climate change and circular economy policy

Climate policy can incentivise or specifically require reductions in organic waste to landfill via economic/pricing and regulatory policies and targets. For example, California's Senate Bill 1383 tackles short-lived GHGs and contains mandatory "targets to achieve a 50 percent reduction in the level of the statewide disposal of organic waste from the 2014 level by 2020 and a 75 percent reduction by 2025."[38] This policy is part of a broader suite of other laws such as a cap-and-trade program and mandatory separate organics collections.

In NZ, the ETS has so far been the main policy tool for emissions reductions. In waste, the ETS is substantially raising the costs of managing methane emissions from organic waste in landfill.[39] As this continues to rise it will help incentivise diversion of organics from landfill.

The NZ Climate Change Commission's (CCC) first advice package to Government, Ināia tonu nei: a low emissions future for Aotearoa, will certainly take organics management policy up a notch. The advice recommended various actions on organic waste, primarily based on a target to reduce biogenic waste methane emissions by at least 40% by 2035.[40] Although various forms of organic waste reduction and diversion (e.g. recycling, composting, AD) were part of their pathway to achieve this target, they also recommended expanding landfill gas capture (LFG) systems. While LFG will help to reduce emissions overall, it must be seen as a last resort and in its place at the bottom of the waste hierarchy. It also highlights the importance of ensuring organics policies do not get stuck in a narrow focus on diversion and greenhouse gas reduction and incorporate the beneficial reuse of organics as a priority.

The CCC did, however, provide useful policy frameworks that could help develop an integrated and holistic organics management system. Chapter 13 on cross-sector policies identified increasing and developing the circular economy and the bioeconomy as key

[36] Munsol Ju et al. (Jan 2016). 'Solid recovery rate of food waste recycling in South Korea.' Journal of Material Cycles and Waste Management, Vol. 18(3), pp. 419-426

[37] See Douglas Broom (12 Apr 2019). 'South Korea once recycled 2% of its food waste. Now it recycles 95%.' World Economic Forum. Retrieved from: https://www.weforum.org/agenda/2019/04/south-korea-recycling-food-waste/; and Marissa Sheldon (18 Mar 2020). 'South Korea Recycles Food Waste in Effort to Become Zero-Waste Society.' Food Policy Snapshot Series, Hunter College New York City Food Policy Center. Retrieved from: https://www.nycfoodpolicy.org/food-policy-snapshot-south-korea-food-waste/

[38] CalRecycle (16 April 2019). 'Short-Lived Climate Pollutants (SLCP): Organic Waste Methane Emissions Reductions.' California Department of Resources Recycling and Recovery (CalRecycle). Retrieved from: https://www.calrecycle.ca.gov/climate/slcp/

[39] See e.g. Geraden Cann (22 Jun 2017). 'Emissions Trading Scheme costs could force Wellington landfill bills to soar.' Stuff. Retrieved from: https://www.stuff.co.nz/dominion-post/news/93962891/emissions-trading-scheme-costs-could-force-wellington-landfill-bills-to-soar

[40] See, among others, chapters 13 and 16: He Pou a Rangi: Climate Change Commission (31 May 2021). Ināia tonu nei: a low emissions future for Aotearoa: Advice to the New Zealand Government on its first three emissions budgets and direction for its emissions reduction plan 2022 – 2025. New Zealand Government. Retrieved from: https://www.climatecommission.govt.nz/our-work/advice-to-government-topic/inaia-tonu-nei-a-low-emissions-future-for-aotearoa/

strategic and interconnected emissions reduction goals. The bioeconomy strategy will be most relevant for organics, but it must retain its link to the circular economy framework to ensure 'bioeconomy' does not simply become a synonym for a biofuels industry. The circular economy concept of 'cascades' (inherently linked to the waste hierarchy) will be important to ensure that resource use and allocation follows a rigorous process of prioritisation based on achieving the greatest benefits and the least harms.[41]

Climate policy informed by these frameworks must also integrate strategies and actions between the waste and agriculture sectors. In the EU, overarching policy frameworks such as the Circular Economy Package and the European Green Deal are driving the increase of separate collection and processing of organic waste.[42] Climate change and creating sustainable food systems (e.g. 'Farm to Fork' strategy) are key issues that these policy frameworks seek to address.

Investment in infrastructure and capacity

Aotearoa has over 100 composting sites (both large and small), but most are only consented to process green waste – NZ's capacity to process food waste is lacking. Investment in organic waste processing facilities thus needs to scale up dramatically. The most effective strategy would be to invest in and incentivise the development of a wide range of facilities – from home and small-scale local composting, on-site composting at institutions such as schools, on farm sites, and large-scale centralised facilities. Councils and central government may tend towards investingnin a large-scale technological solution such as AD, but this tendency should be resisted to support the transition to regenerative agriculture in NZ and achieve overall better environmental and social outcomes (e.g. improving soil health and carbon sequestration, creating jobs, food resilience).

Both central and local government have funding streams that can help develop composting infrastructure. The most obvious source is the Waste Minimisation Fund (WMF), the money for which comes from the waste levy – 50% goes to the national WMF and 50% is distributed among TAs. The upcoming levy increases will markedly boost available funds for investment in various waste minimisation projects, and organic waste management will likely be a priority. However, again, there is a high risk that large-scale technological solutions like AD will be prioritised in these investment decisions.

[41] See Kieran Campbell-Johnston et al. (Sep 2020). 'The Circular Economy and Cascading: Towards a Framework.' Resources, Conservation & Recycling: X. Vol. 7, 100038. Retrieved from: https://www.sciencedirect.com/science/article/pii/S2590289X20300098

[42] See European Compost Network (2021). 'CE Package.' Retrieved from: https://www.compostnetwork.info/policy/circular-economy/eu-circular-economy/; and European Commission (n.d.) 'A European Green Deal: Striving to be the first climate-neutral continent.' European Union. Retrieved from: https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en v

Resource management

Planning, permits, consents etc.

Resource management policies – consenting, planning and zoning rules – present significant costs and barriers to the development of composting sites, particularly community-scale facilities. While composting is generally a permitted activity under certain restrictions in Regional Plans, each District Plan will have different rules, permissions and exemptions. This not only makes it difficult to duplicate and implement successful and safe systems across different areas, but composting may not fit comfortably into plans at all thereby creating an unnecessarily cumbersome and complex consenting process.

There are key strategic areas of RMA policy that could be targeted to streamline pathways for developing composting facilities. At the local level, this could involve proposing changes to local District Plans to designate composting as a permitted (or at least controlled) activity. At the regional level, aiming to have policies around organic waste and composting included in Regional Policy Statements can set broader expectations of TAs within that region. Both District Plans and Regional Policy Statements are reviewed every 10 years, but amendments to District Plans can be requested at any time. Furthermore, models like the Auckland Unitary Plan, which created one set of rules in place of multiple different District Plans plus a Regional Plan, are being considered for places like the Wellington region. If this goes ahead, it will be a good opportunity to lobby for the inclusion of provisions for composting.

At the central government level, the relevant and current RMA policy tools are National Policy Statements and Environmental Standards. These set the overarching priorities and objectives on particular topics (e.g. urban development, air quality etc.) to which local governments must give effect. While these are high level and general, they can be specific. There could be scope for an Environmental Standard on organic waste or composting to be developed in future, particularly to accompany more specific regulations on organic waste, such as mandating separate collection and recycling. The current government has been more willing to issue Policy Statements and Environmental Standards and is likely to continue this trend.

Further research is needed to explore the full range of current issues and future possibilities for local government (and central government in the upcoming RMA reforms) to revise permitting laws, streamline consenting application processes, creating exemptions for composting activities that meet certain quality standards etc.

Quality control and assurance

Quality standards are an important way to encourage the creation of high-quality compost and reduce negative outcomes such as contamination and pollution arising from poor management. Composting that is produced for sale or commercial use should ideally follow the voluntary NZ composting standard NZS4454: 2005, which sets quality standards around physical, chemical and biological requirements, limits for pathogens and contaminants.[43] Some community-scale composting activities may fall into a grey area around the standard (i.e. it does not apply), which raises risks around good process. On the other hand, the NZ Standard does not require testing for emerging chemical contaminants (e.g. additives to compostable packaging such as PFAS), nor does it test for beneficial elements that could grade compost quality (e.g. nutrient quantities, fungal network/soil food web health). Some in the sector have called for updating and expanding this standard and to apply it to a wider range of composting activities. It could be developed into an Environmental Standard under the RMA, for example.

[43] Compost New Zealand (2007). A Tool Kit for: NZS4454: 2005: The New Zealand Standard for Composts, Soil Conditioners and Mulches. Retrieved from: https://www.wasteminz.org.nz/wp-content/uploads/Compost-NZ-a-toolkit-for-NZ-4454-PDF-FINAL.pdf

5. Conclusion and recommendations

Organic waste collection and processing infrastructure in Aotearoa is significantly underdeveloped compared with other developed countries. The country's policy settings are such that few incentives exist to encourage reductions in organic waste to landfill. It is currently too cheap to landfill organics and there are no requirements for TAs, who have responsibility for waste management services, to provide any specific organic waste services. Most of the existing services have arisen due to medium-long term cost savings from extending the life of a council owned landfill (e.g. Timaru) or because a recently full/closed landfill has meant waste has to be trucked much longer distances (e.g. New Plymouth and Ruapehu). Most other TAs have access to cheap landfills and thus no incentive to invest in organic waste infrastructure.

Changing policy settings will thus have the biggest influence on infrastructure development. Raising the cost of landfilling is an obvious policy change that could support the development of organic waste processing infrastructure. However, MfE recently (in 2020) consulted on and adopted a plan to raise the waste disposal levy to $60 per tonne by 2024, which many waste experts agree is not sufficient to properly incentivise organic waste diversion – it will help, but not nearly fast enough. It is unlikely any further levy-related policies will be developed before the review due in 2023 – however, pushing for a targeted levy on organic waste specifically may be worth pursuing. A comprehensive organic waste policy suite that includes direct requirements such as mandatory separate collection and RMA Environmental Standards or Policy Statements will be most effective – however, the likelihood of government acting on this is uncertain.

Best practice?

For collections, there is no 'best' system – different communities require specific designs. However, best results are likely to be achieved if multiple collection systems (centralised kerbside collections, decentralised community-scale composting, on-farm composting, home composting) complement each other. The tendency in NZ is to favour centralised systems. Community-scale, decentralised systems are largely seen as 'nice-to-have' community activities, rather than seriously considered as potentially an integral part of a network of organic waste services. The system developed in Austria, in which farmers are fundamental to the entire system, is a highly successful decentralised model that could potentially work well in Aotearoa.

The clearest factor determining which systems work best in what circumstances is around population density. For predominantly rural areas, low volumes of organic waste and long distances between settlements make centralised collections costly and emissions-heavy, and they remove the organic resource from communities that could benefit from its use. Thus, decentralised systems that emphasise home, community and on-farm composting

will work best in such areas (which Austria and parts of Spain do well).

Centralised collections make the most sense in densely populated city areas where residents may not have access to garden/yard space. Collections can spiral out somewhat from the densest areas to nearby suburbs. However, a centralised collection may become inefficient if it attempts to capture the maximum amount of organic waste. In many NZ cities, decentralised systems would be much more effective in sparser suburbs to complement a defined centralised collection and would have the added benefit of encouraging urban farming to build food resilience for cities. Whatever the case, centralised collections should be designed so not to disincentivise community-scale composting.

Evidence and modelling generally shows that food waste only collections are preferable to combined FOGO collections.[44] In some cases, a separate green waste collection may be appropriate.

The existing organic waste services in Aotearoa have all gone for a 'one-size-fits-all' approach, producing mixed results. Christchurch and Timaru are good models for FOGO collections, but such systems are more costly than food waste only and they likely have difficulties in controlling the composting process (i.e. getting the right C:N ratio) – Christchurch's facility has had numerous issues with odour, for example, indicating a less than ideal process.

Hamilton, New Plymouth, Raglan, Ruapehu and Auckland (Papakura) demonstrate good practice centralised food waste only collections. However, most of these systems involve substantial trucking of organic waste to the composting plant (e.g. New Plymouth has had troubles with consenting of their local facility and is currently trucking collected food waste to Hampton Downs nearly 300km away;[45] Ruapehu district's composting unit is in Taumarunui but food waste is collected as far away as Waiouru). Some of these areas would benefit from having decentralised elements. Raglan has the smallest transport footprint as it only serves that community.

Good examples of decentralised community-scale composting are Kaicycle (Wellington), Community Compost (Nelson) and Easy Earth (Whanganui), but they are currently small-scale and do not generally have the support of their local councils to expand. However, Community Compost has been contracted to run Nelson's food waste collection trial. This will be the first town in NZ to have a council contracted decentralised service, and it will be very worthwhile to watch and investigate further.

For best practice composting methods, again the balance is between quantity and quality. Systems that produce compost with high organic matter content, and good fungal and microbial life, are aligned best with soil restoration and regenerative food growing practises. Such systems require careful management and specific training and thus at present are better suited to smaller community-scale sites. Large-scale centralised systems can produce large quantities of compost, but quality management and good training will be much harder to achieve. Investment in best practice composting of community-

[44] E.g. Yates and Pritchett (2020) (footnote 8).

[45] Deena Coster (11 Dec 2020). 'Formal council hearing needed in New Plymouth compost consent case.' Stuff. Retrieved: https://www.stuff.co.nz/taranaki-daily-news/news/123671527/formal-council-hearing-needed-in-new-plymouth-compost-consent-case

scale composters could over time provide expertise that can be applied to larger-scale operations. The best examples of such an approach would again be Austria and the work of Gerry Gillespie in Australia.

Key Recommendations/Conclusions

Various methods and scales of organics collection and processing infrastructure can and should work in tandem: the conversation is not 'either/or', but 'both, and'. To achieve a wide range of positive social and environmental outcomes beyond simply diverting organics from landfill, a complimentary ecosystem of small, medium and large-scale management approaches should be developed (including centralised kerbside collections, decentralised community-scale composting, on-farm composting, home composting etc). There will likely be space for both composting and AD, though more work is needed to understand the broader outcomes of each approach for various organics streams and circumstances, and alignment with broader goals of soil restoration, carbon sequestration and the transition to regenerative agriculture. The system developed in Austria, in which farmers are fundamental to the entire system, is a successful decentralised model that could potentially work well in Aotearoa.

A comprehensive organic waste strategy is needed at both central and local government. This organics strategy should be integrated with broader waste, climate, circular economy, resource management and agriculture policy. This could follow, for example, the EU's Circular Economy Package, which has a wide range of waste and climate action regulations driving organics policies. In NZ, the Climate Change Commission's advice and the Government's response should provide the impetus to develop organic waste infrastructure via climate action policies, but this should be explicitly tied to the beneficial end-use of organics in agriculture for soil restoration/carbon sequestration.

A rigorous and detailed cross-sectoral organics hierarchy must be developed and integrated into organics policy and strategy to inform procurement and decision-making. It should draw on frameworks like the waste hierarchy, the 'cascades' of biological materials in the circular economy and the circular bioeconomy to ensure the highest and best use of organics, which produce the greatest emissions and waste reduction outcomes, across the economy.

Robust and clear provisions for organics infrastructure in resource management regulations could help increase the capacity of composting and urban farming activities. This could include developing and adapting Environmental Standards, National and Regional Policy Statements, and consenting and planning rules (such as permitted activities under District Plans). The RMA reforms potentially present an opportunity to integrate such changes.

The following key waste policy tools should be signalled in the revised New Zealand Waste

Strategy and adopted in the upcoming review of the Waste Minimisation Act:

- Mandatory separate collection and/or on-site processing of organic waste followed by an eventual ban on landfilling organics. Phasing in these policies at an appropriate pace would ensure the development of widely distributed organic waste infrastructure while minimising the potential for perverse outcomes. Territorial Authorities also have powers to require mandatory collection and recycling of organics via waste bylaws and controls, which may be necessary if central government does not regulate/legislate (regardless, local government will ultimately design the specifics of local systems). Key stakeholders should be consulted and engaged in policy design to determine appropriate details such as a phase-in timeframe, thresholds, exemptions etc. to allow for infrastructure to develop (too short a timeframe or limited stakeholder engagement may lead to investment in problematic technological fixes).

- Ambitious waste minimisation targets for reuse, recycling and resource recovery. Even if targets do not explicitly mention organics, they will not be achievable without separate collection and processing of organics.

- Ongoing increases to the Waste Disposal Levy. The initial increase to $60/t for Class 1 landfills by 2024 is not sufficient to adequately incentivise organics diversion – this figure should continue to rise to well beyond $100/t to level the playing field for organics management.

6. References / Further Reading

Abie Horrocks et al. (Jan 2013). Compost SFF Final Report (2009–12): A report prepared for SFF Project 09/152: Sustainable use of municipal compost for the agricultural sector. Plant & Food Research, SPTS No. 7870. Retrieved from: https://www.envirofert.co.nz/uploads/Final-Report-on-Trial-2009.pdf

Ann van der Linden and Almut Reichel (2020). Bio-waste in Europe – turning challenges into opportunities. European Environment Agency, report No. 04/2020. Retrieved from: https://www.eea.europa.eu/publications/bio-waste-in-europe.

Auckland Council (5 Dec 2019). 'Auckland Council announces world-class food scraps processing contract.' Our Auckland. Retrieved from: https://ourauckland.aucklandcouncil.govt.nz/articles/news/2019/12/auckland-council-announces-food-scraps-processing-contract/

Bijay Singh (April 2018). 'Are Nitrogen Fertilizers Deleterious to Soil Health?' Agronomy, Vol. 8(4). DOI: 10.3390/agronomy8040048

Brenda Platt (4 April 2017). 'Hierarchy to Reduce Food Waste & Grow Community.' Institute for Local Self-Reliance. Retrieved from: https://ilsr.org/food-waste-hierarchy/

Brian Gallagher and Ruth Clarke (Nov 2013). Change for the better, Timaru kerbside organic collection & composting, 7 years on, 2006-2013: Key Learnings. Presentation at WasteMINZ Conference 2013. Transpacific Industries Group & Timaru District Council. Retrieved from: https://www.wasteminz.org.nz/pubs/timaru-kerbside-organic-collection-composting-seven-years-on-key-learnings/

CalRecycle (16 April 2019). 'Short-Lived Climate Pollutants (SLCP): Organic Waste Methane Emissions Reductions.' California Department of Resources Recycling and Recovery (CalRecycle). Retrieved from: https://www.calrecycle.ca.gov/climate/slcp/

Compost New Zealand (2007). A Tool Kit for: NZS4454: 2005: The New Zealand Standard for Composts, Soil Conditioners and Mulches. Retrieved from: https://www.wasteminz.org.nz/wp-content/uploads/Compost-NZ-a-toolkit-for-NZ-4454-PDF-FINAL.pdf

Consolidated text: Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives. EUR-Lex: Access to European Union Law, Document 02008L0098-20180705. European Union Legislation. Retrieved from: https://eur-lex.europa.eu/eli/dir/2008/98/2018-07-05

David Hardwick and Gerry Gillespie (n.d.). Static Pile Inoculated Compost Extension (SPICE): Making quality compost using a no-turn method. Soil Land Food and Returning Organics to Soil. Retrieved from: https://www.gerrygillespie.net/uploads/4/5/6/5/45656863/spice_compost_metric_version.pdf

Decree on the management of biodegradable kitchen waste and green garden waste (17 May 2010). Official Gazette of the Republic of Slovenia, No. 39/10 [translated from Slovenian to English]. Republic of Slovenia Legislation. Retrieved from: http://www.pisrs.si/Pis.web/pregledPredpisa?id=URED5366

Deena Coster (11 Dec 2020). 'Formal council hearing needed in New Plymouth compost consent case.' Stuff. Retrieved: https://www.stuff.co.nz/taranaki-daily-news/news/123671527/formal-council-hearing-needed-in-new-plymouth-compost-consent-case

Douglas Broom (12 Apr 2019). 'South Korea once recycled 2% of its food waste. Now it recycles 95%.' World Economic Forum. Retrieved from: https://www.weforum.org/agenda/2019/04/south-korea-recycling-food-waste/

Duncan Wilson, Tanzir Chowdhury, Tim Elliott, Laurence Elliott & Dominic Hogg. (30 May 2017). The New Zealand Waste Disposal Levy: Potential Impacts of Adjustments to the Current Levy Rate and Structure. Eunomia Research & Consulting. Retrieved from: https://eunomia.co.nz/wp-content/uploads/2017/06/WDL-Final-Report-30-05-17.pdf

Duncan Wilson. Optimising Kitchen Waste Collection. Eunomia Research & Consulting, 2017. https://eunomia.co.nz/wp-content/uploads/2017/04/OPTIMISING-KITCHEN-WASTE-COLLECTION.pdf

Ecogas (2 Sep 2019). Ecogas receives Provincial Growth Fund support. Retrieved from: https://www.ecogas.co.nz/news/ecogas-receives-provincial-growth-fund-support

Effie Papargyropoulou et al. (1 Aug 2014). 'The food waste hierarchy as a framework for the management of food surplus and food waste.' Journal of Cleaner Production, Vol. 76, pp. 106-115.

Enzo Favoino and Dominic Hogg. 'The potential role of compost in reducing greenhouse gases.' Waste Management & Research, Vol. 26, 2008, pp. 61-69

Enzo Favoino in Zero Waste Network Aotearoa (5 Nov 2020). 'Our Zero Waste World Digital Summit – International Perspectives on Organics.' YouTube. Retrieved from: https://www.youtube.com/watch?v=4TfigXWVZ5Q

European Commission (n.d.) 'A European Green Deal: Striving to be the first climate-neutral continent.' European Union. Retrieved from: https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en

European Compost Network (2021). 'CE Package.' Retrieved from: https://www.compostnetwork.info/policy/circular-economy/eu-circular-economy/

Ferran Rosa (2018). The Story of Besançon. Zero Waste Europe. https://zerowasteeurope.eu/downloads/case-study-of-besancon/

Florian Amlinger in Zero Waste Live! (17 March 2020). 'Decentralised management of organic waste.' Zero Waste Cities, Zero Waste Europe. Retrieved from: https://zerowastecities.eu/webinar/decentralised-management-of-organic-waste/

Florian Amlinger (Nov 2009). Biowaste Recycling in Austria: The Decentralised Solution. European Composting Network (ECN). Retrieved from: http://www.samsoluciones.es/sam/wp-content/uploads/2009/11/Estudio-CMC-Florian-Amlinger1.pdf

George Monbiot (17 Mar 2014). 'The Biogas Disaster.' Permaculture Research Institute. Retrieved from: https://www.permaculturenews.org/2014/03/17/biogas-disaster/

Geraden Cann (22 Jun 2017). 'Emissions Trading Scheme costs could force Wellington landfill bills to soar.' Stuff. Retrieved from: https://www.stuff.co.nz/dominion-post/news/93962891/emissions-trading-scheme-costs-could-force-wellington-landfill-bills-to-soar

He Pou a Rangi: Climate Change Commission (31 May 2021). Ināia tonu nei: a low emissions future for Aotearoa: Advice to the New Zealand Government on its first three emissions budgets and direction for its emissions reduction plan 2022 – 2025. New Zealand Government. Retrieved from: https://www.climatecommission.govt.nz/our-work/advice-to-government-topic/inaia-tonu-nei-a-low-emissions-future-for-aotearoa/

Jessica McKenzie (3 Dec 2019). 'The misbegotten promise of anaerobic digesters.' The Counter. Retrieved from: https://thecounter.org/misbegotten-promise-anaerobic-digesters-cafo/

Kate Walmsley (23 Aug 2020). 'Why industrial anaerobic digestion is not the answer to food waste.' The Spinoff. Retrieved from: https://thespinoff.co.nz/food/23-08-2020/why-industrial-anaerobic-digestion-is-not-the-answer-to-food-waste/

Katie Sandson, Emily Broad Leib, Lorenzo Macaluso and Coryanne Mansell. Bans and Beyond: Designing and Implementing Organic Waste Bans and Mandatory Organics Recycling Laws. Harvard Law School Food Law and Policy Clinic & Centre for EcoTechnology, July 2019. https://wastedfood.cetonline.org/wp-content/uploads/2019/07/Harvard-Law-School-FLPC-Center-for-EcoTechnology-CET-Organic-Waste-Bans-Toolkit.pdf

Kieran Campbell-Johnston, Walter J.V. Vermeulen, Denise Reike and Sabrina Brullot (Sep 2020). 'The Circular Economy and Cascading: Towards a Framework.' Resources, Conservation & Recycling: X. Vol. 7, 100038. Retrieved from: https://www.sciencedirect.com/science/article/pii/S2590289X20300098

Linda Bilsens Brolis and Brenda Platt. Community Composting Done Right: A Guide to Best Management Practices. Institute for Local Self-Reliance, March 2019. https://ilsr.org/composting-bmp-guide/

Marissa Sheldon (18 Mar 2020). 'South Korea Recycles Food Waste in Effort to Become Zero-Waste Society.' Food Policy Snapshot Series, Hunter College New York City Food Policy Center. Retrieved from: https://www.nycfoodpolicy.org/food-policy-snapshot-south-korea-food-waste/

Michael Quintern, M. Morley, Bruce Seaton & R. Hamilton. 'How we transform industrial organic waste into vermicompost and champion environmental sustainability.' WIT Transactions on Ecology and The Environment, Vol 202, 2016, pp. 147-159. https://www.witpress.com/elibrary/wit-transactions-on-ecology-and-the-environment/202/35469

Ministry for the Environment (MfE) (May 2005). Options for Kerbside Collection of Household Organic Wastes. Retrieved from: https://environment.govt.nz/assets/Publications/Files/kerbside-collection-organic-wastes-may05.pdf

Munsol Ju et al. (Jan 2016). 'Solid recovery rate of food waste recycling in South Korea.' Journal of Material Cycles and Waste Management, Vol. 18(3), pp. 419-426

Nick Morrison (Dec 9 2019). 'They've Got This Wrong – It's Not Waste To Divert It's Food For Our Soils.' Go Well Consulting. Retrieved from: https://gowellconsulting.co.nz/theyve-got-wrong/

Peter Moon and Harold Ruppert (Dec 2018). Envirofert Compost Facility Operations Plan. Prepared by 02Compost for Waikato Regional Council. Retrieved from: https://www.waikatoregion.govt.nz/assets/WRC/Community/whats-happening/have-your-say/Envirofert/Appendix-A-Operations-management-plan.pdf

Rachel Slater, Jim Frederickson & and Mark Yoxon. Unlocking the potential of community composting: full project report. Report to the Department for Environment, Food and Rural Affairs (Defra), London, 2010. http://oro.open.ac.uk/30542/

Ruth Clarke and Bruce Middleton (July 2017). Timaru District Council Waste Assessment. Timaru District Council and Waste Not Consulting. Retrieved from: https://www.timaru.govt.nz/__data/assets/pdf_file/0017/181124/1002595-PLAN-Waste-Assessment-Timaru-District-Council-2017.pdf

Sarah Pritchett and Sunshine Yates (May 2020). Recommendations for standardisation of kerbside collections in Aotearoa. WasteMINZ. Retrieved from: https://environment.govt.nz/assets/Publications/Files/recommendations-for-standardisation-of-kerbside-collections-in-Aotearoa.pdf

Tessa Vincent (27 May 2020). 'Regenerative Agriculture and Food Waste.' Nature-based Solutions, Pure Advantage. Retrieved from: https://pureadvantage.org/regenerative-agriculture-and-food-waste/

The Composting Collaborative (14 Feb 2019). 'Organic Waste Bans: An Analysis of Existing Policies, Challenges, and Opportunities.' Webinar. Retrieved from: https://www.compostingcollaborative.org/resources/organic-waste-bans-an-analysis-of-existing-policies-challenges-and-opportunities/

Wellington City Council (2021). 'Controls for the Solid Waste Management and Minimisation Bylaw 2020.' Retrieved from: https://wellington.govt.nz/your-council/plans-policies-and-bylaws/bylaws/other-bylaws/controls-for-the-solid-waste-management-and-minimisation-bylaw-2020

Zero Waste Network Aotearoa (March 2021). Organic Waste: A position statement from the Zero Waste Network. Retrieved from: https://zerowaste.co.nz/assets/Organic-Waste-in-Landfill_discussion-doc-2021.pdf

Zero Waste International Alliance (Aug 2017). Composting and Anaerobic Digestion Policy. Retrieved from: https://zwia.org/composting-and-anaerobic-digestion-policy/

Zero Waste International Alliance (2018). 'Zero Waste Hierarchy of Highest and Best Use.' Retrieved from: https://zwia.org/zwh/