Waste and Resource Recovery Infrastructure and Services Stocktake and Gap Analysis

FULL PROJECT SUMMARY REPORT

Prepared for the Ministry for the Environment

24 March 2023

Report for:

Ministry for the Environment

Prepared by:

Duncan Wilson
Anita Lewis

Approved by:

Duncan Wilson
(Project Manager)

Contact Details

Eunomia Research & Consulting Ltd (NZ)
PO Box 78 313
Grey Lynn
Auckland 1245
New Zealand

Tel: +64 9 376 1909
Fax: +64 9 360 5187

Web: www.eunomia.co.nz

Contents

1.0 Introduction

1.1 Report Aim

This report summarises work undertaken by Eunomia in 2020 and 2021 for the Ministry for the Environment (the MfE) to collate information on the waste and resource recovery infrastructure and services provided in New Zealand and make recommendations for their future development.

The detail of the work is contained in a series of project reports provided to the MfE. In addition to being substantive, these reports contain commercially sensitive information provided to the project team in confidence, and hence they are not suitable for publication.

The aim of this summary report is to provide an overview of the key outcomes from the project. This includes:

- A summary of waste and resource recovery infrastructure in New Zealand (as of 2020) broken down by primary material streams and a including brief analysis of the value chain presented by each material type.
- An overview of household waste and recycling collection services, material recovery facilities (MRFs), class 1 landfills, transfer stations and energy recovery (as of 2020).
- The outcomes of a detailed stakeholder engagement exercise to prioritise current and future resource recovery infrastructure gaps that should be addressed.
- Recommendations, derived from engagement and analysis, on a strategic approach to future infrastructure provision. The project team recommended that a 'circular resource network' should be built to optimise the capture of waste materials and maximise their value to enable re-integration into the circular economy. The report outlines proposals for a circular resource network based on standardised systems, integrated logistics, and optimising planning and management, and suggests a high-level roadmap for implementation of the concept.

The report is intended for stakeholders involved in the waste sector and assumes a base-level understanding of waste infrastructure management and related concepts.

1.2 Context

The project was commissioned to inform the development of a national approach to infrastructure investment in the waste and resource recovery sector. The core of the project was to build a solid understanding and evidence base in relation to the sector. In addition, the project encompassed working with key stakeholders to identify infrastructure investment priorities and based on these priorities, developing a framework for planning and investment. The three phases of the work are outlined below:

1.2.1 Stocktake and Gap Analysis

This phase involved extensive research and engagement with the resource recovery sector to identify the services and facilities available, the materials and quantities managed and the key issues and opportunities facing the sector. The gap analysis identified regional and national gaps in infrastructure and service provision across the range of materials that were the subject of the study.

The parts of the sector canvased during the study were:

- Organics
- Fibre (paper and cardboard)
- Glass
- Metals
- Plastic
- Construction and Demolition
- Electrical and Electronic Products
- Farm Plastics
- Reusables
- Tyres
- Material Recovery Facilities
- Collection Services
- Transfer Stations and Resource Recovery Facilities
- Class 1 Landfill
- Energy Recovery

During the stocktake, the project team contacted 255 organisations and completed 173 interviews with stakeholders across the sector. This work has provided an unprecedented level of information, data, and insight into the operation of the sector as a whole. Refer to chapters 3.0 through to 17.0 for details on each of the activity streams.

1.2.2 Prioritisation Workshops

This phase involved engaging with key stakeholders to identify and prioritise options for addressing infrastructure gaps. This phase of the work engaged with sector experts, and established two groups to identify priorities and ensure that options were grounded in real world experience. This included:

- Fourteen Technical Reference Groups (TRGs) each made up of 4-10 representatives from the different parts of the waste and resource recovery sector reviewed in the stocktake. This group provided technical review of the project findings and suggestions for priority actions.

- An Infrastructure Working Group (IWG) comprising 18 subject matter experts representing a cross section of the industry as well as central government. This group was responsible for prioritising potential actions.

A series of three workshops were conducted with the IWG over approximately four months to develop and identify the priority options. For detail on the outcomes of the prioritisation workshops refer to chapter 19.0. When considering how to evaluate the options, it became clear that how an option might be evaluated depended heavily on the assumed context - what the greater objective was and what other options or supporting actions were also in place.

To address this a range of 'scenarios' were developed which consisted of different mixes of supporting actions and infrastructure options that worked together as packages, and that were focused on a particular broad outcome. The scenarios were intended to be illustrative and can be adjusted to account for changes in technologies, or the outcomes that are desired from each.

The top priority actions across the scenarios tended to reflect the perceived importance of addressing key waste streams, in particular construction and demolition waste, organic, e-waste and plastics. These outcomes reflect a synthesis of input from a wide cross-section of the waste and resource recovery sector and provide a robust foundation for further identification and prioritisation of specific facilities as part of an infrastructure investment plan for the sector.

1.2.3 Strategic Framing

While the prioritisation exercise provided a valuable foundation in terms of infrastructure priorities, it also highlighted the need to have a cohesive approach that ensures that investment is not only directed at priority areas but is able to effectively deliver wider strategic outcomes.

This phase developed a proposal for a strategic approach to infrastructure investment that will help ensure, not only that priority actions don't conflict with one another, but ideally that they reinforce each other and work synergistically to achieve objectives for the sector. One of the key findings of the stocktake and gap analysis phase was that everything is interrelated. These connections exist across material types, for example paper, glass, plastic, and metal packaging are commonly collected and sorted in the same collection. Further connections exist across industries where many of those involved in and influencing the sector are not 'waste' or 'recycling' businesses, but retailers, manufacturers or service providers that are either taking responsibility for their own waste, or utilising waste materials from other producers. These connections reinforce the fact that, when it comes to the circular economy, it is necessary to think in systems.

The prioritisation exercise outlined above surfaced a lot of what are likely to be the key options to take forward in terms of infrastructure investment. However, if the analysis were to stop there, then there is a danger that the result would be a collection of disjointed initiatives, which may or may not result in gaps in provision, overlaps, or working at cross purposes (with other possible actions or even other Government priorities). In other words, there is a need to make sure that 'the bits fit together'.

In this phase a strategic approach was developed where the different priority actions are focused through the concept of developing a 'circular resource network'. The concluding two chapters of this report outlines a proposed approach that provides a consistent framework for investment.

1.3 How to Read this Report

Chapters 3 through 17 cover key material streams and facilities. These have a standard structure and can be read as stand-alone chapters according to the reader's interest.

Chapter 18 covers 'cross-cutting themes' from the research that provide insight into the dynamics of the sector, while chapter 19 presents the high-level outcomes of a prioritisation exercise involving sector representatives, and chapter 20 outlines a concept, developed by Eunomia, that would provide a strategic approach to future infrastructure provision.

1.3.1 Caveats

The information and data presented in the report was gathered over a period of time in 2020 and relates specifically to that time period.

The data was gathered through interviews and information supplied to the project team by operators and other stakeholders in the sector. Some of this information was incomplete or estimated, and not everyone contacted agreed to supply information. Furthermore, some information was considered commercially sensitive and supplied in confidence. While the information supplied was sense-checked against other available information, no further investigation as to the accuracy or veracity of the information was undertaken. While the information represents the most comprehensive data set across the sector currently available, it is almost certainly incomplete, and no guarantee is provided regarding any of the information and data.

As noted earlier, this is a summary report and does not represent the full detail of the information that was collated.

1.3.2 Glossary

Term	Definition
Circular economy	A circular economy is an alternative to the traditional linear economy in which we keep resources in use for as long as possible, extract the

Term	Definition
	maximum value from them whilst in use, then recover and regenerate products and materials at the end of each service life.[1]
Gap analysis	In the context of this report a gap analysis assesses where there is a gap between the need for resource recovery infrastructure or services and the provision of such infrastructure and services. It is not restricted to current provision but can also look at future needs.
Greenwashing	Behaviour or activities, including marketing and information, that make people believe that a company or organisation is doing more to protect the environment than it really is.[2]
High performing linear	A scenario used in the prioritisation workshops to describe where efforts are made to recycle and recover as much waste materials as practical without significantly addressing elements that are higher in the waste hierarchy such as avoidance, reduction, re-use, and redesign. This scenario assumes a continuation of the linear economy.
Infrastructure options	Options for infrastructure provision (such as a new compost plant or sorting facility). In this project infrastructure options were further characterised by whether they were 'network options' – i.e., focused on sorting and logistics, or 'processing options' i.e., concerned with processing or manufacture of recovered materials.
Manufacture	In this report 'manufacture' denotes where a process results in a product that is then sold to wholesale or retail customers.
Material flows	This term describes the movement of materials within the value chain. In this report it is primarily concerned with material movements between consumption and disposal or recovery.
Material lifecycle	The different stages materials go through within the value chain
National capacity	Infrastructure or service capacity gaps that exist at a national level. This covers the aggregate national picture as well as capacity gaps in national-scale infrastructure (for example glass or steel manufacture).

[1] https://environment.govt.nz/what-government-is-doing/areas-of-work/waste/ohanga-amiomio-circular-economy/
[2] https://dictionary.cambridge.org/dictionary/english/greenwashing

Term	Definition
Product stewardship	When a producer, brand owner, importer, retailer or consumer accepts responsibility for reducing a product's environmental impact.[3] Product stewardship can be voluntary or regulated.
Regional capacity	Infrastructure or service capacity gaps that exist at a regional level.
Reprocessing	In this report 'reprocessing' denotes where a process results takes in a raw or partially processed material and produces a raw material that can be sold as a commodity.
Reverse logistics	Reverse logistics is a type of supply chain management that moves goods from customers back to the sellers or manufacturers.
Sorting	Sorting is a step in the value chain where mixed materials are separated into single material types. Several sorting steps may be required to achieve the desired grade of material. For example plastic containers may be separated from other types of material but still require further sorting into different polymer types before reprocessing.
Stakeholder mapping	The process of identifying stakeholders and classifying them according to various criteria (for example location, size, role in the value chain).
Supporting actions	Actions that support infrastructure or service outcomes. This includes policies, legislation and regulation, purchasing policies, product stewardship, data and information, access to funding and expertise etc.
Value chain	All of the relevant parts of a material or product's life cycle where value can be added or subtracted. This can include non-physical elements that impact what happens to the product or material, such as marketing or certification.[4]
Value chain analysis	A value chain analysis aims to identify the key parts of the value chain, from consumption through to recovered material markets, where this is opportunity to reduce cost/increase efficiency and add value. A value chain analysis can encompass economic as well as non-monetary values such as eco-system services or social value.

[3] https://environment.govt.nz/what-government-is-doing/areas-of-work/waste/product-stewardship/about-product-stewardship-in-new-zealand/
[4] https://www.cisl.cam.ac.uk/education/graduate-study/pgcerts/value-chain-defs

Term	Definition
Zero carbon	In this report zero carbon refers to a scenario with actions that are consistent with the intent of the Climate Change Response (Zero Carbon) Amendment Act 2019. Specifically to: — (i) contribute to the global effort under the Paris Agreement to limit the global average temperature increase to 1.5° Celsius above pre-industrial levels; and (ii) allow New Zealand to prepare for, and adapt to, the effects of climate change:

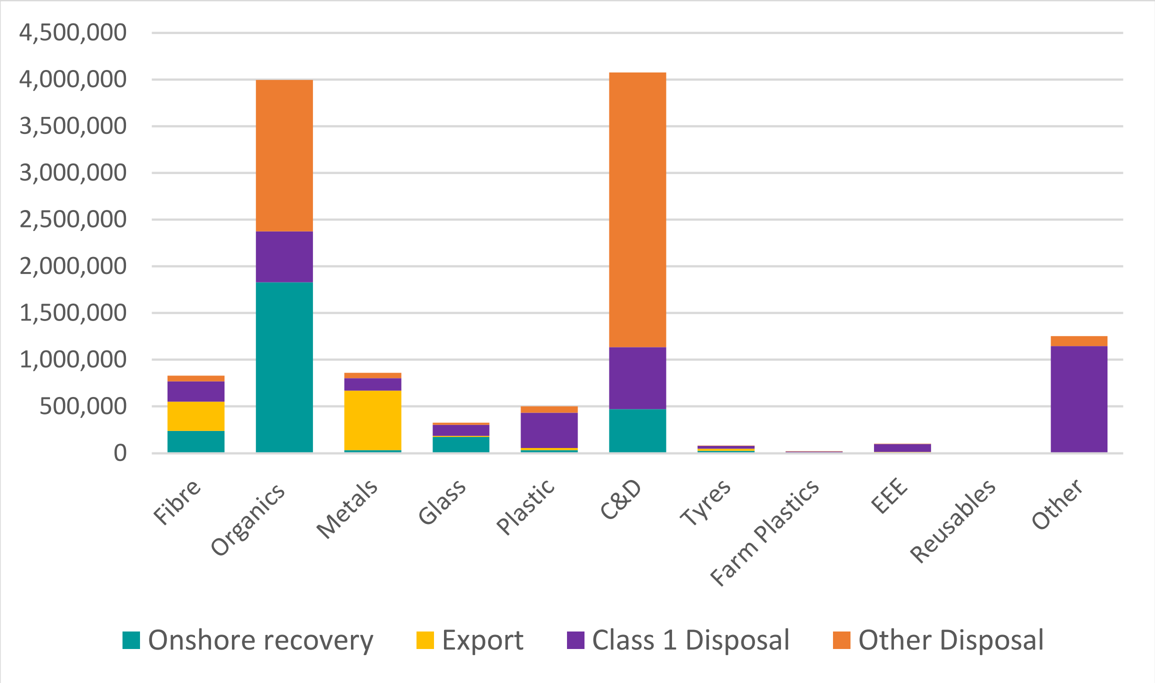
2.0 Material Stream Analysis

2.1 Material Stream Overview

Disclaimer: All data is as collated in 2020. Data shown is based on information supplied during the stocktake period and is unlikely to be complete because not all organisations contacted supplied data and there were organisations that were not able to be identified or contacted during the stocktake.

The stocktake work was able to identify approximately 12 million tonnes of material that reaches end of life in NZ annually. A breakdown of this material is shown in the chart below.

Figure 1: Estimated Tonnes Recovered and Disposed of by Material Type



The recovery data shown represents quantities that were able to be identified through the stocktake. As it is probable that not all recovery was accounted for, this is likely an under-estimation.

The data gathered showed that the largest waste streams are organics and construction and demolition waste, each accounting for in the order of 4 million tonnes of material. Approximately 50% of known organic waste is recovered while in the order of 12% of construction and demolition waste was able to be accounted for as being recovered. However, based on information obtained in the stocktake, both of these waste streams are likely to include relatively large quantities of material that are not formally reported or included in the data. For example, organic waste recovered and used on-farms or between farms, and construction and demolition material such as aggregate or wood chip that may be processed and used on site or within a business's operations.

The majority of material recovered is fed into onshore markets, with the exceptions of fibre and metals (and to a lesser extent, plastic). A gap analysis was undertaken for each of the 15 parts of the sector.

2.2 Key Gaps

Table 1 provides a brief overview of the key gaps identified during the stocktake and gap analysis. Gaps relating to national and regional capacity; as well as transport and logistics are discussed in more detail within each relevant section.

Table 1: Overview of Key Gaps

Sector	Profile	Gaps
Organics	• Large quantities to landfill • Household food waste • Need valuable end uses • A lot of material unaccounted for • Carbon impact potential	• Household collection • Food waste processing • Market development
C&D	• Large quantities of heavy material • A large proportion to disposal • A lot of regional variation • Low value materials	• Sorting facilities • Markets and end uses
Plastics	• Most plastic is not recovered • A lot of work on packaging but not durables • A lot of plastic is not recoverable • Recovered plastic lower value	• Onshore processing • Kerbside standardisation • Eliminate hard to recycle

Reuse	• Currently small but has potential • Product providers tend to run own systems • No standardised containers • Carbon impact potential	• Standardised container fleets • Regional wash plants
Transfer Stations	• Lack of standardisation • Scope for greater separation • Uneven service provision	• Higher, consistent, service levels • Re-use • Access to consistent range of material recovery
Energy Recovery	• Key driver is clean energy • Forestry residues key focus • Crossover with organics • Limited energy potential from waste materials	• Processing into fuels • Energy generation facilities

3.0 Organic Material Stream Analysis

3.1 Description of Organics Material Stream

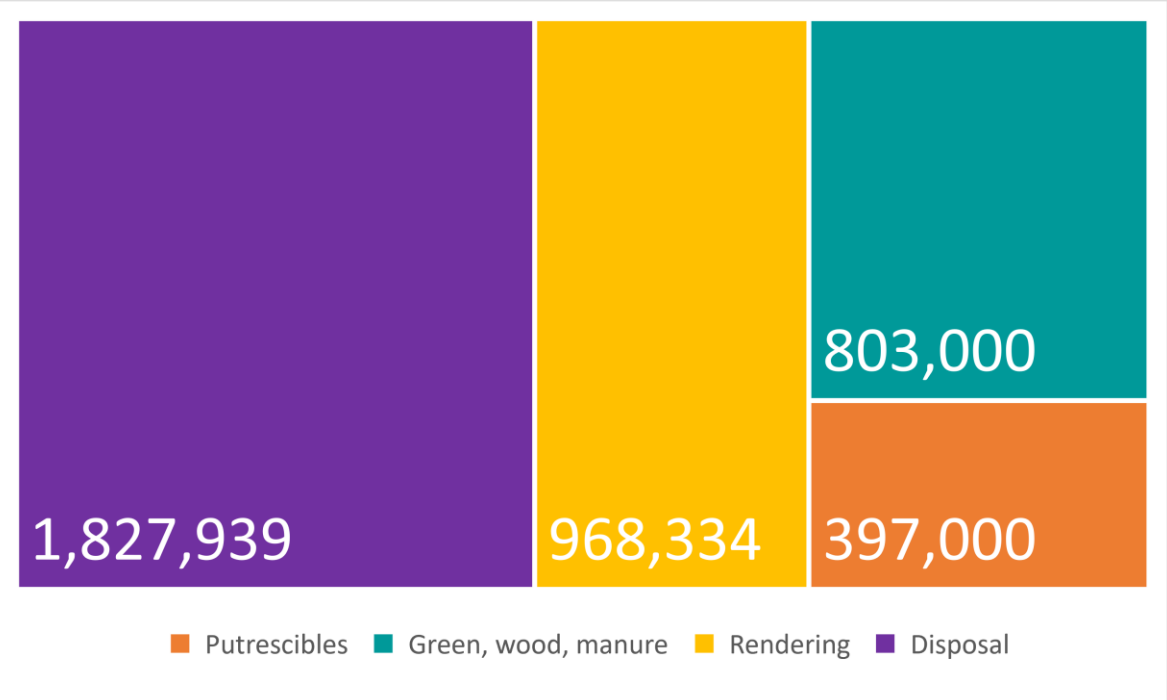
The organics material stream, while predominantly focused on composting, encompasses a diverse range of feedstocks, processes, markets, and types of operators.

3.2 Materials & Quantities

The main material streams that are processed through formal systems in New Zealand include wood and timber wastes, garden waste, commercial sludges, and animal manures.

The chart below presents estimates of the total tonnes of organic waste recovered and disposed of:

Figure 2: Total Tonnes Organic Waste Recovery and Disposal



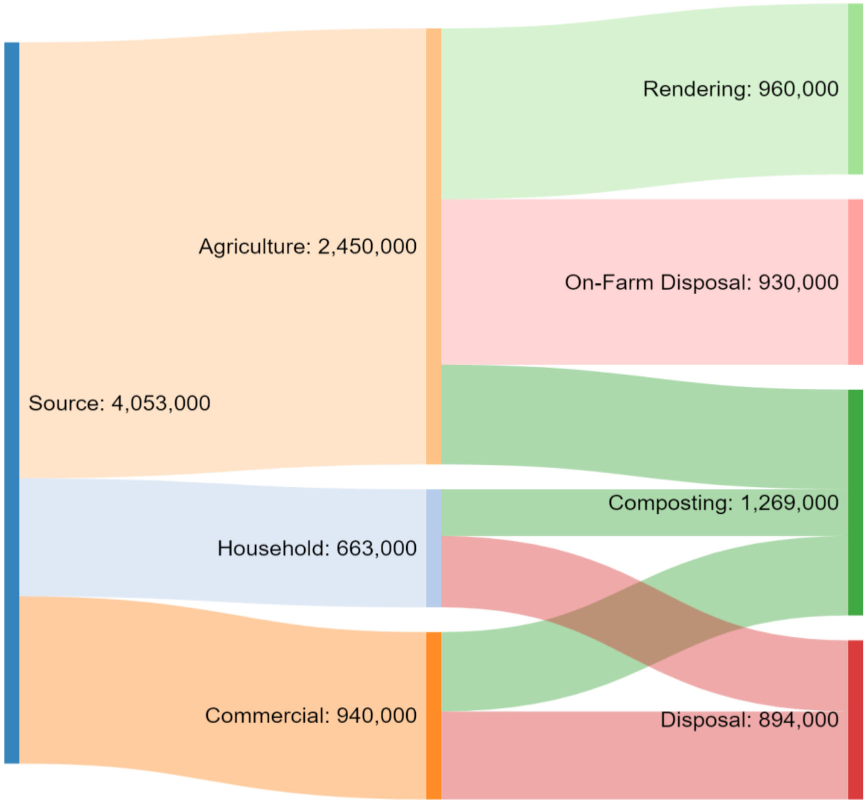
The data for putrescibles and for green, wood and manure are derived from information gathered in the stocktake. Rendering facilities were not included in the study and so data for rendering plants were calculated based on industry data on the quantity of meat sold and the proportion of the carcass that is utilised.[5] Approximately half of the organic waste disposal is estimated to occur on farms, with a further 546,627 tonnes going to

[5] https://www.mbie.govt.nz/assets/8fdebf6c7b/investors-guide-to-the-new-zealand-meat-industry-2017.pdf

Class 1 disposal[6], and the remainder mainly consisting of timber processing waste going to industrial monofills.[7]

Figure 3 summarises the flows of organic material in New Zealand.

Figure 3: Sankey Diagram of Organic Material Flows from Generation through to Recovery or Disposal



The data indicates there is in the order of 4M tonnes of organic waste generated annually with over half of this coming from the rural sector, a further quarter from the commercial sector (including sludges) and the remainder from households. Of the waste material generated, over half is recovered, with approximately a quarter estimated to go to rendering or value add from abattoir processes and close to a third going to some form of composting or biological treatment process. The figures however should be treated with some caution, as they represent information that was able to be compiled for the stocktake and do not represent estimates of overall activity. For example, there

[6] Waste Not (2020) Update of National Average Waste Composition for Class 1 Landfills, Report to Ministry for the Environment

[7] Sewage sludge (biosolids) going to landfill is classified as 'hazardous and special waste' in composition data and is not included in the above totals. There is in the order of 800-900,000 tonnes of 'hazardous and special waste' sent to Class 1 landfill annually.

is no information on the quantity of materials recovered on-farm, and not all recovery operations contacted supplied quantitative information.

3.3 Facility Types

In total, 62 active facilities that process organic waste (excluding small scale facilities) were identified. The most common type of facility found was windrow composting (40%) followed by in-vessel processing (15%), vermicomposting (11%), aerated windrow (8%) and mulching (8%).

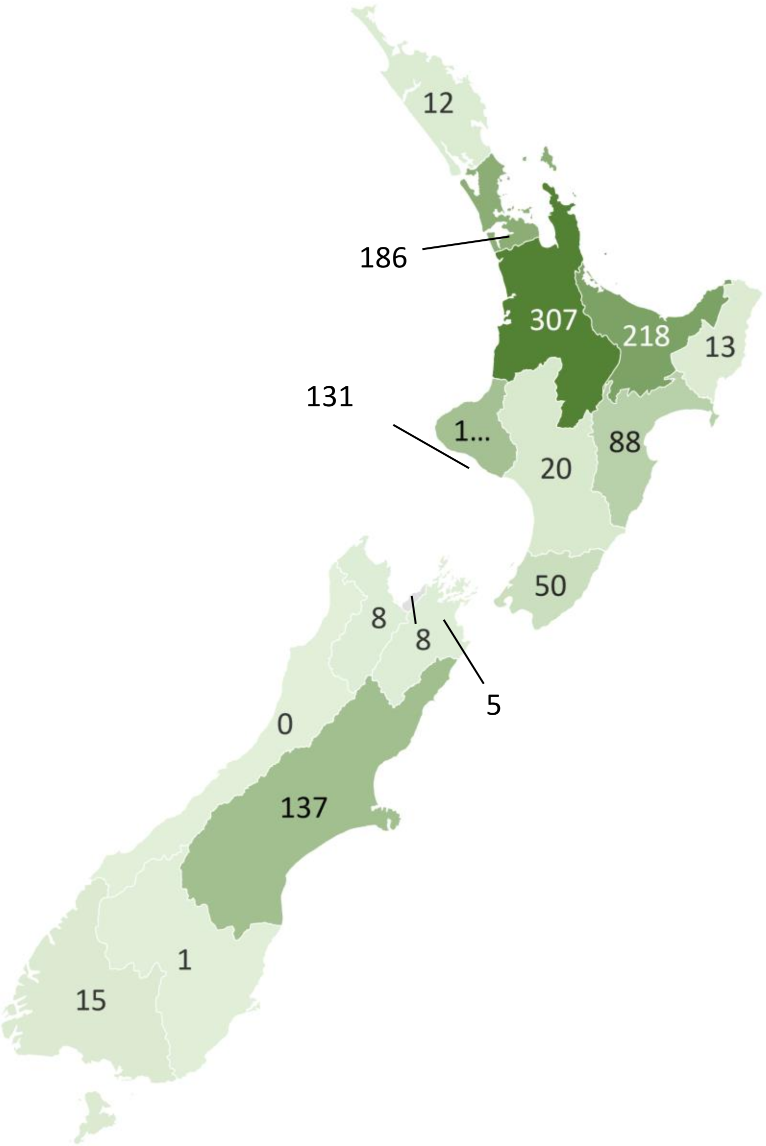
3.4 Regional Distribution

Household and ICI garden waste tends to be recovered widely across the country while timber waste is concentrated in areas of greater forestry and sawmilling activity, particularly the central North Island. Similarly, with animal manures, formal recovery of these is heavily concentrated in the middle of the North Island and is mostly associated with chicken farms. Commercial sludges are predominantly from food, and fruit packhouse processing wastes across the middle of the North Island.

The quantity of organic material recovered is dominated by activity across the middle - upper North Island. Of the approximately 1.2 million tonnes of organic waste identified as being recovered in New Zealand, 840,000 tonnes (70%) occurs across just four regions – Waikato, Bay of Plenty, Auckland and Taranaki. The quantities are illustrated in Figure 6.

Cross boundary movement of feedstock material is limited and occurs with a relatively small number of operators. Except where the facilities are located near a regional boundary, the tonnages involved are a small percentage of their total inputs.

Figure 4: Quantities by Region (x1,000 tonnes)



3.5 Market Segments and Dynamics

Key market segments for the sale of products from organic processes include:

- domestic market
- bulk landscaping supply
- farming. Within the farming segment there are further key markets such as kiwifruit and orchards, feedcrops, pasture, and market gardening.

The three main factors that affect the dynamics of activity in the organic waste recovery sector include:

- The demand for products from organic waste. This is generally static for urban markets[8] but increasing in rural markets.
- The supply of organic material. Certain valuable materials such as chicken shed manure and bark are sought after and supply constrained. Other less valuable feedstocks are generally not supply constrained.
- The cost of disposal. The planned increase in costs of disposal (due to an increase in the waste levy) are likely to make alternatives to disposal more attractive and this will increase the supply of material.

3.6 Small Scale Composters

The smaller composters interviewed processed less than 1% of overall organic waste streams in New Zealand yet process about 5% of overall food waste recovered. Types of organisations ranged from commercial entities to, particularly in urban areas, community groups. A variety of composting methods were applied, and the end-product was generally locally used, sold, or shared to improve soil quality.

The challenges faced by this group of composters relate to the ability to obtain funding, council contracts, space, and resource consents. Despite these hurdles, almost all operators were experiencing increases in demand, both for use of community composting facilities, and the demand for end-products.

3.7 Compostable packaging

Compostable packaging could become a more common feedstock as businesses search for alternatives to plastic, and as local authorities introduce food waste collections which utilise compostable bin liners.

For most operators spoken to, compostable packaging is a risk factor. In general, composters are focused on the quality of their outputs and making sure that these meet customer requirements. Compostable packaging has no nutrient value as a feedstock and introduces risk - principally through the potential for contamination, ecotoxicity, and incompletely degraded material in the end-product.

Only a few operators were found to be actively pursuing development and testing of processes for compostable packaging.

3.8 Future Opportunities

From the 48 operators interviewed, 23 indicated some form of intention to expand future operations. A few of these were in the actual planning or development phases, but most were statements that their businesses were growing and that they felt they could expand capacity or utilise more of existing capacity in the future.

---

[8] One stakeholder noted that this has changed since Covid 19 lockdowns with an increase in demand for landscaping products.

Key potential future demand drivers noted in the stocktake included:

- The potential for biochar to improve soils and sequester carbon
- The potential to create valuable products from organic wastes
- Food waste, particularly from households, becoming available as a feedstock
- Animal skins and stock casualties, requiring processing
- Grape marc requiring processing
- 'Regenerative Agriculture' and soil fertility driving demand for organic soil amendment products
- Businesses focusing on developing products and markets
- Ongoing expansion of the poultry industry
- Increase in the use of compostable packaging
- Increase in the waste levy

3.9 Gap Analysis – Organic Waste

A gap analysis exercise was conducted to identify the national, regional and transportation gaps, across the material lifecycle. The results are shown in the table below.

Key:

The gap is analysis is presented using a 'traffic light' grading system as shown below.

No significant gaps/issues	Some/potential gaps/issues	Significant gaps/issues

Table 2: National, Regional and Transportation Gaps Identified within the Organics Material Stream

Infrastructure Type	National Capacity	Regional Capacity	Transport & Logistics
Household Organic Waste Collections	Household collections of garden and food waste are limited. 4 councils collect food waste, 4 collect food and garden mixed, and 3 councils collect garden waste Private collections of garden waste are more widespread with the service being offered in 26 TA areas.	Those councils that do collect organic waste are all in the upper half of the North Island or in Canterbury	Depending on facility locations, development of bulking facilities may be necessary to deliver efficient organic waste collection services

Infrastructure Type	National Capacity	Regional Capacity	Transport & Logistics
Commercial Organic Waste Collections	Collection of organic waste from larger processors is usually not problematic where there is local demand, however there are limited collection services for commercial food waste	Commercial green waste is widely collected, but commercial food waste collections are more limited and tend to focus on main centres. Key areas where the service is available includes Auckland, Hamilton, New Plymouth, Wellington, Palmerston North, Napier & Hastings, and Christchurch	Development of bulking facilities may be necessary to deliver organic waste collection services efficiently
Rural Organic Waste Collections	The rural sector can generate large quantities of organic waste. Where this is managed off site it is usually because the material is sought after	In general, specialised collection services are not required for rural organics, and collections are able to be made using standard vehicles	Where material is generated, and the location of the markets may be different. Not noted as an issue however.
Organic Waste Sorting	Depending on facility locations, development of bulking facilities may be necessary to deliver efficient organic waste collection services	Depending on facility locations, development of bulking facilities may be necessary to deliver efficient organic waste collection services	N/A
Organic Waste Reprocessing	Organic waste is processed from a waste into a product generally in a single facility. Therefore, the gaps are captured under the 'Manufacture' heading below. There is some mulching on one site and transport to another facility for finishing, but data on this distinction was not captured in the stocktake.		
Organic Waste - Manufacture	Overall, the market responds to where there are supplies of materials and a demand for the products. However, there are gaps in the processing capacity for some streams such as household food waste and compostable packaging. Compostable packaging and household food waste are seen as potentially contaminated and difficult to produce a quality product from. Gaining consents for food waste processing facilities can be a significant barrier	There are clear regional gaps in processing capacity, most notably lower South Island, upper South Island, West Coast of the South Island, and North of Auckland. In these areas there are limited processing facilities for organic wastes including putrescible wastes from household, commercial primary processing sources, and agricultural sources (e.g. skins, fish farm waste, fallen fruit, grape marc). There are also Forestry residues, wood processing	With a few exceptions, feedstock does not move far from its point of generation.

Infrastructure Type	National Capacity	Regional Capacity	Transport & Logistics
	Limited data supply and quality.	wastes in key regions (Otago-Southland, Hawkes Bay, Gisborne, Northland) Other common gaps include WTTP biosolids, and processing waste such as DAF sludges, and liquid food processing wastes	
Markets - Household, Landscaping and Rural	Household and landscaping markets are relatively mature and stable, but primary sector markets are seen as a potential growth area. Farming practices have been slow to change. There is a need for education around the role of compost products, and a need for standards to generate greater consumer confidence. Increased demand for compost products will be essential to drive further diversion from disposal	The regional gaps in markets mirror the gaps in processing capacity with lower South Island, West Coast, and Northland regions of lower demand	Bagged composts may be sold nationally but bulk supply is more likely to be met regionally.

3.10 Summary of Value Chain Analysis

Following the gap analysis, a value chain analysis was also conducted. Where the gap analysis focused on infrastructure gaps, the value chain analysis aimed to identify the key parts of the value chain, from consumption through to recovered material markets, where this is opportunity to reduce cost/increase efficiency and add value. The key steps in the value chain for organic waste are input (generation, collection and transport), transformation (pre-treatment, technological process, post-treatment) and output (distribution and utilisation).

3.10.1 Factors Highlighted by the Value Chain Analysis

- Opportunities to reduce costs/increase value exist across the whole organics value chain.
- The largest opportunities identified are in establishing processing capacity for putrescible materials, and in stimulating markets to increase demand for soil amendment products and increasing the value they can command on the market.

- Higher levels of source separation and reducing contamination in collection would preserve the value of materials in the value chain and enable greater value to be realised.
- Supporting actions, tend to target the beginning and end of the value chain, notably collection, but in particular markets. The supporting actions are predominantly about changing the demand side of the equation – i.e., what products and quantities are in the system and addressing the demand drivers for pulling through reclaimed material into valued product.
- There are also a number of supporting actions identified in the bulking and manufacture stages including undertaking regional organic waste studies to identify opportunities in low performing regions, establishing regional waste infrastructure agencies/roles to enable regional procurement/development of facilities, and standardising consenting processes to reduce cost and risk associated with establishment of organic waste processing facilities.
- Infrastructure actions for organics are heavily focused on the processing/manufacturing activities, with some also noted around collections.
- The analysis also identified a number of potential initiatives that were not previously articulated. Specifically:
  - Invest in shredding processes that can accept fibrous material
  - Promoting resource efficiency in industrial processes.

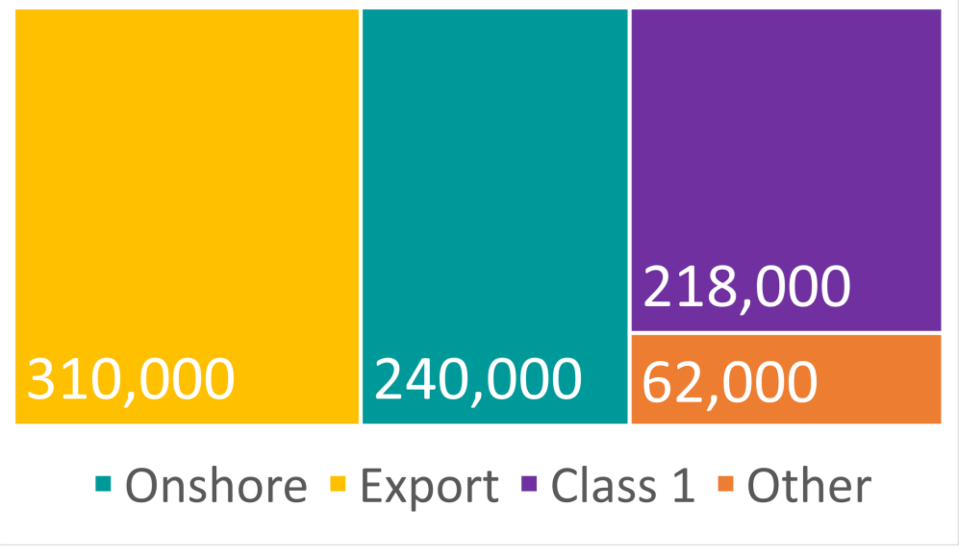
4.0 Fibre Material Stream Analysis

4.1 Description of Fibre Material Stream

'Fibre', for the purposes of this project, is defined as paper and cardboard made from virgin timber pulp or re-processed recovered fibre. In New Zealand, recovered fibre includes old corrugated cardboard (OCC); mixed paper (newspapers, magazines, office paper, liquid paperboard e.g. Tetra Pak® aseptic packaging and gable-top milk cartons); offcuts/pre-consumer; and newspaper (sometimes sorted separately to other mixed paper, and often noted as 'old newsprint' - ONP).[9,10]

4.2 Materials & Quantities

Figure 5: Total Tonnes Fibre Recovery and Disposal



Of the 830,000 tonnes of waste fibre that is collected annually in New Zealand, 550,000 tonnes or 68% is recovered and reprocessed, with the other 32% being disposed of to landfill. Of this recovered material, 240,000 tonnes, or 43%, is reprocessed domestically. The remaining 310,000 tonnes is exported to various international reprocessing markets.

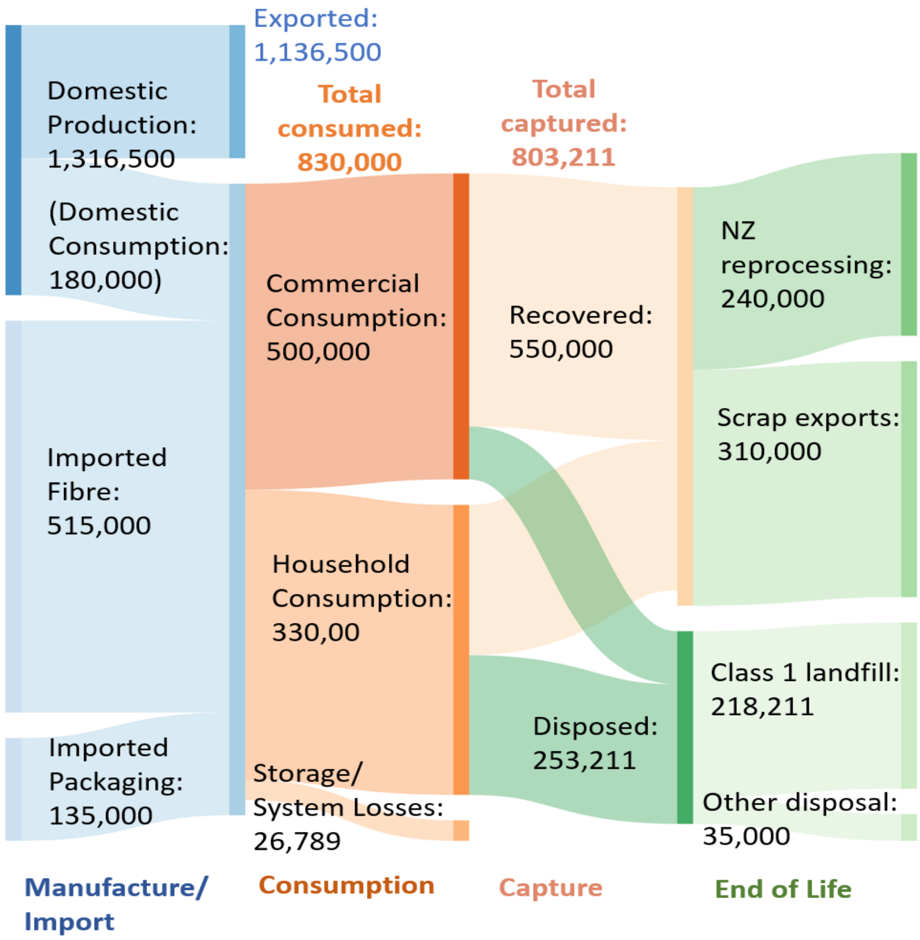
Figure 6 summarises the flows of fibre material in New Zealand.

---

[9] Note that these are not necessarily the categories or grades used elsewhere – there is significant variation internationally.

[10] Tetra Pak® and other liquid paperboard containers have been included with fibre for the purposes of this project, although we note that they are a multi-material packaging product (alongside plastic and metal)

Figure 6: New Zealand Fibre Material Flows Overview



As depicted in the Sankey diagram above Figure 6, the data demonstrates that 800,000 tonnes of fibre waste are captured annually. Approximately 60% coming from commercial consumption and the remainder from post-consumer sources. Of the waste material captured around two thirds is recovered, with the remaining third going to some type of land-based disposal or burnt. Of the 550,000 tonnes that is captured and recovered, 240,000 is reprocessed within New Zealand and the remainder exported to various markets (mostly south-east Asian). A large (but unquantified) proportion of the captured fibre reprocessed domestically is old corrugated cardboard.

The majority of the data relating to captured and reprocessed/exported fibre are robust and reliable. The data points with most uncertainty include the quantities to 'other disposal' i.e., class 2-5 landfills, 'farm fills' and burning – this data is based on sparse data and estimates.

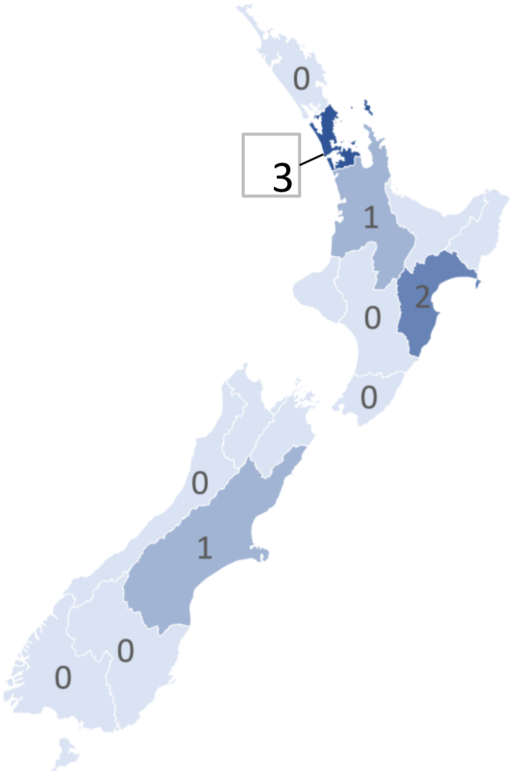
The key characteristics of fibre infrastructure in New Zealand are:

1. The majority of recovered fibre reprocessed within New Zealand passes through one facility, located in Auckland.

2. There is little additional capacity available for domestic reprocessing, although there are several projects underway to expand or offer new options for reprocessing in the order of 5 – 10,000 additional tonnes per annum.
3. A large quantity of recovered fibre is currently exported for reprocessing.
4. Roughly a third of collected fibre goes to some form of disposal.

4.3 Regional Distribution

Figure 7: Number of Fibre Manufacturing Facilities by Region



4.4 Stakeholder Mapping

The stakeholder map in Table 3 includes only those stakeholders that actually reprocess separated fibre material in New Zealand.

Material recovery facilities (MRFs) are an important part of the fibre recovery process, taking material from kerbside collections and sorting it into separate material streams. However, this section focuses on the operators that take the sorted fibre material streams and reprocess the materials into a new product. MRFs are covered separately in section 13.0.

Table 3: Stakeholder Mapping

Operator	Feedstock	Facility Sub Type	Region
OJI	OCC; mixed paper	Paper	Auckland
Hawk Group	OCC; mixed paper	Paper	Hawkes Bay
Huhtamaki	ONP	Paper	Auckland
Opal (Nippon Paper Group)	mixed paper	Paper	Auckland

4.5 Key Drivers

There are four main factors that affect the dynamics of activity in the waste fibre recovery sector:

- **International changes in the value of recovered fibre.** Due to recent changes, such as China's Green Fence and National Sword policies and other global market trends (largely as a result of China's policies), the value of recovered fibre on international markets had decreased significantly over the last five years, although this effect has been partially reversed in the short term due to COVID-19 impacts (as a result of changing supply vs demand). Ensuring continued access to international markets will require ongoing effort towards maximising the quality of the fibre offered to the market from New Zealand
- **Fibre re-processing infrastructure is costly.** Compared to the infrastructure required to re-process other recovered materials such as plastic, fibre infrastructure is expensive, and the introduction of new capacity requires a longer lead-in time. While, globally, fibre re-processing infrastructure is well on the way to replacing the capacity lost when China restricted imports of recovered fibre; there has been little development in domestic re-processing infrastructure. The private sector has generally concluded in the past that additional domestic re-processing infrastructure is not a financially viable option without some government intervention[11]. This was one of the options identified for further

[11] Personal communication with many industry contacts

investigation in the resource recovery sector situational analysis and options carried out by Eunomia and MRA in 2019.[12][13] However, it was also highlighted at the time that low landfill costs and high infrastructure costs were barriers to implementing this option.

- **A high proportion of exported fibre is mixed paper from fully comingled collections.** The largest domestic re-processor pursues OCC as its preferred feedstock. Although other smaller re-processors accept mixed paper, they do not accept mixed paper from a fully comingled collection. This currently leaves the recovered fibre from the Auckland and Canterbury fully comingled household kerbside collections with export as the only option. While currently the market supply and demand is favourable for sellers of recovered fibre, it is not known how long this situation will last. Mixed paper is the least preferred feedstock, with mixed paper from a fully comingled collection the least preferred sub-category. While recent investment into MRF infrastructure[14] has been significant in an attempt to improve the sorting of materials, as discussed in section 13.0, it remains to be seen whether this will be sufficient to meet increasingly stringent export market contamination limits.
- **Domestic demand for re-processed fibre products.** This is a limiting factor for the three smaller domestic re-processors. OJI produces a material that is exported and incorporated into products in other markets (largely Australia). The three smaller re-processors produce a finished product, and if this product cannot be sold into the domestic market, then it needs to be competitive on the export market. Due to economic factors such as relatively high employment and environmental compliance rates, this can be challenging.

4.6 Gap Analysis – Fibre

A gap analysis exercise was conducted to identify the national, regional and transportation gaps, across the material lifecycle. The results are shown in the table below.

Key:

The gap is analysis is presented using a 'traffic light' grading system as shown below.

No significant gaps/issues	Some/potential gaps/issues	Significant gaps/issues

[12] Eunomia (2019) "National Resource Recovery Project: Situational Analysis Report" redacted version available at www.mfe.govt.nz/publications/waste
[13] MRA Consulting Group (2019) "Proposals for Short to Medium Term Responses to National Sword" redacted version available at www.mfe.govt.nz/publications/waste
[14] As detailed here: https://www.stuff.co.nz/environment/climate-news/122139078/government-invests-124-million-in-recycling-infrastructure-to-reduce-waste

Table 4: National, Regional and Transportation Gaps Identified within the Fibre Material Stream

Infrastructure Type	National Capacity	Regional Capacity	Transport & Logistics
Domestic Reprocessing – general	Capacity for less than half of recovered fibre (and only 69% of consumed fibre currently recovered)	Auckland region is well served; also small facility in Hawkes' Bay	Fibre cannot easily be stored, so must be transported for reprocessing or export soon after collection or bulking. This is a particular issue for fibre sourced in the South Island.
Domestic Reprocessing – end markets	There are limited markets within New Zealand for products that can be manufactured from waste fibre	This is a national gap	Indirect impacts as increased export is required
Domestic Reprocessing – mixed paper	Domestic reprocessing capacity targets high quality fibre (generally non-domestic cardboard); any mixed paper taken is only from glass-out collections	Auckland and Canterbury, as the regions with most of the comingled collections, are particularly affected by this	Shipping costs are a key factor in choosing export markets and is one of the main reasons why most exported fibre currently goes to south-east Asia.
Packaging	Lack of consistent, clear, information for brand owners, marketing and packaging advisors, importers, and packaging manufacturers	This is a national gap	May result in better capture of fibre waste, requiring additional collection, bulking, and transport
Collections	Fibre from fully comingled collections is least preferable on export markets and is not able to be reprocessed domestically	Auckland and Canterbury have a particularly high proportion of fully comingled collections	Indirect impact on logistics as additional reprocessing options may become available. Key goal is maximising access to export markets for mixed paper.
MRF sorting quality	Covered in MRFs section		

Capture of fibre waste	Nationally, less than 70% of recyclable fibre waste is captured	Available data does not make it possible to identify regional variation	As per collections

4.7 Summary of Value Chain Analysis

Following the gap analysis, a value chain analysis was also conducted. Where the gap analysis focused on infrastructure gaps, the value chain analysis aimed to identify the key parts of the value chain, from consumption through to recovered material markets, where this is opportunity to reduce cost/increase efficiency and add value. The key steps in the value chain for fibre are manufacture and import; consumption; capture (collection, MRF and transfer); and end-of life.

4.7.1 Factors Highlighted by the Value Chain Analysis

- The key issues with recovered fibre are before it becomes a waste stream, and in the household kerbside collection phase.
- Many of the opportunities fall into two camps – new domestic reprocessing, and those options that seek to increase the quality of recovered fibre to a point where access to export markets are protected.
- Opportunities to manage end-of-life fibre products are limited, given that these generally reach landfill as part of a general household residual waste collection and therefore will be very difficult to capture for alternative processing.
- Supporting actions tend to focus on increasing the quality of the captured fibre stream through reducing multi-material fibre packaging and making it easier for consumers to identify recyclable fibre products.

5.0 Glass Material Stream Analysis

5.1 Description of Glass Material Stream

In terms of resource recovery, glass divides approximately into two types – bottle and jar glass and window glass.

5.2 Materials & Quantities

The best currently available estimates indicate that in 2019 in 278,613 tonnes of bottle and jar glass was placed on the New Zealand market.[15] Available estimates suggest that, of the total glass consumed, approximately 170,000 tonnes is collected for recycling, and of these some 120,000 tonnes is returned to Visy Glass for remanufacture into glass bottles. Some 24,000 tonnes go to aggregate, 25,000 goes to 'other' uses (stockpiling, system losses, filter media, sand etc.)[16]

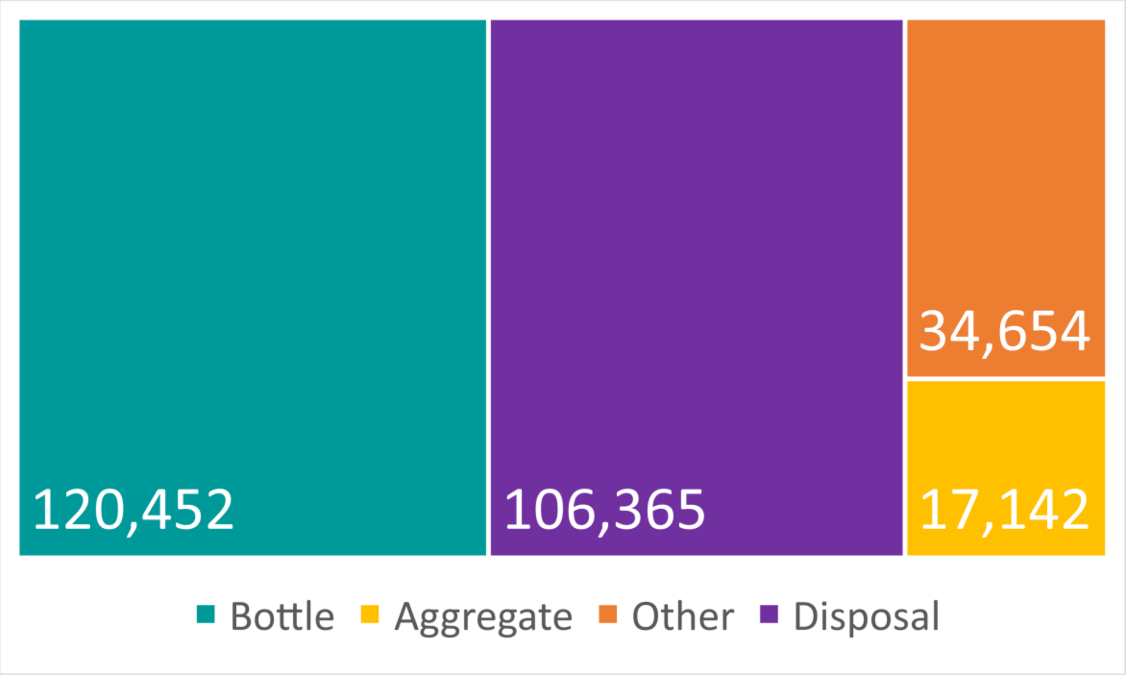
About 35,000 tonnes of flat glass is collected annually with a growing quantity being collected. About 7,500 to 9,000 tonnes of this is used in glass wool insulation and a further 15,000 to 17,000 tonnes is used by Visy Glass in the bottle making process. The remainder is exported as filter media or feedstock for insulation or other products.

The chart below presents estimates of the total tonnes of glass recovered and disposed of:

[15] Data from the CRS process shows total glass figures of 278,613 for 2019. This was made up of 250,113 tonnes of beverage container glass and a further estimated 28,500 tonnes of non-container glass. Source: MfE. It should be noted that this figure is disputed by the Glass Packaging Forum who arrived at an estimate of 256,923 tonnes of glass to market in 2019-20. (GLASS PACKAGING FORUM Product Stewardship Scheme Accreditation Report 2019-2020). Eunomia notes that using the higher CRS figure results in a higher quantity of material that is unaccounted for and is less aligned with available landfill composition data.

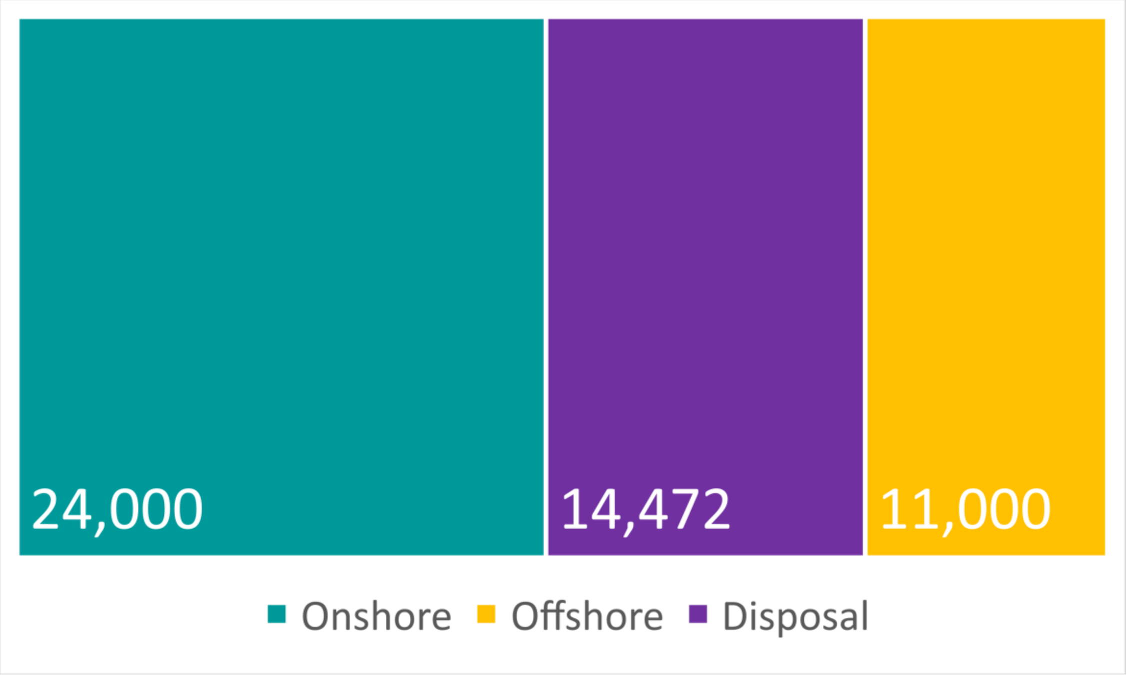
[16] Data is sourced from the Glass Packaging Forum (GPF) - a voluntary product stewardship organisation for the glass packaging sector (GLASS PACKAGING FORUM Product Stewardship Scheme Accreditation Report 2018-2019). They undertake estimates of mass flows and recovery rates annually. The 2019 figures were used to better align with the CRS data. The 2019-20 figure calculated by the GPF was 193,259 collected of which 120,452 tonnes went to bottle, 17,142 to aggregate, 19,323 to 'council use', 21,012 to landfill and 15,331 was 'loss in the glass supply network'.

Figure 8: Total Tonnes Glass Recovery and Disposal (Bottle)



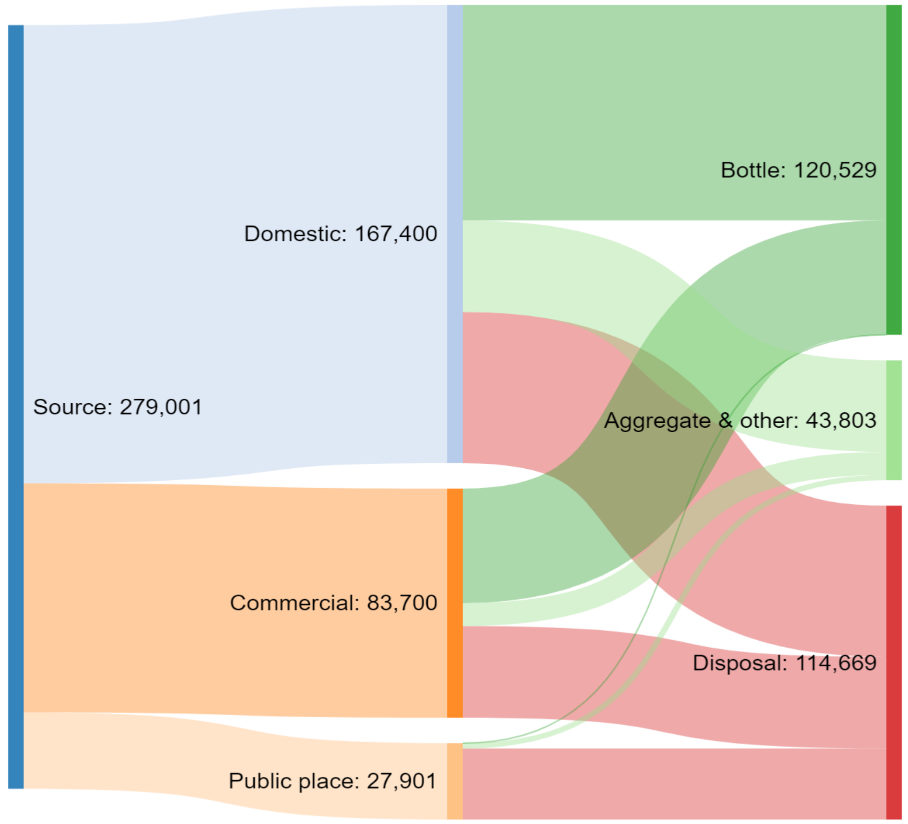
'Stockpiling and other' includes stockpiled material and 'losses in the system'. The figure for disposal is based on the remainder from the total quantity placed on the market, minus tonnages otherwise accounted for and includes litter and other unregulated disposal.

Figure 9: Total Tonnes Glass Recovery and Disposal (Flat Glass)



The disposal figure is uncertain. A figure for total glass to disposal was derived from composition data from Eunomia 2020[17], and tonnages for different fill types from MfE 2019[18]. The total estimate for bottle glass (above) was then subtracted from this figure to derive the total disposal figure for flat glass.

Figure 10: Sankey Diagram of Glass Bottle Material Flows



The data in Figure 10 indicates there is in the order of 280,000 tonnes of bottle glass enters the market in NZ annually with about 60% of this coming from domestic sources, a further third from the commercial sector and the remainder from public places. Of the waste glass generated over half is recovered, with approximately a quarter estimated to go to bottle glass and 15% going to aggregate or other value add process.

5.3 Facility Types

There is one glass bottle manufacturing facility in NZ (Visy Glass in Penrose, Auckland), and one facility that manufactures glass wool insulation (Tasman Insulation in Auckland).

[17] Eunomia (2020) *Improvements to Estimates of Greenhouse Gas Emissions from Landfills*. Report to the Ministry for the Environment. An industry stakeholder suggests the above estimate of flat glass to landfill is likely to be overstated in their experience.
[18] Ministry for the Environment. 2019. *Reducing waste: a more effective landfill levy – consultation document.* Wellington: Ministry for the Environment.

Other facilities include a bottle glass beneficiation plant[19] (Visy Glass in Onehunga, Auckland), and 10 regional hubs (5 operational and 5 commissioned) for bulking flat glass and bottle glass (operated by 5R), with glass crushing and re-processing taking place at the 5R Auckland and Christchurch facilities.

5.4 Regional Distribution

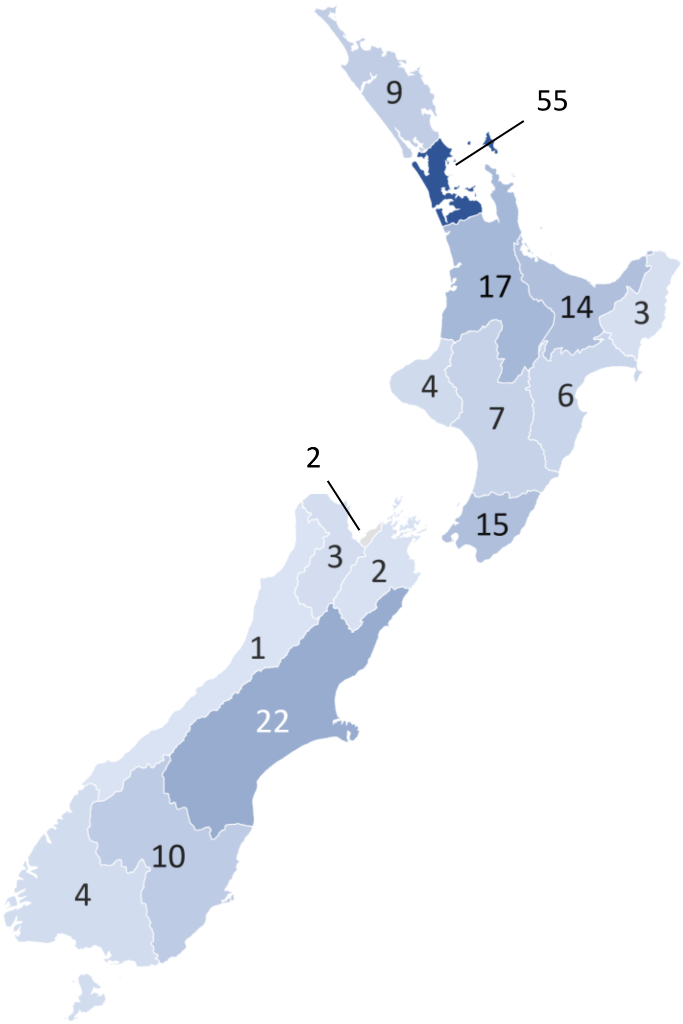
Bottle glass is recovered in all regions of NZ with the largest quantities coming from Auckland, Canterbury, Waikato and Wellington. The quantities are illustrated in Figure 11.

Flat glass current is predominantly recovered in Auckland and Christchurch with smaller amounts also coming aggregated in Bay of Plenty, Wellington, Hamilton, Palmerston North and Nelson.

There are substantial movements of material across boundaries, with the principal flows being to the bottle and flat glass re-processing facilities in Auckland. The majority of bottle glass that is collected in the South Island is stockpiled or use as aggregate, however bottle glass from Dunedin, Queenstown and Wanaka, Nelson, Tasman, Selwyn, Waimakariri, South Canterbury, South Westland, commercial Canterbury and Marlborough is transported to Auckland for recovery.

[19] Beneficiation is a process to remove contamination before the glass cullet is used in the furnace.

Figure 11: Bottle Glass Quantities Collected by Region (x1,000 tonnes)



5.5 Market Segments and Dynamics

5.5.1 Bottle Glass

The dynamics of recycling of glass in New Zealand is closely associated with the dynamics of the bottle glass industry. In New Zealand there is a single glass bottle manufacturing facility located in Penrose, Auckland. The fortunes of this particular facility therefore will have substantial impact on the recycling of glass overall. Key factors include the following:

- The local Visy Glass plant competes with imported glass. They are estimated to have a bit over half of the market share.
- While a portion of glass imported and manufactured here is exported (primarily as bottle wine), there is more glass on the market in NZ than Visy Glass could utilise.

- The proportions of colours Visy receives back from recycling do not necessarily match their need for those colours.
- The supply chain for getting bottle glass to Visy Glass does not have much resilience, and it is difficult for them to manage flows of materials, particularly during peak times. Improving the resilience of the supply chain is a key focus for Visy Glass and the Glass Packaging Forum.

5.5.2 Flat Glass

While flat glass has historically had some limited recycling (utilised by Tasman Insulation to manufacture Pink Batts), the recovery of flat glass has increased substantially in recent years due primarily to the efforts of 5R. 5R have developed their business by securing local and international markets for the material they collect and process, as well as working with glaziers, glass factories etc. to secure supply. They estimate that they are collecting and recycling 90% of the available flat glass and, of the material they collect, 90% is recovered. The market is currently viable without the use of public money or local authority infrastructure.

5.6 Future Opportunities

As noted above, the key infrastructure issues for bottle glass are to manage glass flows while ensuring the continued viability of local glass bottle production, and to develop viable, valuable end use markets for the glass that cannot be processed back into bottles. The flat glass sector is close to reaching a stable market situation once current expansion plans are completed.

Key potential future options noted in the stocktake included:

- Reducing glass consumption (for example through increased use of refillables)
- Increased storage at the beneficiation plan
- Increased the capacity of beneficiation plan
- Increased storage capacity in the regions
- Shipping excess glass to Australia or Asia
- Increasing local production capacity (subject to market demand)

5.7 Gap Analysis – Bottle and Flat Glass

A gap analysis exercise was conducted to identify the national, regional and transportation gaps, across the material lifecycle. The results are shown in the table below.

Key:

The gap is analysis is presented using a 'traffic light' grading system as shown below.

No significant gaps/issues	Some/potential gaps/issues	Significant gaps/issues

Table 5: National, Regional and Transportation Gaps Identified within the Glass Material Stream

Infrastructure Type – Bottle Glass	National Capacity	Regional Capacity	Transport & Logistics
Household Collections	Most TAs have kerbside collection and/or drop off for bottle glass. Quantity of bottle glass collected roughly matches demand Overall capture rate for bottle glass is estimated at around 67%, with about 50% back to bottle	The quality of material is an issue in co-mingled systems. Auckland, Christchurch, Timaru, and Southland are the key examples, and the quantities of glass going back to bottle is limited in these areas.	Uneconomic to transport from the South Island to Visy Glass There is a lack of spare capacity in the bulking systems to cope with fluctuations in supply and demand for cullet. Data quality and supply issues
Commercial Collections	Commercial collections are limited with much of the glass to landfill from this source Overall capture rate for bottle glass is estimated at around 67%, with about 50% back to bottle	Because commercial collections are usually on a user-pays basis they are mostly restricted to the upper North Island, where transport costs are lower, and the service can compete with disposal options.	Uneconomic to transport from the South Island to Visy Glass There is a lack of spare capacity in the bulking systems to cope with fluctuations in supply and demand for cullet. Data quality and supply issues
Rural Collections	There are very limited rural recycling services. However, the quantities of bottle glass from rural sources is relatively low	Rural collection systems are only in place in some trial areas.	The relatively small quantities from rural sources and the distances involved create logistical problems Data quality and supply issues
Sorting	N/A	Localised bulking and regional MRFs consolidate material	Location of sorting facilities important to balance economies of scale and transport costs
Beneficiation	The Visy beneficiation plant in Onehunga, Auckland, has some issues around peak capacity, and the site is not owned by Visy.	N/A	Location of the beneficiation plant in Auckland results in cost transport issues to get material from around the country

Infrastructure Type – Bottle Glass	National Capacity	Regional Capacity	Transport & Logistics
Manufacture	The quantities of glass collected currently roughly balance with the demand for glass, but this could be disrupted by a number of factors.	Glass is crushed for use as aggregate where it is not economic for recycling by Visy Glass. This is notably the case in Christchurch. Some applications (e.g. filter media) may be high value. There are gaps in access to viable processing outlets in parts of the country, notably the lower South Island,	There is a lack of spare capacity in the bulking systems to cope with fluctuations in supply and demand for cullet Visy Glass has historically assisted some councils in transport arrangements to reduce cost
Commercial Collections	Operators active in the sector estimate they are (or soon will be) capturing 90% of the available flat glass. Collection is through arrangements with glaziers, glass factories etc.	Collection arrangements are strongest in the main centres, but the roll out of bulking centres in key locations is expected to improve coverage	Logistics have centred around development of regional bulking sites. There appears to be sufficient value in the product to cover transport and bulking costs
Sorting	Any sorting occurs at re-processing sites		
Beneficiation	There are sites in Auckland and Christchurch that process material and have sufficient capacity for anticipated demand.	The NI and SI processing, allied to a network of regional consolidation hubs appears to address any gaps	The network of regional consolidation hubs improves logistics
Manufacture	About 70% of reclaimed flat glass is re-manufactured in NZ (8k tonnes into insulation, 16k tonnes to bottle glass). The remainder is exported	All re-manufacture takes place in Auckland	The stakeholders did not note transport to Auckland for manufacture as an issue

5.8 Summary of Value Chain Analysis

Following the gap analysis, a value chain analysis was also conducted. Where the gap analysis focused on infrastructure gaps, the value chain analysis aimed to identify the key parts of the value chain, from consumption through to recovered material markets, where this is opportunity to reduce cost/increase efficiency and add value. The key steps in the value chain for glass are manufacture and import; consumption; capture (collection, MRF and transfer); re-use and end-of life.

5.8.1 Factors Highlighted by the Value Chain Analysis

- Opportunities to reduce costs/increase value exist across the whole glass value chain.
- The largest opportunities identified are in establishing re-use collection fleets and wash plants, and in improving beneficiation capacity and capability.
- There are also however, likely to be cumulative advantages to improving the logistics of glass collection – from higher levels of source separation and reducing contamination in collection through to increasing local and regional bulking capacity and bulk transport.
- Supporting actions tend to target the beginning and end of the value chain (consumption, collection, and markets). The supporting actions are predominantly about changing the demand side of the equation – i.e. what products and quantities are in the system and addressing the demand drivers for pulling through reclaimed material into valued product.
- Infrastructure actions tend to target the middle 'reverse logistics' part of the value chain – i.e. improving the technology, capacity and efficiency of sorting, bulking, processing and transporting materials.
- Initiatives identified through this analysis include the provision of bottle banks at convenient locations (e.g. reverse vending machines at supermarkets), upgrade optical sorters at MRFs, and market development.

6.0 Metal Material Stream Analysis

6.1 Description of Metal Material Stream

The waste metal material stream in New Zealand is made up of a range of different metal items and components that are recovered from both the domestic and commercial sectors. Recovered material is captured through a wide range of pathways as a result and may be re-processed domestically or (more commonly) sold into global export markets.

A small quantity of recovered ferrous metal (iron and steel) is reprocessed within New Zealand, mostly within manufacturing facilities. Most non-ferrous metals (aluminium, copper, lead, alloys, and other less common metals) are exported, but there are still several non-ferrous foundries operating within New Zealand. Within the larger categories of ferrous and non-ferrous metals, there are a number of sub-categories or grades which are based on a mixture of metal type, size, and use.

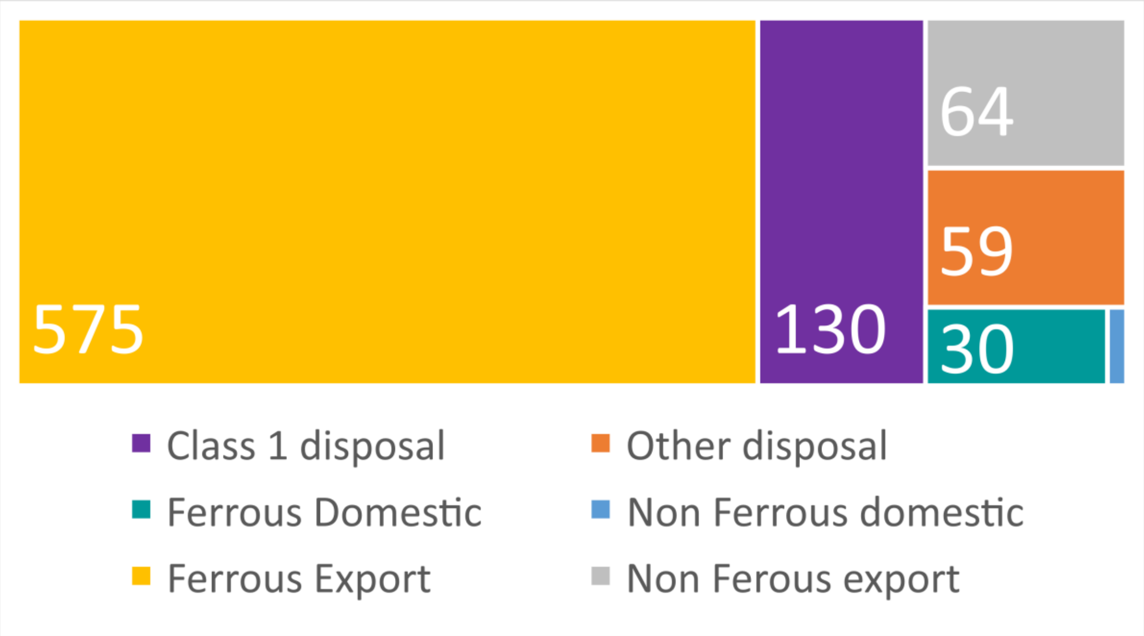
The global recovered metals market generally fluctuates in terms of quantities and commodity prices. The markets are largely driven by supply and demand, and the impact of lockdown due to COVID-19 felt since early 2020 has added variability to these factors, with operators in the metals sector noting increased shipping costs in contrast to other waste operators, that have reported reduced costs. This may be due to the differences in geographical locations material is being shipping to. The general volatility of the shipping industry currently is a factor noted across the board.

Analysis shows that demand for recovered metal streams has recovered while supply has been affected, and some raw materials are becoming more expensive and difficult to extract. This has led to strong market prices for many recovered metals.

6.2 Materials & Quantities

The chart below presents estimates of the total tonnes of metal recovered and disposed of:

Figure 12: Total Tonnes (x1,000) Metal Recovery and Disposal

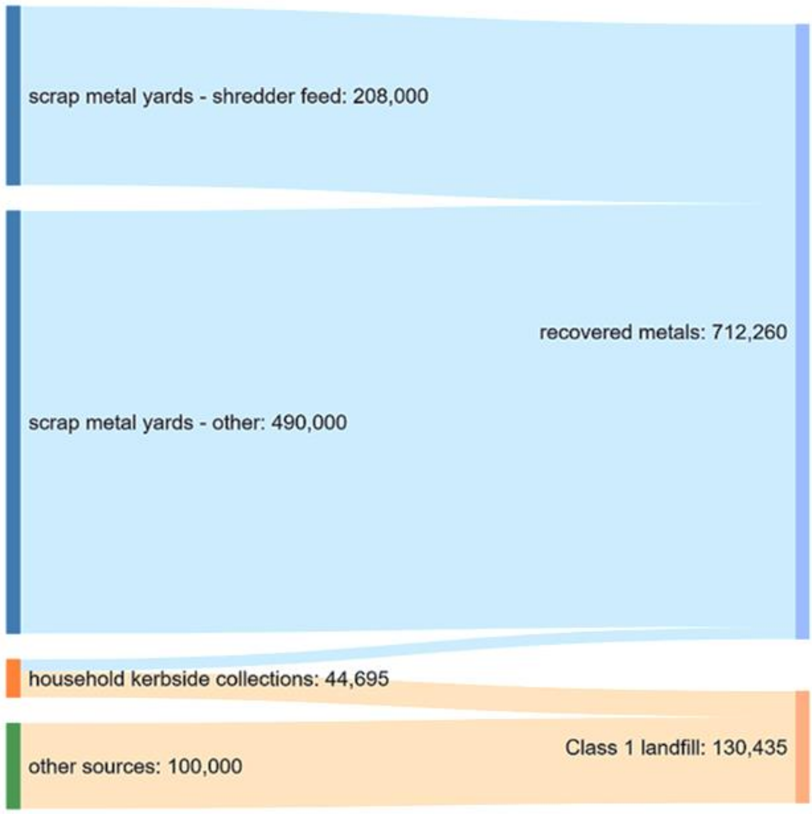


Disposal figures are based on composition data from Eunomia 2020[20], and tonnages for different fill types from MfE 2019[21].

[20] Eunomia (2020) Improvements to Estimates of Greenhouse Gas Emissions from Landfills. Report to the Ministry for the Environment

[21] Ministry for the Environment. 2019. *Reducing waste: a more effective landfill levy – consultation document.* Wellington: Ministry for the Environment.

Figure 13: Sankey Diagram of Metal Material Flows



The data in Figure 13 indicates that just over 860,000 tonnes of metals are captured in NZ annually, with the majority of this being exported for reprocessing. Small quantities of both ferrous and non-ferrous metals are reprocessed within NZ, but these tend to be within production chains (for example, NZ steel feeding offcuts and waste back into the smelting process) or small operations providing material for a variety of bespoke applications.

Export markets for recovered metals are currently strong, although transporting to these markets has been affected by COVID-19-related shipping disruption.

Around 130,000 tonnes are disposed of to landfill each year; although there is little information on what these metal items are, nor what path these are taking to reach landfill.

6.3 Stakeholder Mapping

Stakeholders operating key infrastructure directly relating to recovered metal falls into four main categories:

- Shredder operators; shredders are used to pre-process items that have a component of recoverable metal such as end-of-life vehicles and whiteware;
- Metal processors which use other equipment such as shears, balers, and granulators to prepare recovered metal for export;

- Metal re-processing smelters or foundries; used to process recovered metals of various types into new products for sale;
- Mills, such as NZ Steel which are largely closed-loop systems, only recycling material recovered within their manufacturing process.

Table 6: Stakeholders

Operator and location	Shredder/Re-processor	AMR member	Region
Global Metal Solutions (Hamilton)	Shredder	No	Waikato
Global Metal Solutions (Papakura)	Shredder	No	Auckland
Glucina Alloys (Avondale)	Re-processor – accepts aluminium, copper, and alloys	Yes	Auckland
New Zealand Steel (Glenbrook)	Mill and re-processor (limited) – incorporates manufacturing waste back into process	No	Auckland
Pacific Steel (Otahuhu)	Mill	No	Auckland
National Steel (Manukau)	Shredder	Yes	Auckland
SIMS Metal Management (Otahuhu)	Shredder	Yes	Auckland
Endless Metals (Onehunga)	Shredder	Yes	Auckland
Macauley Metals (Lower Hutt)	Shredder	Yes	Wellington
MetalCo (Te Puke)	Shredder	Yes	Bay of Plenty
Wairarapa Scrap Metals	Shredder	Yes	Wellington
SIMS Metal Management (Christchurch)	Shredder	Yes	Canterbury
MetalCorp (Christchurch)	Shredder	Yes	Canterbury
A W Fraser	Re-processor	Yes	Canterbury
E Hayes & Co	Re-processor	Yes	Auckland

Many stakeholders are members of the New Zealand Association of Metal Recyclers (AMR). The AMR does not consider the material they handle to be a 'waste', and states that its industry operates on a fully commercial basis with no external funding.

6.3.1 Shredders

Shredders, as the name suggests, shred a range of items accepted as 'scrap metal' with the aim of separating the metal components from other materials, and to reduce overall volume. Shredder feedstock, known as 'shredder feed', is mostly post-consumer items such as vehicles, whiteware, end of life machinery, wire, roofing iron that is not suitable for reuse, and manufacturing waste along with a high proportion of other materials.

The outputs from shredders are various types of scrap metal; and waste, known as shredder floc, which is sent to landfill. The price received for the output depends on global market conditions and the material type and can vary considerably. On average, shredder floc usually makes up around 35-40% of shredder feed; however, this proportion can vary considerably for specific items with whiteware reaching as high as 60%[22].

Shredders are expensive items (ranging from $2M to $20M), and to extract best return from this infrastructure operators are likely to operate these even when the return is marginal.

However, there is also a tension between the economies of scale required to sustain a shredder operation, and the need for a geographical spread of shredder facilities to limit transport costs. Transport costs are a key factor in determining the viability of recovering shredder feed. This tension is unlikely to exist to the same extent in many other countries due to their relatively high population densities compared to New Zealand and is likely to be a key factor behind the apparently high number of shredder facilities.

Other key factors in determining the ideal operating level for a shredder are prices achievable for recovered metals in export markets, and the cost of disposing of shredder floc.

6.3.2 Re-processing infrastructure

The most common metal re-processed within New Zealand is steel manufacturing waste, along with small amounts of copper, stainless steel, and aluminium alloys. The majority of the product made at these re-processing facilities is then sold to export markets.

6.3.3 Other relevant infrastructure

Other waste infrastructure categories are relevant to the recovery of metals in New Zealand, particularly MRFs (where much of the kerbside collected material is sorted) and kerbside recycling collections which accept a varying range of waste metal items.

6.4 Analysis of Material Flows

There is little data relating to the total quantity of metal waste that could be recovered in New Zealand.

There is reliable information relating to the amount of material that is recovered from shredder operators, and to how much shredder floc is disposed of. An average proportion of 60% recovered metal to 40% shredder floc can be assumed based on previous industry analysis.

---

[22] Eunomia (2019) "Metals Recycling in NZ", report for the New Zealand Association of Metal Recyclers.

Table 7: Shredder Feed Quantities (Estimated Tonnes per Annum)[23]

	Total Material Available	Re-processed by Metal Recycling Industry	Straight to Landfill
Estimated Total Shredder Feed	**261,000**	**208,000**	**34,100**

The main metal type reprocessed within New Zealand is steel, with two large steel production facilities in the Auckland region incorporating recovered steel in their processes. The quantities used at these facilities varies year on year, and operators advise that the proportion of recycled steel incorporated is largely driven by the quantity of recovered steel available for their use.

Waste composition data for Class 1 landfills shows that there is around 130,000 tonnes of waste metal being sent to these facilities[24]:

Table 8: Metal Waste Disposal to Class 1 Landfills

Material Type	Proportion of waste to Class 1 landfills	Quantity based on 2018 OWLS data
Ferrous metal	2.7%	99,708
Non-ferrous metal	0.8%	30,438

The quantity of waste metal going to Class 2-5 landfills or other forms of disposal is unknown, as there is very little composition data for these facilities.

There are significant cross-boundary movements of shredder feed. The most significant cross-boundary movements are in the lower South Island, where all shredder feed is processed in Christchurch.

There are few plans amongst stakeholders to expand or introduce new infrastructure to the metals sector. There is currently additional capacity at virtually every shredder around New Zealand. Both Pacific Steel and New Zealand Steel report that there is potential to incorporate more recovered steel into their production lines, and that this proportion varies depending on supply rather than any quality limitation or strict proportion.

[23] These figures are based on data provided by the AMR, with 'straight to landfill' figures based on Ministry for the Environment landfill data

[24] Waste Not Consulting (2020) "National Waste Composition Estimate 2020", confidential report prepared for the Ministry for the Environment.

Hayes Metals are currently exploring an initiative which would enable the recovery of steel and aluminium from bottle tops and food-contaminated aluminium foil.

6.4.1 Key Drivers

There are four main factors that affect the dynamics of activity in the metals recovery sector:

- **New Zealand Association of Metal Recyclers:** The AMR represents a large proportion of the commercial entities involved in the metals recovery sector. The AMR has a very specific view of its sector, which is predicated on the principle that the material they handle is not waste. There are various reasons for this, some of which are related to concern about the implications for international rules and conventions such as the Basel Convention.
- **Infrastructure Cost:** Shredders are costly items, and once an operator has a shredder in place, the balance of economics in achieving sufficient return from operating the shredder while also minimising landfills costs for shredder floc is an ongoing operational adjustment. One of the key factors is the prices achievable for recovered metals on export markets. Other key factors are business expenses such as increasing insurance costs as global insurers place increasing restrictions on facilities deemed to be at high risk of fires which applies to shredder operators.
- **Landfill Disposal Costs:** Shredder operators are vulnerable to landfill disposal costs as such a high proportion of shredder feed must later be landfilled; this cost will increase as the land fill levy is increased and expanded. Some operators use internal transport logistics and backfilling loads to access cheaper disposal prices or use landfills that are not classed as municipal landfills and therefore do not (currently) need to charge the landfill levy. The increase in rate and scope of the landfill levy is likely to have an impact on the economics of shredder operations. Previous analysis has suggested that this is likely to result in reduced capture by scrap metal operators of some items including whiteware, end-of-life vehicles, and other 'light gauge' shredder feed. This is likely to be felt more so in isolated and rural areas where transport costs already make this marginal. This may result in more illegal disposal of these items, or the items may be stockpiled or recycled through other pathways such as waste collection companies and RTS[25].
- **Export Market Volatility:** Alongside a reliance on export markets for recovered metal commodities comes exposure to any volatility in these markets. Although this is currently a positive trend, there has been concern in recent years following the impact of China's National Sword policies. There is variation in the extent to

---

[25] Eunomia (2019) "Metals Recycling in New Zealand: Painting the Picture of the Impacts of An Increase in the Waste Levy", report for the AMR

which individual industry stakeholders engage with trade bodies, government departments, and market variation.

In general, there is generous provision of shredders overall across the country, with some issues in the geographical distribution of these.

6.5 Gap Analysis – Metal

A gap analysis exercise was conducted to identify the national, regional and transportation gaps, across the material lifecycle. The results are shown in the table below.

Key:

The gap is analysis is presented using a 'traffic light' grading system as shown below.

No significant gaps/issues	Some/potential gaps/issues	Significant gaps/issues

Table 9: National, Regional and Transportation Gaps Identified within the Metal Material Stream

Infrastructure Type	National Capacity	Regional Capacity	Transport & Logistics
Domestic Collections	Almost all households have access to kerbside collections that accept, at a minimum, aluminium and steel tins and cans. Some accept a wider range of materials such as aerosol cans.	Rural areas may have less access to collections than other households	Rural households may need to transport recyclable metal to a transfer station
Non-domestic collections	Scrap yards will collect from non-domestic customers where quantities are sufficient to make this viable	Non-domestic customers in more isolated areas (e.g. farms) may have more difficulty getting metal collected	More isolated non-domestic customers may need to transport waste metal themselves or stockpile until there is sufficient volume to make collection viable

Infrastructure Type	National Capacity	Regional Capacity	Transport & Logistics
Drop-off Capture	There is a comprehensive network of refuse transfer stations (RTS) and scrap yards across New Zealand, meaning the vast majority of the country has access to drop-off facilities for a wide range of waste metals	Non-urban areas may have longer journey's to reach an RTS or scrap metal yard	Non-urban areas may have longer journey's to reach an RTS or scrap metal yard
Landfilled metals	There are around 100,000 tonnes of ferrous metal going to Class 1 landfill each year and around 30,000 tonnes of non-ferrous metal; and an unknown quantity going to Class 2-5 landfills and other disposal.	This is a national issue.	This issue is unlikely to be related to transport/logistics factors.

6.6 Summary of Value Chain Analysis

Following the gap analysis, a value chain analysis was also conducted. Where the gap analysis focused on infrastructure gaps, the value chain analysis aimed to identify the key parts of the value chain, from consumption through to recovered material markets, where this is opportunity to reduce cost/increase efficiency and add value. The key steps in the value chain for metal are manufacture; consumption; capture; reprocessing (export and local) and end-of life.

6.6.1 Factors Highlighted by the Value Chain Analysis

- The metals sector is a mature one, with a vocal sector group in the Association of Metal Recyclers
- Shredders are expensive items, and once an operator has a shredder in place, the balance of economics in achieving sufficient return from operating the shredder while also minimising landfills costs for shredder floc is an ongoing operational adjustment. Landfill costs and export markets are key factors.
- The impact of increasing landfill costs on the acceptance and processing of shredder feed is likely to be felt in rural and more isolated areas first.
- Alongside a reliance on export markets for recovered metal commodities comes exposure to any volatility in these markets. There is variation in the extent to which

individual industry stakeholders engage with trade bodies, government departments, and market variation.

7.0 Plastic Material Stream Analysis

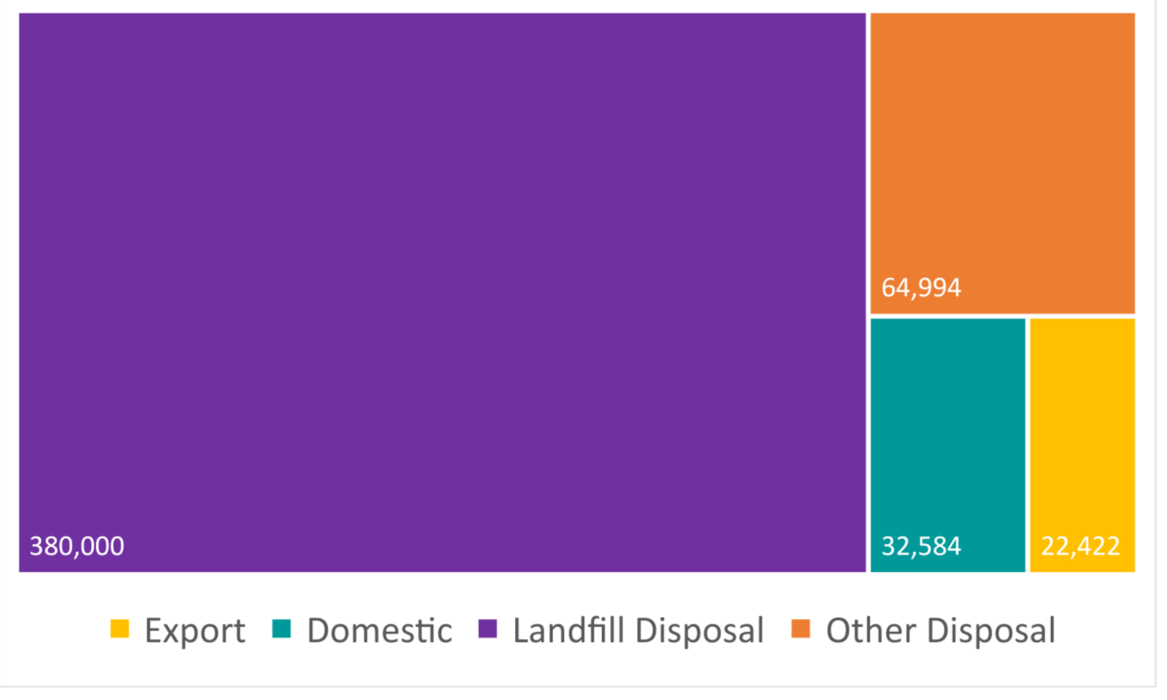
7.1 Description of Plastic Material Stream

The plastic material stream encompasses a range of different polymers used for diverse applications in both the commercial and residential sectors. New Zealand has onshore reprocessing facilities for both post-industrial and post-consumer polymers. These re-processors convert recovered plastic products into recycled plastic resin granules or powder[26], and/or finished products, including consumer food packaging, agricultural products, films, bags, and piping. With a few exceptions, the majority of processors deal with end-of-life plastic packaging – there are gaps around comprehensive and consistent recovery and reprocessing of durable (non-packaging) products that include plastic as the sole, or significant, material component.

7.2 Materials & Quantities

The chart below presents estimates of the total tonnes of plastic recovered and disposed of:

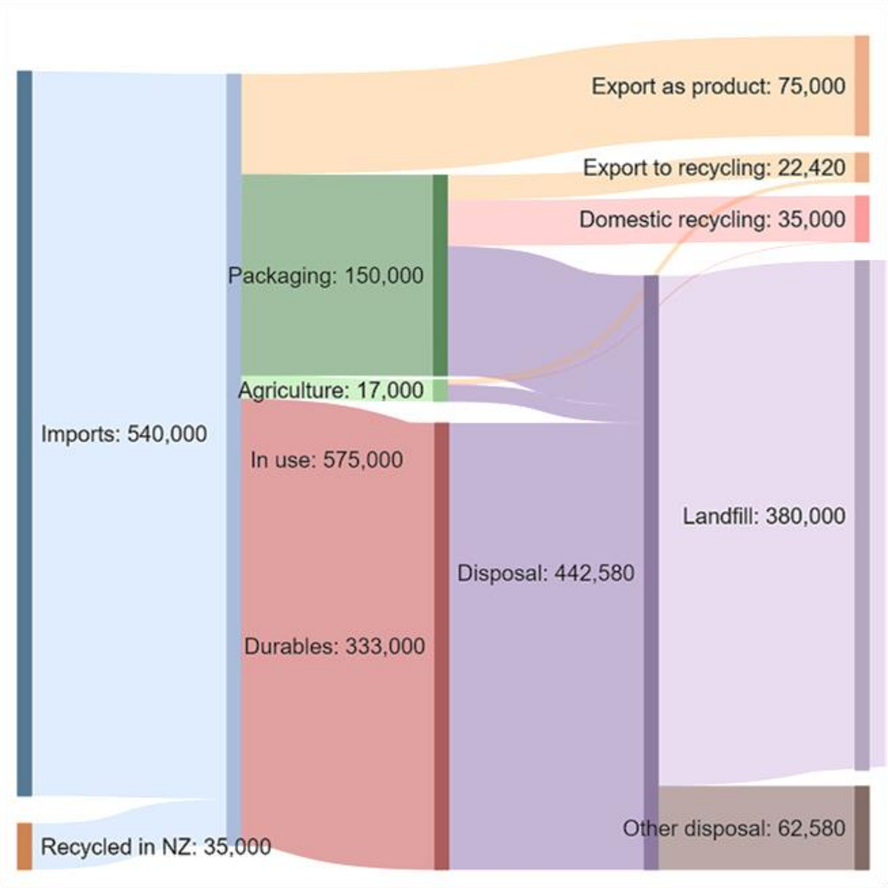
Figure 14: Total Tonnes Plastics Recovery and Disposal



[26] 'Resin' is an industry term, which refers to the raw form of the plastic formulation before it is made into a product. Resin is most commonly in the form of pellets but can take other forms.

The landfill disposal figure is based on the PMCSA report[27], domestic reprocessing is from stocktake data. Export figures were obtained from Statistics NZ Infoshare (data to year ended Dec 2020). 'Other disposal' covers material unaccounted for based on the quantity of material placed on the market and subtracting the export, domestic processing and landfill disposal figures. It includes litter and other unregulated disposal.

Figure 15: Sankey Diagram of Plastic Material Flows



The data in Figure 15 indicates there is in the order of 575,000 tonnes of plastic entering the market in NZ annually in the form of resin, finished product, packaged product or packaging, with 35,000 tonnes of this consisting of material recycled domestically. About 75,000 tonnes of plastic is estimated to be exported in the form of packaging around products, or as product. Of the material consumed, about 150,000 tonnes is estimated to be packaging. At end of life over 55,000 tonnes of material is recycled with (as noted) 35,000 tonnes being recycled onshore, and the remainder exported. Of the approximately 440,000 tonnes of material disposed of, in the order of 380,000 tonnes is estimated to go to Class 1 disposal with the remainder assumed to go to other forms of

[27] https://www.pmcsa.ac.nz/topics/rethinking-plastics/quantifying-aotearoas-plastic/

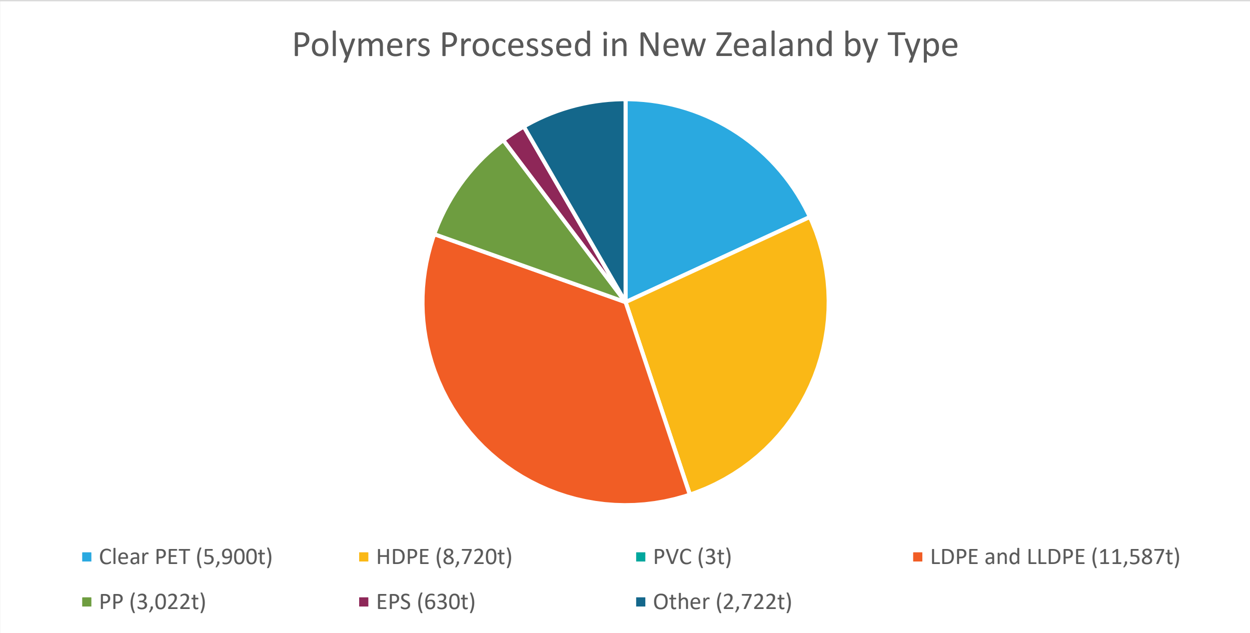
disposal such as Class 2-5 disposal, burning, littering or discharge into the environment, and stockpiling.

7.3 Capacity

Collectively, stakeholders re-process 32,584 tonnes of plastic onshore each year. Re-processing capacity is spread unevenly between polymer types (see Figure 16). The polymers most commonly collected and re-processed in New Zealand are:

- Post-commercial low-density polyethylene (LDPE) and linear low-density polyethylene (LLDPE) (35%)
- Post-commercial and post-consumer high-density polyethylene (HDPE), both natural and pigmented (27%)
- Post-consumer and post-commercial clear polyethylene terephthalate (PET) (18%)
- Post-commercial and post-consumer polypropylene (PP) (9%)
- Post-commercial poly vinyl chloride (PVC) (<1%)
- Post-commercial polystyrene (PS), including expanded PS (EPS) (2%)
- Other post-consumer polymers, including ABS, HIPS (8%)

Figure 16: Polymers Processed in New Zealand by Type



The remainder of New Zealand's waste polymers are either:

- put towards niche applications (such as fence posts or roading aggregate) that can tolerate co-mingled, contaminated or hard-to-recycle polymers without prior conversion to flakes or granules;
- collected and exported as scrap for offshore re-processing;
- landfilled; or
- in use or stockpiled

- lost to the natural environment.

The total flow of plastic in New Zealand, of which onshore plastic reprocessing is just one part, is outlined using best available data in Chapter 5 of *Rethinking Plastics in Aotearoa*.

7.4 Stakeholder and Facility Types

Twenty stakeholders were identified and 19 interviewed. The activities these stakeholders conduct include:[28]

- Re-processing plastic products into recycled resin granules or powder that can then be manufactured into a finished product (75%).
- Manufacturing products from New Zealand recycled resin or putting plastic waste to an end-use (60%).
- Exporting New Zealand recycled resin, partially re-processed recyclate, and/or finished products containing New Zealand recycled resin (45%).

7.5 Regional Distribution

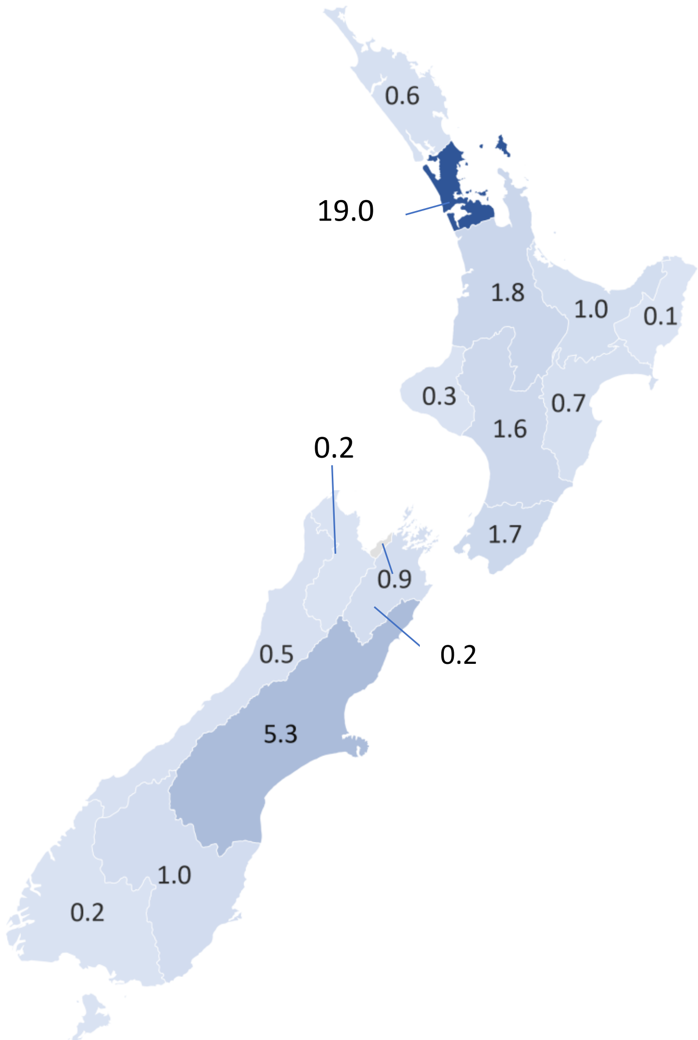
New Zealand's plastic reprocessing facilities are unevenly dispersed across the country. Most are concentrated around Auckland and the Lower North Island. The South Island processors are in Canterbury.

Accordingly, any plastic collected in New Zealand that is destined for onshore recycling will be transported to one of the facilities in Auckland, the Lower North Island or Canterbury. Auckland re-processors are more likely to receive recyclate from Auckland, whereas the Canterbury re-processor receives recyclate from across the South Island, and the Lower North Island re-processors receive material from a wide array of districts. Interviews indicated there may be some logistics challenges transporting scrap plastic between the North and South Islands, and further analysis may be required to fully understand the provenance of these challenges and how best to address them.

Both activity source and geographic source (particularly the island upon which the plastic waste is generated) are reliable indicators of the distance recyclate will travel. Post-commercial plastic recyclate is generally re-processed in the region it is generated, whereas post-consumer plastic recyclate often travels further. No appreciable tonnage moves from the North Island to the South Island for re-processing, but some plastic recyclate travels from the South Island to the North, especially clear PET. However, the shipping cost to cross the Cook Strait can be higher than exporting to offshore re-processors (or landfilling).

[28] Note the percentages do not total 100% because some stakeholders conduct more than one of the listed activities.

Figure 17: Provenance of the Plastic Processed Onshore by Region (x1,000 tonnes)



7.6 Market Segments and Dynamics

Collectively, stakeholders produce roughly 43,000 tonnes per year of recycled resin and/or finished products containing recycled resin. This tonnage exceeds the weight of the plastic recyclate re-processed because finished products generally contain a proportion of virgin content.

The three key market segments for sale of re-processed plastic (based on tonnage) are:

- Domestic market for finished products made of recycled resin or granules (51%).
- Domestic market for recycled resin (29%).

- Export market, predominantly for recycled resin or partially re-processed recyclate (14%).

The key dynamics affecting the market and the economic viability of re-processors (either positively or negatively) are:

- The low price of virgin plastic resin vis-à-vis recycled plastic resin, especially when crude oil prices drop.
- The willingness of manufacturers and brands to use recycled content in their products and/or packaging.
- The low price of imported plastic products made of virgin resin vis-à-vis equivalent products made in New Zealand using recycled content.
- Growing public awareness about sustainability and increased demand for recycling activity, but also negative public attitudes towards plastic.
- The price of scrap recyclate, particularly when competing with offshore buyers.
- Plastic export restrictions, especially unprocessed scrap material.
- The poor quality of recovered plastic material, particularly post-consumer.
- Policy activity in the area of plastic waste and recycling, which would improve market drivers for recycling in the long-term, but which also creates a degree of market uncertainty in the short-term.
- The high capital cost of recycling equipment meaning many recyclers use old, small-scale equipment, resulting in comparatively low productivity and high production costs.

7.7 Future Capacity

During interviews, a number of stakeholders indicated plans to expand their onshore re-processing capacity over the next five years. Together, these planned expansions would see annual onshore re-processing capacity increase by at least 30,000 tonnes over the next five years. This capacity increase would be predominantly for post-consumer clear PET, and post-consumer and post-commercial HDPE (natural and coloured) and PP.

7.8 Key Opportunities to Expand Onshore Re-processing Capacity

Whether a polymer or particular type of plastic product can be effectively re-processed in New Zealand partly relates to onshore re-processing capacity and available equipment and facilities. Stakeholders highlighted a number of infrastructural gaps. Key suggestions are noted below:

- The need for more re-processing plants distributed across the country, including in the South Island. Re-processing plants do not necessarily need to make finished products to be viable, as good offshore markets remain for re-processed recycled resin. Though there was debate amongst stakeholders regarding the relative value of fewer large-scale processors or multiple small-scale processors.

- Equipment to granulise a wider range of polymers, including niche polymers, and infrastructure that can granulise mixed plastic and then sort and separate it into polymer type and colour.
- Pyrolysis plants or collection for chemical/advanced recycling for hard-to-recycle plastics. There was debate amongst stakeholders regarding whether waste-to-energy was commercially viable or philosophically desirable for plastics.
- Improved sorting and washing facilities to guarantee clean, high quality, uncontaminated feedstock.
- Small-scale sorting and densifying equipment for the regions to reduce the logistics issues in bringing materials to the major centres for reprocessing.

However, barriers and opportunities are not always infrastructural. Most re-processors have capacity to take greater tonnages of the polymers they already re-process or could expand into a wider range of polymer types provided that:

- the material arrives in clean, separate streams; and
- a viable market exists for the recycled resin and/or finished product(s).

With this in mind, interviewees also suggested other methods to increase onshore re-processing capacity, and these are collated as follows:

- Improve collection methodologies, particularly for post-consumer plastics or dirty post-industrial plastics, e.g. national kerbside standardisation around best practice with accompanying public education/messaging, and deposit return systems and product stewardship.
- Appropriate sorting and washing technology where collection methodologies cannot be improved.
- Policies to increase the economic viability of recycled resin and recycled plastic products (e.g. minimum recycled content legislation).
- Rationalise the polymers used in certain contexts (e.g. phase-out PVC and PS for food and beverage packaging) and continue to reduce the use of hard-to-recycle polymer products, such as composites.

7.9 Gap Analysis – Plastic

A gap analysis exercise was conducted to identify the national, regional and transportation gaps, across the material lifecycle. The results are shown in the table below.

Key:

The gap is analysis is presented using a 'traffic light' grading system as shown below.

No significant gaps/issues	Some/potential gaps/issues	Significant gaps/issues

Table 10: National, Regional and Transportation Gaps Identified within the Plastics Material Stream

Infrastructure Type	National Capacity	Regional Capacity	Transport & Logistics
Plastic - Household Collection	Low recovery rates, though data is lacking to provide precise detail. Collection methodologies (e.g. commingling) created contaminated and commingled recyclate. Household collection system not suited to picking up soft plastics.	Most TAs provide household kerbside collection of plastic polymers, but increasingly restricted to PET, HDPE and PP. Most regions no longer collecting other polymer types. Voluntary product stewardship/third party drop-off points for plastic products not accepted in kerbside are not convenient and accessible—largely restricted to Auckland and Wellington regions.	Household plastic recyclate will often travel long distances to get to processors. Cost of transport can be high, such as between the North and South Islands. Export markets for scrap plastic (particularly mixed plastic) closing as a result of Basel Amendment and China National Sword policies such as limitations on contamination.
Plastic - Commercial Collection	Low recovery rates, though data is lacking to provide precise detail No consistent service across the country for commercial collections	Collections concentrated around Auckland, Wellington, and Christchurch. Voluntary product stewardship/third party drop-off points for plastic products not accepted in kerbside are not convenient and accessible—largely restricted to Auckland and Wellington regions	Commercial plastics usually processed in the region it is generated, indicating that transport costs are a barrier or disincentive for national commercial collection outside of areas without processors.
Plastic Sorting	Too few washing and sorting facilities, and many of the existing facilities aren't able to deal with contamination from mixed collection methodologies	Lack of densifying equipment at regional aggregation sites.	Lack of spare capacity in the bulking systems to cope with fluctuations in supply and demand.

Infrastructure Type	National Capacity	Regional Capacity	Transport & Logistics
Re-processing into flakes or pellets	Processors often not operating at capacity because of a lack of clean and separated polymer types due to collection methodology.	Major gap in regional processing facilities, particularly in the South Island. Other processing facilities concentrated around the Lower North Island and Auckland.	Lack of processors means plastic recyclate will often travel long distances to get to processors. Cost of transport can be high, such as between the North and South Islands. Export markets for scrap plastic (particularly mixed plastic) closing as a result of Basel Amendment and China National Sword policies such as limitations on contamination.
Manufacture (onshore use of recycled polymers	High cost of recycled plastic resin vis-à-vis virgin plastic resin. Lack of plastic products using New Zealand recycled plastic content. Lack of closed loop circular applications for plastic recyclate (e.g. recycled plastic resin being used for products with the same function, such as bottle-to-bottle). Many plastic products not designed for recyclability (such as composite products).	Major gap in regional processing facilities, particularly in the South Island. Other processing facilities concentrated around the Lower North Island and Auckland.	Recycled resin often used by processors in their own products. However, resin can be easily transported around New Zealand.

7.10 Summary of Value Chain Analysis

Following the gap analysis, a value chain analysis was also conducted. Where the gap analysis focused on infrastructure gaps, the value chain analysis aimed to identify the key parts of the value chain, from consumption through to recovered material markets, where this is opportunity to reduce cost/increase efficiency and add value. The key steps in the value chain for plastic are production (recycling and imported); consumption (commercial and household); collection and sorting; recycling and disposal (end-of life).

7.10.1 Factors Highlighted by the Value Chain Analysis

- Most of the plastic material and value is lost right after consumption. If the material becomes more valuable, it will prevent the vast majority from going to landfills. However, many supporting actions are needed to support and maintain this value and provide circularity.
- Infrastructure options are especially needed for collection and processing.
- By combining collection and local and regional bulking a significant uptick in collections might be achieved with the potential of reduced recovery costs per unit.
- Adding a system of material tracking throughout the lifecycle of the products will provide an opportunity to award plastic credits for proper plastic (waste) management and substitution for reusables. A plastic credit is a transferable 'certificate' representing the collection of a specified weight of plastic waste recovered or recycled that would otherwise have ended up in the environment. For example, combined with accurate measurement, plastic credits can enable businesses to offset their plastic footprint and go 'Plastic Neutral' by eliminating as much plastic waste from the environment as they use.
- An increased material collection would enable redesign into either reusables or like-for-like recycling.
- Supporting actions target the beginning and end of the value chain (consumption, collection, and manufacturing). The supporting activities are predominantly about changing the disposal route of plastics and the manufacturing – i.e. incentivise reuse and recycling, optimise collection and processing.
- Infrastructure actions tend to target the middle 'reverse logistics' part of the value chain – i.e. improving the technology, capacity and efficiency of sorting, bulking, processing and transporting materials.

8.0 Construction and Demolition Material Stream Analysis

8.1 Description of Material Stream

Construction and demolition waste (C&D) includes a wide range of material streams, with the most common waste types being concrete and rubble, timber (treated and untreated), plasterboard and mixed waste. C&D is a waste stream generally defined best by activity source rather than material type.

Construction and demolition waste is usually captured in one of three ways:

- An unsorted waste receptacle at the site, which is subsequently removed and sorted at a specific facility (the most common methodology for smaller construction project, e.g. a single residential home construction) to remove readily divertible material types and reusable material;
- Specific material streams separated at the site; most often cardboard and rubble, transferred for recycling; and
- An unsorted skip/s at the building site, which is subsequently removed and disposed of to landfill without any further sorting or re-processing.

There is no data in New Zealand to suggest the frequency of each method. However, the relatively scarce provision of facilities that enable the sorting and recovery of C&D waste means it is likely that the last option is used most frequently.

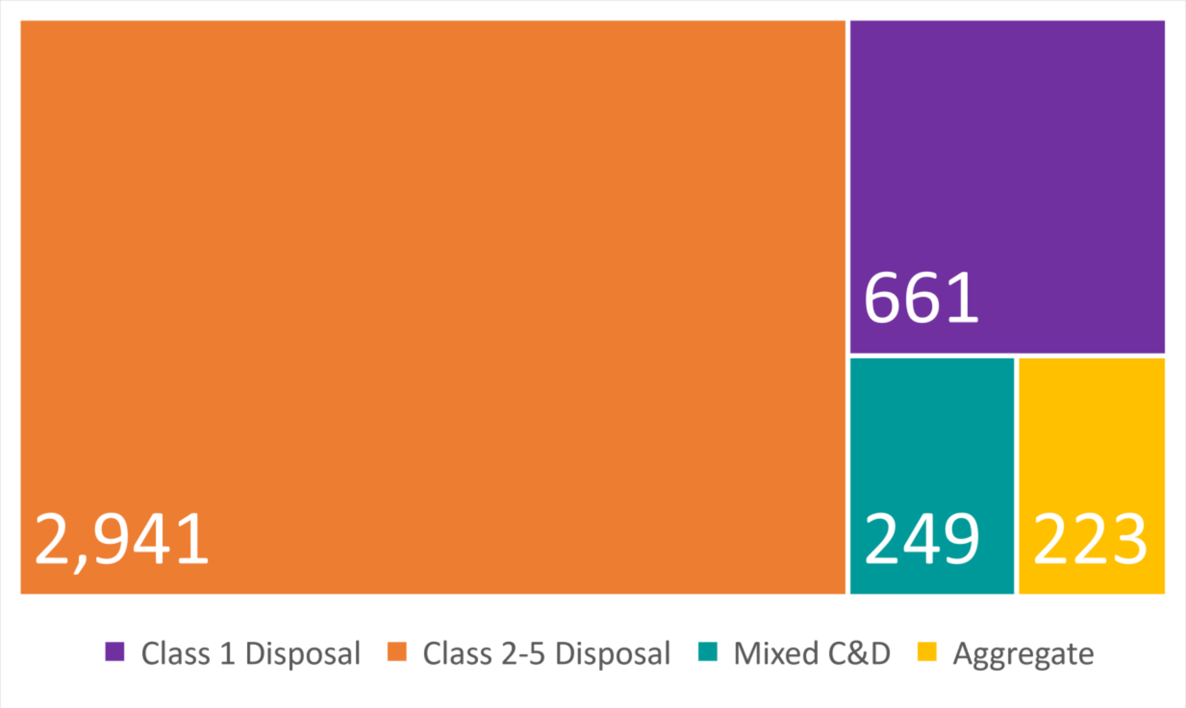
The logistics involved in having source-separation of construction wastes can be reduced in large construction projects, as there is more likely to be space available for multiple containers, and quantities of individual material types make it more likely that separate collection systems will be cost-effective.

Some construction projects also offer greater opportunity for modular and/or off-site construction, such as hotels and apartment buildings.

8.2 Materials and Quantities

The chart below presents estimates of the total tonnes of C&D waste recovered and disposed of:

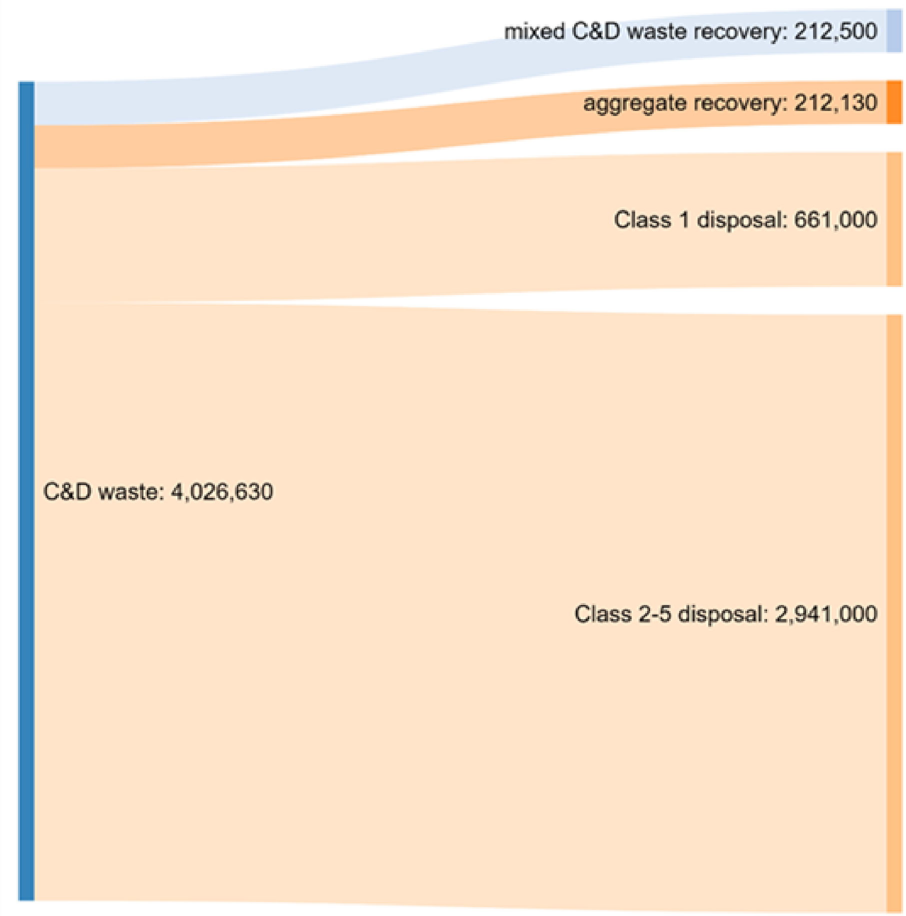
Figure 18: Total Tonnes (x1,000) Construction & Demolition Waste Recovery and Disposal



Disposal figures are from MfE 2019[29], Recovery figures are based on data obtained during the stocktake, but these figures are likely to be incomplete, as data was not obtained from all parties. The quantum of the material recovered but not accounted for may be of a similar order to the aggregate recovery above, however this is highly uncertain, hence it is not represented above.

[29] Ministry for the Environment. 2019. *Reducing waste: a more effective landfill levy – consultation document*. Wellington: Ministry for the Environment.

Figure 19: Sankey Diagram of Estimated Flows of Construction and Demolition Wastes from Generation through to Recovery or Disposal



The data in Figure 19 indicates there is just over 4M tonnes of construction and demolition waste produced annually. However, nearly two thirds of this quantity is assumed to be disposed of to Class 2-5 landfills; and given the poor data relating to these fills, the total quantity and the quantity going to Class 2-5 landfill disposal are rough estimates. Recovery figures are reasonably accurate and have been split between recovered aggregate waste and mixed construction and demolition (C&D) waste as most operations focus on one or the other. In total, 272,000 tonnes is recovered annually, split between aggregate (223,000 tonnes) and mixed C&D waste (249,000 tonnes).

C&D waste is considered to be anything that arises from construction and demolition activities rather than comprising a specific material stream. Common materials include concrete, metal, timber, plasterboard, and packaging such as cardboard and plastic (both rigid and films). While a small proportion of C&D waste may be disposed of through household kerbside recycling collections, the vast majority is collected through commercial skips or specific C&D waste collection services.

Little C&D waste will be exported due to the high cost involved compared to the low cost of disposal to Class 2-5 landfills. A small proportion of recovered metal, fibre and plastic products may be exported once combined with material recovered through other pathways.

There is a strong focus on C&D waste recovery around Auckland and north Waikato, with only a few facilities available elsewhere in the country including Wellington, Christchurch, and Dunedin.

8.3 Stakeholders

Stakeholders have been separated into those that deal with general construction waste, and those that focus on aggregate and bulk demolition waste recovery. There is a significant difference in the equipment required to recover and recycle aggregate, as opposed to mixed construction and demolition waste.[30] For this reason, facilities have been split according to which type of service they offer.

For the purposes of this study 'demolition yards' were not included.

Table 11: Stakeholder Mapping

Stakeholder	Brief Description	Material stream	Region(s)
D&T MacDonald	Concrete and metal recovery and managed fill disposal	Demolition and aggregate	Waikato
Green Gorilla	Construction waste sorting and recovery (alongside other waste services)	Construction waste	Auckland
Green Vision Recycling	Aggregate, asphalt and topsoil recovery; managed fill disposal	Demolition and aggregate	Auckland
Hall Brothers	Aggregate, asphalt, metal and topsoil recovery. Some plasterboard timber and joinery	Demolition and aggregate	Otago
Human Aid Focus	Timber recovery, some scrap metal	Construction waste	Palmerston North

[30] 'Aggregate' consists of concrete, brick, asphalt and other heavy inert materials which are crushed and graded for reuse. Mixed C&D waste includes timber, plasterboard, metals, insulation, plastics, glass etc.

Nash & Rosh	Concrete and metal recovery and managed fill disposal	Demolition and aggregate	Otago
Nikau Group	Aggregate recovery	Demolition and aggregate	Auckland/north Waikato
SimKen Concrete Recycling	Aggregate recovery, cleaning and grading	Demolition and aggregate	Auckland/north Waikato
Ward Demolition	Aggregate recovery	Demolition and aggregate	Auckland
Woods Waste	Construction waste sorting and recovery	Construction waste	Wellington central
Fulton Hogan	Aggregate recovery	Demolition and aggregate	Blenheim
Winstone Wallboards	Construction waste recovery – plasterboard	Construction waste	National
WasteCo	Construction waste sorting and recovery (alongside other waste services)	Construction waste	Christchurch
Waikato Demolition	Construction waste recovery and aggregate processing	Construction, demolition and aggregate waste	Hamilton
Atlas Concrete	Aggregate processing	Demolition and aggregate waste	Auckland

8.4 Regional Distribution

Table 12: Facilities by region

	Construction	Demolition and aggregate	Total
Auckland	1	4	5
Waikato	1	2	2
Horizons	1	0	1

Bay of Plenty	1	0	1
Wellington	1	0	1
Marlborough	0	1	1
Canterbury	1	0	1
Otago	0	2	2
TOTAL	**5**	**8**	**13**

Outside of Auckland, the number of construction and demolition waste facilities is limited.

Some additional data on C&D waste diversion was obtained through interviews with the larger waste companies, particularly ESL and WMNZL. Anecdotally, a number of construction and demolition operators recover waste from their own operations (mainly aggregates and steel), but they do not necessarily publicise this fact. It is likely that there is additional recovery of materials taking place at a smaller scale that was not picked up in our survey.

There is a clear focus for C&D waste recovery around Auckland and the north Waikato. In addition to their main Auckland yard, Nikau Group also have a site in Meremere, Waikato.

8.5 Market Segments and Dynamics

There are quite different dynamics in the C&D waste recovery sector for demolition/aggregate waste, and mixed construction waste. Demolition and aggregate waste operators tend to be very high volume, and outputs are low value per unit but similarly produced in volume. Construction waste operators tend to handle much lower volumes, and the outputs from this sector are more likely to be high quality, high value items such as native timber, joinery and household fittings. It is also common for scrap metal and fibre (paper/cardboard) to be recovered.

An increase in the landfill levy for Class 1 landfills, and the expansion of the landfill levy to Class 2-5 landfills, may make diversion of C&D waste more common as it becomes economically viable. Over 80% of construction companies reported that they expect the costs of waste minimisation and increasing landfill levies to have a negative or neutral impact on their operations over the next three years, while also ‘waste minimisation and recycling' as the top priority action to help their operations become more environmentally sustainable[31].

The general feeling of those involved in the construction waste diversion industry is that until disposal costs are higher, the motivation to sort at source or to use a construction waste service that incorporates a sorting stage will remain purely as an environmental choice and the market will be limited.

8.6 Key Opportunities

With landfill costs, including the option of disposal to Class 2-5 landfills in many areas, such a key factor in construction and demolition waste diversion; the forthcoming increase and expansion of the landfill levy has the potential to drive significant change in this sector.

Other opportunities highlighted by stakeholders include:

- Driving demand for services (for aggregates and construction waste) through requirements in tender and service agreements; such as minimum requirements for inclusion of recycled aggregates in roading projects, and waste management and minimisation plans for construction projects;
- Addressing the current restrictions on asbestos contamination in aggregate, as these are currently felt to be unnecessarily strict;
- Tighter consenting and enforcement of consent conditions for Class 2-5 landfills, particularly those that operate as 'cleanfills' but accept material that sits outside the normal acceptance criteria for these facilities.

8.7 Gap Analysis – Construction and Demolition (C&D) Waste

A gap analysis exercise was conducted to identify the national, regional and transportation gaps, across the material lifecycle. The results are shown in the table below.

Key:

No significant gaps/issues	Some/potential gaps/issues	Significant gaps/issues

[31] Teletrac Navman and Civil Contractors New Zealand (2020) "Construction Industry Survey" available at www.civilcontractors.co.nz

Table 13: National, Regional and Transportation Gaps Identified within the C&D Material Stream

Fibre	National Capacity	Regional Capacity	Transport & Logistics
C&D waste collections	There are few collection services specifically for C&D nationally that are intended to maximise later recovery and diversion	Auckland has a few providers although only one that specialises in mixed C&D waste, and central Wellington has one provider.	It would not be economic to transport mixed C&D waste long distances to a recovery facility, given the large numbers of Class 2-5 landfills that accept C&D waste, and the cost of many Class 1 landfills.
C&D sorting	There are very few facilities that can accept and sort C&D waste	Auckland and central Wellington are the only areas served and capacity is limited	As above
C&D reuse	There are numerous facilities for sale of recovered items, ranging from budget community-run facilities to large commercial operations. However, the focus is often on high value items only.	All regions have access to some level of C&D reuse	There may be some issues with transport and logistics where some areas have a high supply of reusable items, and other areas have a high demand.
C&D waste reprocessing	There are very few sites that accept C&D waste for reprocessing, such as composting (plasterboard) or firewood (e.g. Palmerston North)	This is a national gap	As outlined above; transport of C&D waste is not economically viable when there are numerous disposal options
C&D waste treatment	There are very few sites that accept C&D waste for treatment, such as a fuel (e.g. Portland Cement)	This is a national gap	As above; although logistics are improved if waste (e.g. wood waste) can be pre-processed, such as producing wood pellets

8.8 Summary of Value Chain Analysis

A value chain analysis was conducted. The key steps in the value chain for construction and demolition waste are consumption and collection; recovery and end-of life.

8.8.1 Factors Highlighted by the Value Chain Analysis

- The analysis highlights that the single biggest barrier to recovering more C&D waste for reprocessing is the low cost of disposal to Class 2-5 landfills.
- Driving demand for services (for aggregates and construction waste) through requirements in tender and service agreements, such as minimum requirements for inclusion of recycled aggregates in roading projects, and waste management and minimisation plans for construction projects.
- Addressing the current restrictions on asbestos contamination in aggregate, as these are currently felt to be unnecessarily strict.
- Tighter consenting and enforcement of consent conditions for Class 2-5 landfills, particularly those that operate as ‘cleanfills’ but accept material that sits outside the normal acceptance criteria for these facilities.

9.0 Electrical and Electronic Products Material Stream Analysis

9.1 Description of Electrical and Electronic Products Material Stream

Electrical and electronic products span a huge variety of items – from everyday appliances through to specialised medical or telecommunications equipment, and batteries. These products contain componentry and parts that encompass multiple material streams – metals, glass, plastics, battery chemistries, and packaging.

In New Zealand, onshore re-processors mostly dismantle products into these component materials, or commodities like printed circuit boards (PCBs), to on-sell for further re-processing – mostly offshore where final re-processors or refineries are located. Some operate reuse activities, such as refurbishing, repair or parts harvesting.

Because of the potential for reuse, the electrical and electronics material stream is broader than 'e-waste' or WEEE. A complete definition can be found in the "Declaration of Priority Products" in the New Zealand Gazette.[32]

9.2 Materials and Quantities

The chart below presents estimates of the total tonnes of electrical and electronic waste recovered and disposed of:

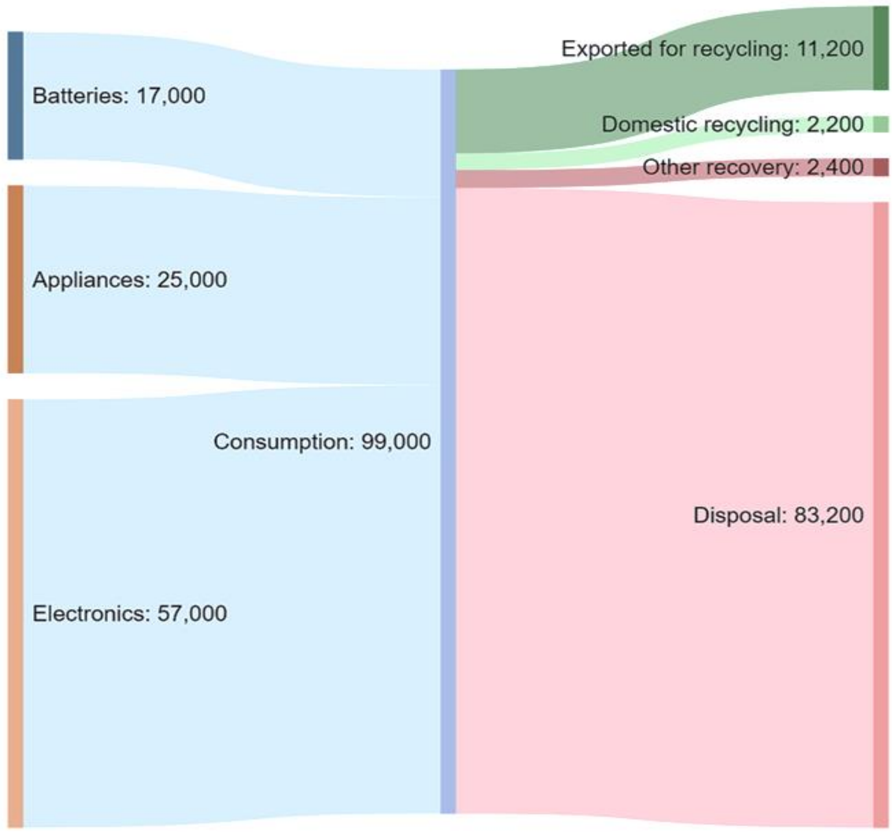
[32] "Declaration of Priority Products" (29 July 2020) *New Zealand Gazette* No 2020-go3343. Retrieved from https://gazette.govt.nz/notice/id/2020-go3343.

Figure 20: Total Tonnes Electrical and Electronic Waste Recovery and Disposal

Disposal is estimated based on a total of 99,000 tonnes of consumed waste generated in NZ annually,[33] minus the total quantity collected. 'Other' is the difference between total collected material, and the total quantity exported or managed onshore. The fate of this material is unaccounted for in the data, partly because of difficulties getting accurate data from stakeholders that covered both inputs and outputs. However, having been collected, it is likely these materials are either processed and exported, stockpiled, or landfilled as residual materials.

[33] V Blake, T Farrelly, J Hannon (2019) Is Voluntary Product Stewardship for E-Waste Working in New Zealand? A Whangarei Case Study *Sustainability* 11(11); https://doi.org/10.3390/su11113063.

Figure 21: Sankey Diagram of Estimated Flows of E-Goods



There is much uncertainty regarding the available data. Data on consumption and sources of consumption are high-level estimates drawn from a number of sources[34]. Recovery data is based on information supplied by operators interviewed, but not all operators supplied data. Disposal figures represent the balance of material and include material to all classes of disposal as well as material stockpiled, and material illegally disposed of. National data for e-waste to Class 1 landfill is not available but is included under the 'potentially hazardous' classification. However, it should be noted that the disposal figure is substantially higher than the quantity of 'potentially hazardous' material (excluding sludges). It is likely that there is a significant quantity of stockpiled material included in the 'disposal figure'.

[34]We note that a recent desktop survey of e-product recyclers conducted by the Circular E-Steward Network (CEN) identified a far higher number of recyclers (92). The CEN study took a wider definition of recyclers, and also included various stakeholders who have been captured in other material chapters of our research (metal recyclers, transfer stations and resource recovery centres).

9.3 Stakeholders, Activities and Facility Types

We identified 24 stakeholders managing used electrical and electronic products and interviewed 14.[35] In New Zealand, stakeholders operating in the sector include both commercially driven organisations, and community-driven organisations working towards a range of social and environmental outcomes.

Most stakeholder re-processing activities are manual and rely on labour and space rather than technical equipment and infrastructure, though some operators have specialised equipment for dismantling particular items (e.g. machinery to separate glass from leaded glass in CRT monitors). Based on the stakeholders interviewed, the main activities in the sector are:

- Dismantling products into component commodities to on-sell (86%)
- Reuse activities, such as refurbishing, repair or parts harvesting (57%)
- Exporting with Basel Permits (36%)
- Re-processing activities, e.g. CRT splitting, plastic granulation, and extracting metals from PCBs (36%)
- Professional data destruction (29%)

In addition, most of the stakeholders interviewed offer private e-waste collection services for commercial clients and/or manage public-facing drop-off points (93%).

9.4 Regional Distribution and Cross-Boundary Movement

New Zealand's re-processing facilities for used electrical and electronic products are grouped around the main centres of Auckland, Wellington and Christchurch. Drop-off/collection points are more dispersed around the country, so collected products are aggregated and transported to one of the main centres for re-processing.

Products and components may also move across regional borders for other reasons. For example, some operators do not dismantle certain products (such as CRTs and printers) and instead send them intact to another operator with the necessary specialised equipment. Furthermore, after dismantling most products, stakeholders usually send components elsewhere for final re-processing. Metals are mostly sent to onshore scrap metal dealers. Plastics are often landfilled (though some are stockpiled or granulated, and then exported in clean and sorted polymer streams). Some materials, such as leaded glass, PCBs and batteries must be exported to offshore refineries, which requires a Hazardous Waste Export Permit (Basel Permit). Operators who do not hold the relevant Permit Basel Permit will send the materials to another operator who does.

---

[35] We note that a recent desktop survey of e-product recyclers conducted by the Circular E-Steward Network (CEN) identified a far higher number of recyclers (92). The CEN study took a wider definition of recyclers, and also included various stakeholders who have been captured in other material chapters of our research (metal recyclers, transfer stations and resource recovery centres).

Figure 22 Facilities by Region

9.5 Market Segments and Dynamics

Given New Zealand's lack of re-processing facilities for electrical and electronic products and components, stakeholders rely on export to complete the recycling process for e-waste. The key market segments for stakeholders interviewed were:

- Onshore scrap metal recyclers
- Offshore refineries for components such as PCBs and leaded glass
- Offshore re-processors for batteries

By weight, metal and batteries constitute stakeholders' largest output. However, PCBs generate the most revenue because they contain precious metals. Most PCBs are exported to offshore refineries, but a small quantity are bought by an Auckland-based research and development facility that undertakes 'bio-mining' (using microbes to extract precious metals from PCBs).

Reuse and refurbishing represent a fraction of total stakeholder activity. However, for the stakeholders who pursue reuse and refurbishing, these activities generate much higher revenues than dismantling for recycling and save the most material from landfill by extending the product lifespan. A number of stakeholders want to grow this part of their business.

The key dynamics affecting the market and the economic viability of re-processors (either positively or negatively) are:

- Low recovery rate of used/discarded electrical and electronic products (c.2%) due to a lack of incentive (and cost barrier) for recycling at end-of-life compared with landfill, and patchy collection infrastructure.
- Diminishing economic viability of re-processing and exporting legacy products, such as CRT TVs.
- Reliance on offshore re-processors, but high costs and complicated logistics associated with exporting unprocessed products that require a Basel Permit.
- Increased public awareness about the issue of e-waste and growing public demand for e-waste recycling and reuse and repair services.
- The difficulty of re-processing plastics from electrical and electronic products, particularly flame retardant or brominated plastic.
- The fact that modern electrical and electronic products are not designed to be repairable.
- Insufficient attention to ensuring there is a market for recycled products prior to reprocessing and/or investment.
- For non-profit stakeholders, the difficulty of maintaining a foothold in the market alongside purely commercial operators.

9.6 Health and Safety, Accreditation and Compliance

Lots of stakeholders were worried about the lack of consistent standards for managing e-waste in New Zealand, resulting in risky processes, false environmental claims about services, and even the illegal export of hazardous materials without permits. All stakeholders agreed that New Zealand should adopt one common standard for e-waste re-processing that all stakeholders accredit against, such as AS/NZS 5377:2013. Some called for sensitivity for smaller stakeholders who may struggle with compliance costs.

9.7 Future Capacity

Most stakeholders interviewed are not operating at capacity because e-waste recovery rates are low, but most indicated readiness and willingness to expand to absorb any sustained and ongoing increases in volume. Given that most activity currently relies on manual processes like dismantling, expansion requires increased warehouse space and storage, and more staff.

The most significant planned increases in infrastructural capacity were in the area of battery re-processing, with one stakeholder having invested in a battery recycling plant for lithium and other dry-cell batteries, and another having lodged an application for a

Basel Permit to export mixed batteries to Australia (including lithium batteries and batteries containing cadmium) for further processing and/or consolidation and shipping offshore.

One stakeholder has invested in an e-waste automatic separation line to reduce the need for storing and scheduling product and to enable the dismantling of products that are not economically viable to dismantle manually.

9.8 Key Opportunities to Expand Onshore Re-processing

Stakeholders support more onshore re-processing but noted the need for investment to be strategic given New Zealand's small population (which may mean e-waste volumes limit the number of refineries and re-processing plants that can be viable), and to ensure there is an end-market for reprocessed products. Some interviewees noted it is unrealistic to expect New Zealand will ever be able to re-process all e-waste onshore, and that this is not necessary to achieve good environmental outcomes. Bearing this in mind, some of the key areas of opportunity for infrastructure investment cited were:

- More onshore capacity for preliminary, pre-processing to extract greater value before export, and potentially reduce reliance on Basel Permits and/or recirculate critical raw materials in local supply chains.
- Specialist equipment for items that cannot be dismantled manually, such as TV and computer desktop screens, flatscreens, modems with heavy plastic content etc.
- Machinery to mechanise processes, including dismantling.
- Shared equipment to assist with the safe logistics of transporting and stored e-waste prior to re-processing, such as fireproof containers for used batteries.

Barriers and opportunities are not always infrastructural. At present, low recovery rates of electronic and electrical products is the primary barrier to stakeholders expanding activities and capacity because most operators rely on their revenue to expand. There was a feeling that low recovery rates were to do with a lack of incentive for users to return e-waste for re-processing rather than landfilling it.

For this reason, all stakeholders strongly support product stewardship and believe it will significantly affect the sector but see scheme design as critical to harness this potential. The key messages stakeholders communicated about product stewardship were:

- Communicate effectively with all stakeholders from the outset and ensure inclusive design and an inclusive scheme.
- Ensure that costs are fairly allocated and that the scheme is equitable and transparent.
- Design product stewardship to protect diverse operators and ensure non-profits are not squeezed out of the e-waste market.
- Prevent cherry-picking activity and ensure all products are re-processed properly.
- Adopt an iterative scheme design process that meets the 'low hanging fruit' standards first, then pushes further to improve over time.

- Support operators with the cost of accrediting to a national quality assurance/best practice e-waste recycling standard.
- Avoid a competitive model where importers “call the shots” and recyclers have to compete on price, which leads to a “race to the bottom”. Finance and empower recyclers to do the job properly.
- Ensure convenience, ease and simplicity for the consumer.
- Require that importers, businesses and OEMs demonstrate a clear end-of-life plan for their products at time of import to New Zealand.

Aside from product stewardship, stakeholders also suggested other methods to increase onshore capacity:

- Increased access to labour and space to dismantle and/or refurbish growing quantities of used and discarded electronic and electrical products.
- Policies to lift recovery rates of discarded electronic and electrical products, particularly mandatory product stewardship incorporating advanced disposal fees, but also a ban on landfilling e-waste and continued increases to the landfill levy.
- Consistent collection infrastructure to ensure access across the country, particularly filling gaps in the regions.
- More public education and training schemes with the private sector on what to do with end-of-life electrical and electronic products.

9.9 Gap Analysis – Electrical and Electronic Products

A gap analysis exercise was conducted to identify the national, regional and transportation gaps, across the material lifecycle. The results are shown in the table below.

Key:

The gap is analysis is presented using a ‘traffic light’ grading system as shown below.

No significant gaps/issues	Some/potential gaps/issues	Significant gaps/issues

Table 14: National, Regional and Transportation Gaps Identified within the E-Waste Material Stream

Infrastructure Type	National Capacity	Regional Capacity	Transport & Logistics
Domestic Collections	No nationwide free, convenient, comprehensive collection service for used domestic electrical and electronic goods. Public need to take their used electrical and electronic goods to public drop-off points (if available), and usually have to pay to drop-off. This service gap is resulting in very low recovery rates of used electrical and electronic goods.	Drop off locations are more common around main centres. Some regions have minimal or no drop off points, such as the West Coast and Northland. Public usually has to pay when dropping products off. Sometimes TAs subsidise fees, which is not economically efficient. The service gap in many regions is contributing to very low recovery rates of used electrical and electronic goods.	Products dropped-off are often dismantled on-site. Commodities then bulk packed on to pallets and sent to buyer or next processor. No major gap here. Ensuring safe collection, storage and transportation of some types of e-waste (e.g. lithium batteries) requires access to expensive equipment. Risk that e-waste is put in general rubbish, which can cause harm to people and property.
Commercial Collections	No nationwide, free, convenient, comprehensive collection service for used commercial electrical and electronic goods. Many providers offer commercial pick-ups of e-waste, but national coverage is patchy and requires commercial clients to pay or sign-up to this service. This service gap is resulting in very low recovery rates of used electrical and electronic goods.	Commercial collections typically are available for clients willing to pay, regardless of where they are in the country.	Products usually collected by client until there is enough to justify a pallet. This makes transport and logistics much simpler and cheaper. Ensuring safe collection, storage and transportation of some types of e-waste (e.g. lithium batteries) requires access to expensive equipment.
Sorting	Limited capacity to store large quantities of used electrical and electronic goods prior to assessment and processing if recovery rates increase. Currently this is managed by individual stakeholders who act as drop-off points,	Regional hubs to consolidate and store collected material prior to transport to processor is limited if recovery rates increase. Currently this is managed by individual stakeholders who act as drop-off points, but	If collection points increase to include more collectors who are not dismantlers, then the bulkiness of the material to be transported will increase, along with cost.

Infrastructure Type	National Capacity	Regional Capacity	Transport & Logistics
	but storage space matches very low recovery rates.	storage space matches very low recovery rates.	
Dismantling	On-shore processors primarily conduct manual dismantling activity. Most processors are currently not operating at capacity because of low e-waste recovery rates, so there is spare capacity. However, if recovery rates increase dramatically (e.g. through product stewardship) then there will be a need to expand dismantling capacity across New Zealand, which requires more labour and warehouse space. Lack of automated dismantling capacity for specialist equipment that is difficult to dismantle manually. There is a lack of clear and universal environmental and safety standards or certification for processing, which means that processing may not be occurring to a consistent standard across the country.	Dismantling activities usually occur at drop-off sites, so the regional gaps for collection match those for dismantling, meaning capacity is concentrated around the main centres of Auckland, Wellington and Christchurch.	Products dropped-off are often dismantled on-site with commodities then bulk packed on to pallets for shipping to next processor/end-market. No major gap here. Export of commodities often requires Basel Permits, which are costly and time-consuming to acquire.
Re-processing	Major gap in on-shore processing capacity beyond dismantling - e.g. pre-processing, refining/extraction of precious metals. Aside from some granulating capacity, most plastics recovered from electrical and electronic goods is going to landfill. Lack of clear and universal environmental and safety	Current processing ventures (lithium and dry cell batteries and R&D in biomining of printed circuit boards) located in Auckland and Wellington. No activity elsewhere.	Lack of on-shore processing creates dependence on export of unprocessed e-waste that often requires Basel Permits, which are costly and time-consuming to acquire.

Infrastructure Type	National Capacity	Regional Capacity	Transport & Logistics
	standards or certification for processing.		
Reuse, Repair, Refurbish	Most processors conduct some reuse, repair and refurbish activities, but this is typically only a small fraction of overall business. A lack of skilled workforce for repair, combined with proliferation of products on the market that are not designed to last or not designed for repairability, and continual technological innovation that means consumers replace functional products for newer models.	n/a	Some items for reuse are exported (e.g. to the Pacific Islands). Items for reuse must be treated with greater care in order to avoid damage.

9.10 Summary of Value Chain Analysis

Following the gap analysis, a value chain analysis was also conducted. Where the gap analysis focused on infrastructure gaps, the value chain analysis aimed to identify the key parts of the value chain, from consumption through to recovered material markets, where this is opportunity to reduce cost/increase efficiency and add value. The key steps in the value chain for e-waste are manufacture; consumption; collection; reuse and repair; end-of life.

9.10.1 Factors Highlighted by the Value Chain Analysis

- Almost all (98%) of the value of this material stream is lost after consumption. Considerable gains can be made by creating an improved collection rate through a combination of infrastructure and policy.
- Infrastructure options are especially needed for collection and processing.
- Warehousing might benefit from being co-located with reuse/repair and/or bulking locations.
- By combining collection and local and regional bulking a significant uptick in the collection might be achieved with the potential of reduced recovery costs per unit.
- Adding a system of material tracking throughout the lifecycle of the products will provide an opportunity to optimise the value chain.

- Supporting actions target the beginning and end of the value chain (consumption, collection, and manufacturing). The supporting actions are predominantly about changing the disposal route of EEE and the manufacturing – i.e. incentivise reuse and recycling, optimise collection and processing.
- Demand and prices for component material might outcompete prices obtained from reuse/repair option.

10.0 Farm Plastics Material Stream Analysis

10.1 Description of Farm Plastics Material Stream

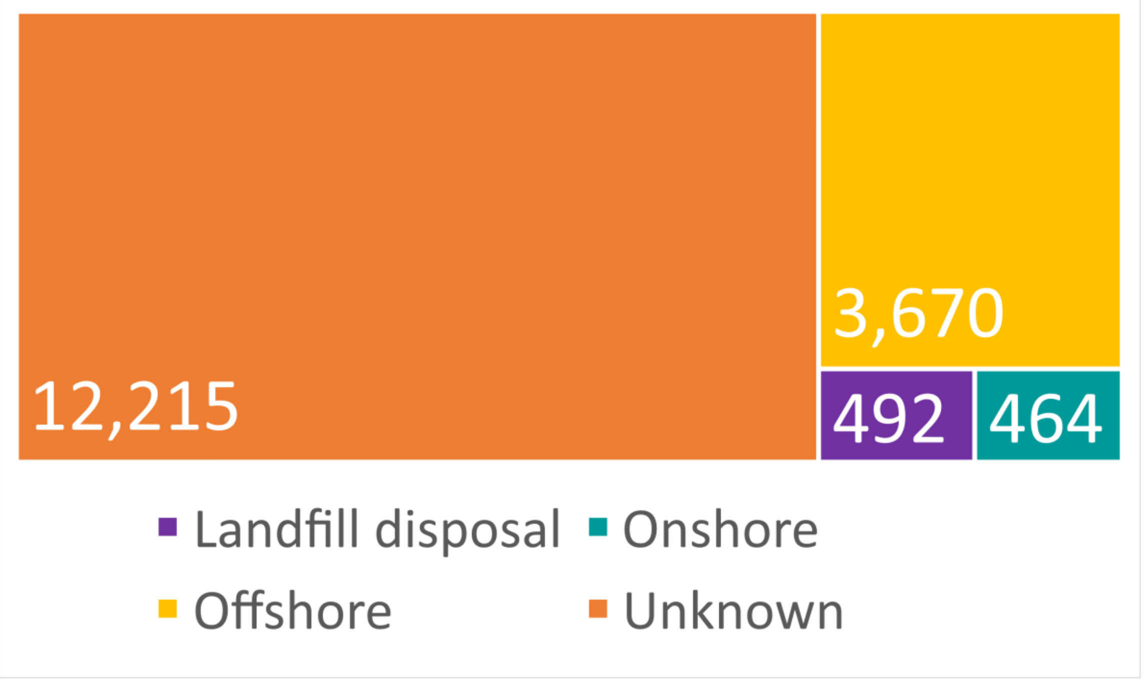
The farm plastics material stream researched included agrichemical (AG) containers and silage wrap as these product groups have both been declared priority products. Farm plastics in its entirety encompasses a much larger group of materials.

10.2 Materials

The main farm plastics material streams that are processed through formal recovery systems in New Zealand include wrapping material for hay, and plastic containers and drums used on farms containing fertilizers, insecticides, pesticides, cleaning, and veterinarian products.

The chart below presents estimates of the total tonnes of silage wrap and agricultural chemical containers recovered and disposed of:

Figure 23: Total Tonnes Silage Wrap and Agricultural Chemical Containers Recovery and Disposal

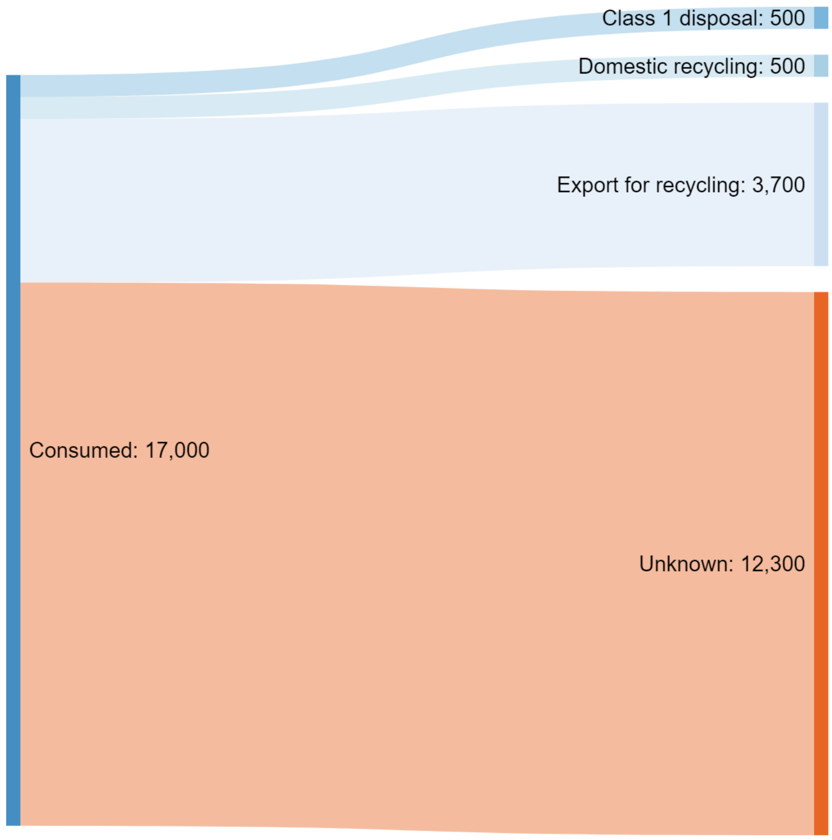


Total quantities are from the PMCSA report[36] which estimates a national total of 14,518 tonnes of silage wrap, and 2,323 tonnes of drums and containers placed on the market. Recovery data was supplied by stakeholders. Landfill disposal is the quantities of farm

[36] https://www.pmcsa.ac.nz/2019/11/05/agricultural-plastic-waste/

plastics collected and disposed of by voluntary scheme providers. ‘Unknown’ includes on farm disposal and other classes of disposal.

Figure 24: Sankey Diagram of Primary Flows of Farm Plastic in New Zealand



There is limited data available on what happens to farm plastics at end of life. Consumption data indicates that in the order of 17,000 tonnes of material is place on the market but, of this, only about 4,700 tonnes can be accounted for through formal disposal and recovery channels. The approximately 500 tonnes farm plastics noted as going to Class 1 disposal are items that are collected as part of voluntary product stewardship schemes but not able to be recovered (e.g. due to contamination). Other farm plastics that may be going to Class 1 disposal are not identified in composition analyses and so there is no data split available between on-farm disposal and formal disposal to Class 1.

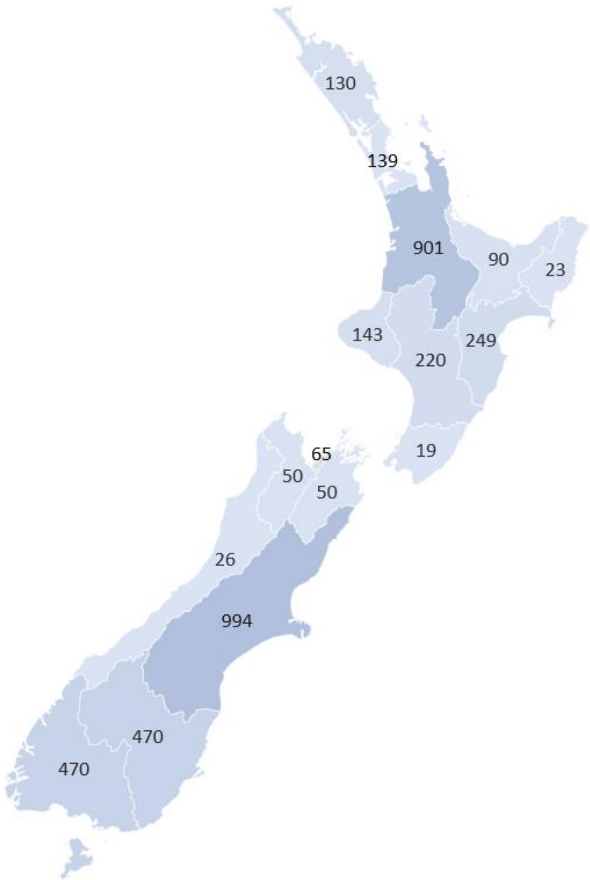
10.3 Facility Types

Three organisations are involved with collecting and processing of these farm plastic wastes. Two of which operate nationally, and one operates out of 2 regions.

10.4 Regional Distribution

All regions in New Zealand have farms, and all 58,071 farms generate plastic waste. Most of the recovered farm plastics are either picked up or deposited at local collection centres. Materials are then transported to regional collection hubs where they are processed, which involves ongoing cross boundary movements. Most farm plastics originate from Waikato (20%) and Canterbury (24%), see Figure 25.

Figure 25: Quantities of Farm Plastics Collected by Region (Tonnes)



10.5 Market Segments and Dynamics

Collectors estimate that they recover at most 35-45% of their respective waste stream. Exact data and insights about what happen with the remaining material is lacking, however industry sources suggest a small amount (10%) of the containers are recycled (all others are landfilled) and the majority of processed silage wrap is exported.

The main factors that affect the dynamics of activity in the waste farm plastics recovery sector include:

- The prevalence of subsidised local collection events which increases the quantities collected.
- Regulation and enforcement, in most regions of New Zealand, burning or burying farm waste is a permitted activity through regional rules.
- The need for additional collection points and equipment (balers).
- General awareness and education around the long-term harmful effects of burying and burning (plastic) waste.

- Increase in waste levy.

10.6 Product Stewardship

All three operators are currently running voluntary product stewardship schemes and are interested in converting these to mandatory schemes. Their believe is that further regulation, awareness, and enforcement, is needed to capture the remaining 55% of this waste stream.

The suggested agricultural chemical and container scheme would be partly paid for by including the price of disposal/processing in the original sales price. Furthermore, financial assistance would be sought from other sources to assist in dealing with legacy waste and imported materials or from manufacturers that are not part of the scheme.

The majority of silage wrap is imported through a variety of suppliers from different nations, resulting in recommendations to increase processing equipment and infrastructure.

10.7 Future Opportunities

An increase in on-farm plastics usage is expected. All parties interviewed indicated they have additional processing capacity; however, there are limitations around the domestic market capacity for re-processed materials, and safe disposal of the products that cannot be recycled.

To process more silage wrap, additional balers are needed. There is currently international demand for the re-processed product, however an increase in domestic re-processing capacity and markets for recycled material would be beneficial.

The cleaning of containers is mainly a manual process; therefore, the critical component is labour.

Key potential future demand drivers noted in the stocktake included:

- Introduction of mandatory product stewardship schemes.
- Disallowing (and enforcing) the burning and burying of waste on farms through regional rules.
- The potential to research reuse options for farming materials currently packaged in single use plastics.
- Increase in the waste levy.
- Controls on imported products, to avoid free riding.
- Including farm plastic's management in certification and accreditation programs.
- Eco-tax virgin plastics, to make reused materials more competitive and viable.
- Require minimum amount of recycled material in production of farm plastics.
- Limit the use of mixed materials in packaging.

10.8 Gap Analysis – Farm Plastic

A gap analysis exercise was conducted to identify the national, regional and transportation gaps, across the material lifecycle. The results are shown in the table below.

Key:

The gap is analysis is presented using a 'traffic light' grading system as shown below.

No significant gaps/issues	Some/potential gaps/issues	Significant gaps/issues

Table 15: National, Regional and Transportation Gaps Identified within the Farm Plastic Material Stream

Infrastructure Type	National Capacity	Regional Capacity	Transport & Logistics
Rural Collection	Suboptimal capture of waste stream, with less than 45% of waste stream collected. Remainder is burnt, landfilled or disposed into the environment – but exact info is lacking	Lack of sufficient regional collection and aggregation locations, particularly when supply increases. Low collection rates	Product needs to be clean (uncontaminated) and is collected by local contractors or can be dropped off at certain transfer stations. Is very bulky, balers are essential for cost effective transport
Sorting – Silage Wrap	Additional sorting capacity needed if to process currently uncaptured material	All material is collected and baled in the regions, transported to locations of containers in which material is shipped.	Bailers condense the material fourfold – reducing lorry movement
Sorting – Agrichemical Containers	Lack of processing options higher in the waste hierarchy – majority of material is landfilled, some of which overseas	Lack of regional processing capacity outside regions where processing occurs, particularly in Northland, Taranaki, Wellington, and West Coast	Transport is pre-arranged and is either done by contractors or directly when in geographic area of processing
Re-processing – silage wrap	Lack of processing capacity. About 10% of collected silage material is processed in NZ, rest is sent overseas for processing.	All material is collected and baled in the regions, transported to container locations in which material is shipped.	N/A

Re-processing – Agrichemical containers	Lack of processing capacity. About 10% of collected Ag container material is sent to Astron. Remainder is landfilled, either in NZ or overseas.	Lack of regional processing capacity	N/A

10.9 Summary of Value Chain Analysis

A value chain analysis was conducted. The key steps in the value chain for farm plastic are consumption; capture (reuse and repair); end-of life.

10.9.1 Factors Highlighted by the Analysis

- The two groups of farm plastics have different collection/processing channels and infrastructure. However, both collect less than half of the materials on-farm even though containers have a pre-paid recovery fee.
- Combining collection and bulking, a significant uptick in collection rates might be achieved with reduced recovery costs per unit.
- Adding a system of material tracking throughout the lifecycle of the products will provide an opportunity to award plastic credits for proper on-farm waste plastic management.
- An increased material collection would enable redesign into either reusable or like-for-like recycling.
- Supporting actions target the beginning and end of the value chain (consumption, collection, and manufacturing). The supporting activities are predominantly about changing the disposal route of farm plastics and the manufacturing – i.e. disallow on-farm disposal, incentivise correct disposal, optimise collection and processing and create easier to reuse or recycle materials.
- Infrastructure actions tend to target the middle ‘reverse logistics’ part of the value chain – i.e. improving the technology, capacity and efficiency of sorting, bulking, processing and transporting materials.

11.0 Reusables Material Stream Analysis

11.1 Description of Reusables Material Stream

The reusables material stream encompasses a range of materials, delivery models, products, markets, and types of operators. While there are a number of different models for reusable packaging systems, we have focused on the 'returnable packaging' model, in which retailers, manufacturers and brands take empty reusable packaging back from customers for sanitisation and refill.

Reusable packaging has the potential to help reduce some of the waste streams addressed in other sections of this report and to alleviate some of the pressures currently faced by the resource recovery system for single-use packaging. However, to do so successfully, a number of infrastructural gaps must be addressed.

11.2 Materials & Quantities

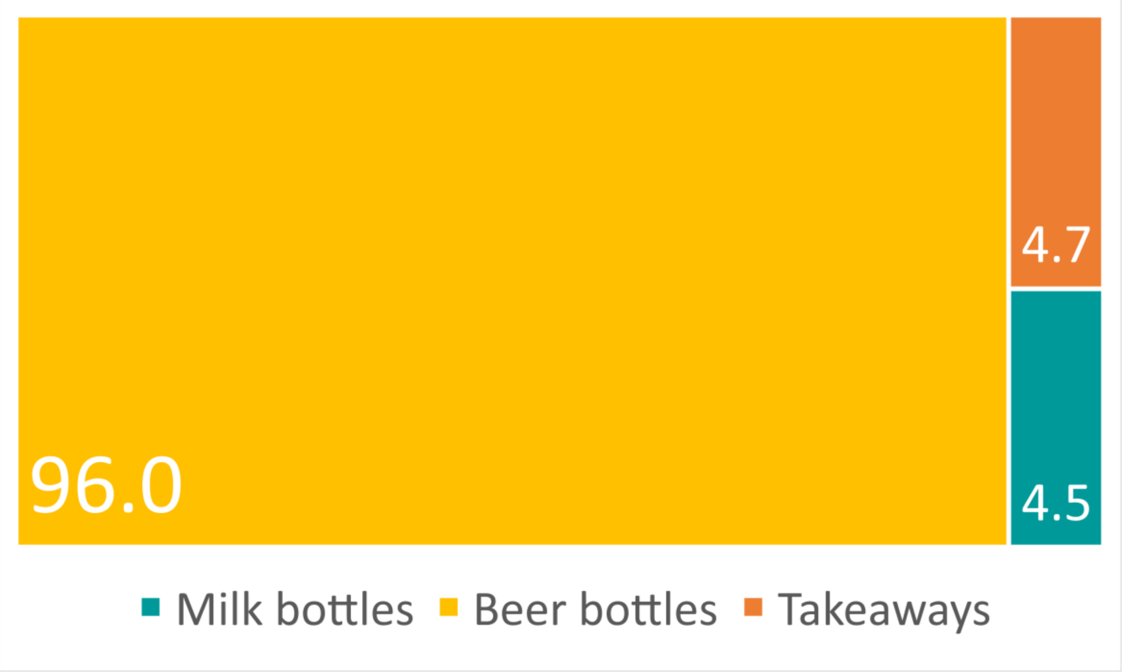
This report focuses on reusable packaging systems for the following products:

- beverages,
- takeaway packaging,
- groceries, and
- janitorial, personal care, and cleaning products.

The different reusable packaging fleets used by stakeholders are made of various materials, including glass, metal, and plastic. The reusable packaging also replaces single-use packaging across material types.

The chart below presents estimates of the total numbers of containers avoided through reuse annually:

Figure 26: Total Numbers of Containers Avoided (Millions) through Reuse Annually



The number of containers avoided was calculated by multiplying the container fleet sizes (provided by stakeholders or through other available sources) by refill rates obtained from stakeholders and industry sources.

11.3 Facility Types

Overall, 49 operators of reuse systems using the returnable packaging model were identified. By numbers of individual stakeholders, the most common provider of reusable packaging interviewed for this section were suppliers of milk in reusable glass bottles (24). However, reuse systems for takeaway coffee cups are the most widely available reusable packaging option going by number of outlets offering this packaging across the country, unfortunately we did not have enough data points to include in the overall assessment.

11.4 Regional Distribution

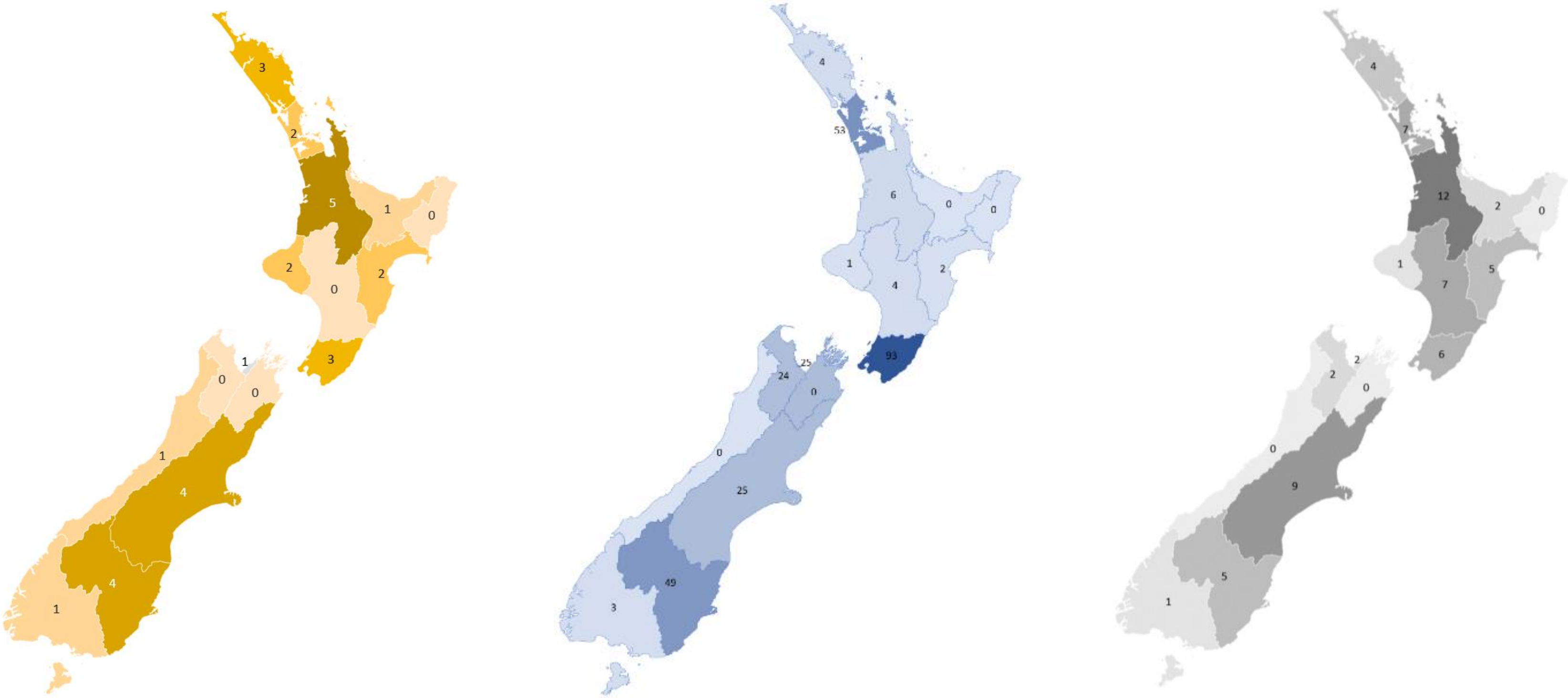
Milk is being sold in reusable bottles throughout the country. However, in the North Island we did not identify providers in Gisborne and Manawatu-Whanganui. In the South Island, Tasman and Marlborough did not have milk in reusable glass bottle providers, but these regions are services by a facility based in Nelson.

Takeaway packaging reuse systems, and in particular reusable coffee cup schemes, are mainly concentrated in Wellington (93), Auckland (53) and Otago (49). There are also a number of stakeholders who service events and venues nationwide, with one such stakeholder operating a central washing facility in Auckland for their reusable service ware.

There are currently three grocers in New Zealand who operate a returnable packaging model for the food products they retail. These grocers are all in the Upper North Island, in Auckland, Whangārei and Mangawhai.

We identified six stakeholders who operate reusable packaging systems for janitorial, cleaning, and personal care products. One of these stakeholders is a third-party washing facility in Auckland. The other stakeholders are all manufacturers of cleaning products and personal care products who sell their products in returnable bulk dispensers that are available in a variety of outlets nationwide.

Figure 27 Providers by Region of Reusable: (Left) Milk Bottles, (Middle) Takeaway Packaging, and (Right) Washing and Refill Stations (darker colours indicate increased numbers)



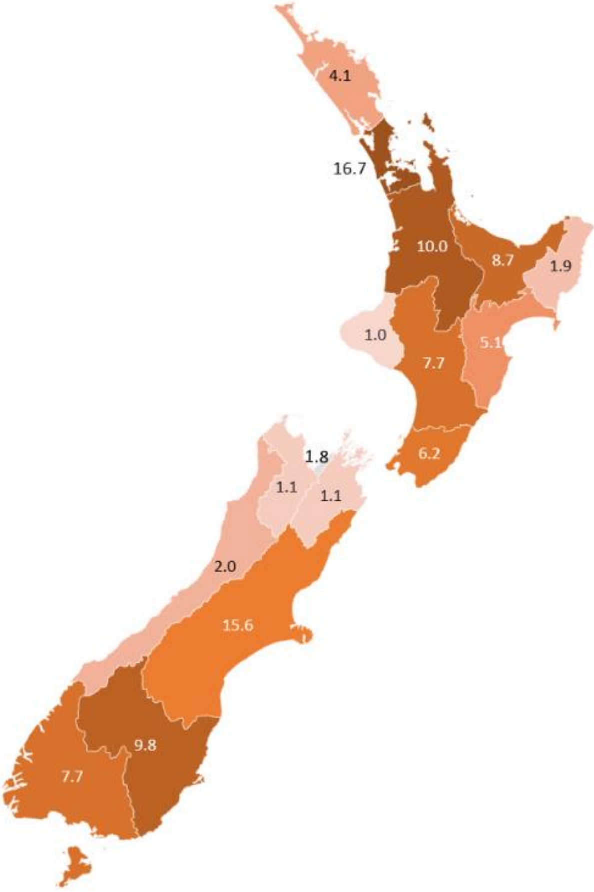
11.5 Waste Prevention and Circularity

New Zealanders use an estimated 2.3 billion single-use beverage containers a year, many of which are landfilled or enter the natural environment.[37] Most operators of reusable schemes have not been in business long enough to establish accurate waste prevention data, except for two longer term operating providers. Conservative estimates are that the reusable glass bottle providers, with a combined fleet of 30.1 million bottles, prevent an estimated 100.5 million single-use containers from being manufactured, and then entering New Zealand's waste recovery system per year. Most of this prevention occurs in Auckland with 16.7 million, followed by Canterbury with 15.6 million items. It should be noted that 30 million of the 30.1 million total fleet is provided by a single operator ABC, who provide the 'swappa crate' beer bottles.

Similarly, six reusable cup schemes, with an estimated fleet size of 563,000 are expected to collectively prevent 4.7 million single-use cups from being manufactured, and then going on to enter New Zealand's waste streams.

[37] https://www.mfe.govt.nz/waste/container-return-scheme-option

Figure 28 Estimated Single-Use Containers Prevented Annually by Reusable Glass Bottle Schemes (in millions)



11.6 Market Segments and Dynamics

The reusables sector in New Zealand is nascent and growing but is facing start-up hurdles. The main factors that affect the viability of the reusable packaging sector are dependent on the type of packaging, product, and the companies' maturity, and include:

- A dominance of smaller operators who currently lack economies of scale and the capital needed to finance the types of infrastructure and systems logistics that would enable the sector's growth
- A lack of third-party reusable packaging providers, which means that the majority of reusable packaging is currently operated by 'vertically integrated' businesses who run their packaging system alongside manufacturing their product, which increases costs and hinders scalability
- High upfront capital costs to establish a reusable packaging offering, alongside the difficulty of competing against the low cost and perceived convenience of single-use packaging
- A perceived lack of public, brand and government awareness and education around reuse

- A lack of regulation around “greenwashing”
- A lack of standardised containers, collection, washing and redistribution infrastructure that would reduce the overall cost to brands of using reusable packaging.

11.7 Key opportunities for infrastructural investment

For reusable systems to become competitive pricewise, economies of scale are required. However, this comes with high upfront capital investment that stakeholders are currently unable to address individually. Accordingly, stakeholders identified three key areas where infrastructural investment was most needed:

- Washing and sanitisation facilities (especially run by third-party operators).
- Digital and physical infrastructure to support reverse logistics and collection to achieve high recovery rates for reusable packaging.
- Supporting reusable packaging fleet development and more onshore manufacture of reusable products, including reusable glass bottles for beverages and opportunities to use agricultural by-products.

Stakeholders also noted current difficulties with accessing traditional funding and grants, which they perceived as hindering their ability to expand. They suggested ways in which existing funding opportunities, such as the Waste Minimisation Fund, could be updated to increase access for smaller operators.

11.8 Future Opportunities

Globally, reusable packaging is a growing area of interest, yet it remains a small percentage of the packaging market overall. In New Zealand, many operators are experiencing growth in demand, but many are not always able to address their growing pains in order to break even financially, maintain a long-term growth trajectory, and/or translate their own growth into a wider societal shift towards reusable packaging.

Stakeholders largely believed that reusable packaging has positive environmental credentials and aligned with the government’s circular economy aspirations, but that it requires support to break into the mainstream. In addition to direct investment in infrastructure noted above, other potential opportunities that could drive an increase in reusable packaging infrastructure included:

- Policy efforts to level the playing field between single-use and reuse, such as banning or taxing of single-use packaging, prohibiting greenwashing, incentives to reduce costs associated with reverse logistics, particularly transport, container return scheme and product stewardship.
- Greater coordination of the sector through incorporating reuse into the government-led waste strategy, and encouragement of a representative body of the reusable packaging sector.
- Prioritising activities higher in the waste hierarchy for both policy and funding decisions.

- Investing in public education about reuse, the circular economy, and the waste hierarchy.
- Leverage corporate drive for sustainability and behaviour change around reusables.

11.9 Gap Analysis – Reusables

A gap analysis exercise was conducted to identify the national, regional and transportation gaps, across the material lifecycle. The results are shown in the table below.

Key:

The gap is analysis is presented using a 'traffic light' grading system as shown below.

No significant gaps/issues	Some/potential gaps/issues	Significant gaps/issues

Table 16: National, Regional and Transportation Gaps Identified within the Reusable Material Stream

Infrastructure Type	National Capacity	Regional Capacity	Transport & Logistics
Commercial Collection	Lack of funding for small or new businesses starting up in this space to run system logistics.	Currently, retailers often act as dispensing and collection points for reusable packaging, such as refilleries for cleaning products, or cafes for reusable takeaway packaging. This means that the regions with fewest retailers offering reusables also have a lack of collection points. Retailers are currently concentrated around Auckland, Wellington and Otago.	High freight costs for returning empty containers.
Domestic Collection	Uneven playing field as public waste and recycling services do not accommodate for reusables, so companies must run their own collection system.	Retailers often act as dispensing and collection points for reusable packaging, such as refilleries for cleaning products, or cafes for reusable takeaway packaging.	Lack of standardized technology to track and retrieve reusable packaging or process deposits, such as 'reuse bins', RFID or app technology

Sorting	Lack of economies of scale: Containers are retrieved from homes or outlets by product suppliers or returned by consumers. No third-party reusable packaging provider/collector.	N/A	Lack of standardized technology to track and retrieve reusable packaging or process deposits, such as 'reuse bins', RFID or app technology
Processing	Lack of third-party collection, washing and distribution facilities. Companies opting for reusable packaging often must be 'vertically integrated' and run the packaging system as well as manufacture their product.	Cafes/outlets/events using reusable takeaway packaging use their in-house washing facilities to wash reuse system cups and containers.	Containers often must be returned across long distances for processing – no regional hubs or aggregation points where reusable packaging can be processed.
Manufacture	Lack of domestic supply of reusable containers. No third-party reusable packaging supplier that operates fleets of reusables for different packaging needs.	N/A	N/A

11.10 Summary of Value Chain Analysis

No material flow analysis is currently available for reusable packaging. It is recommended that further work be undertaken to track the flow of materials more clearly through the reusable packaging value chain.

11.10.1 Factors that could be Highlighted by a Value Chain Analysis

- In the circular model of reuse, all material value is retained. Infrastructure options are particularly needed for the reverse logistics of collection, sanitizing and redistribution.
- Reusables overlaps with other materials streams, many supporting actions for the plastics stream apply to reusables.
- By combining collection/bulking at local and regional levels, economies of scale and efficiencies might be achieved with the potential of reduced processing costs per unit.
- Adding a system of material tracking throughout the lifecycle of the products will provide data on reuse factor and offer insights as to how to optimise logistics.

- Ideally, reusables would be manufactured from fully recycled and recyclable materials.
- Supporting actions are concentrated at the front end of the value chain (consumption, collection, and manufacturing). The supporting acts are predominantly about changing the system through carrots and sticks– i.e. incentivise reuse and recycling and impose restrictions on non-reusables and optimise collection and processing.

12.0 Tyres Material Stream Analysis

12.1 Description of Tyres Material Stream

In 2019, an estimated 81,000 tonnes of tyres reached end-of-life in New Zealand. Tyres come in various sizes depending on their activity source, such as small scooters, cars, vans, busses, trucks, motorcycles, farm equipment and heavy machinery.

12.2 Materials & Quantities

Tyres are a composite product made up of various materials, including synthetic rubber (27%), carbon black (28%), natural rubber (14%), steel (14%), and textiles and other fillers, accelerators and antiozonants (16%). The three key material types in tyres that are relevant for recycling are rubber, steel, and textiles. Tyres are re-processed by repurposing, retreading, or recycling tyre-derived medium (TDM) created by cutting or shredding tyres into smaller sizes or by turning the rubber to crumb. Tyres have a high caloric value and can therefore also be used as a fuel source referred to as tyre-derived fuel (TDF).

The chart below presents estimates of the total tonnes of tyres recovered and disposed annually:

Figure 29: Total Tonnes of Tyres Recovered and Disposed Annually

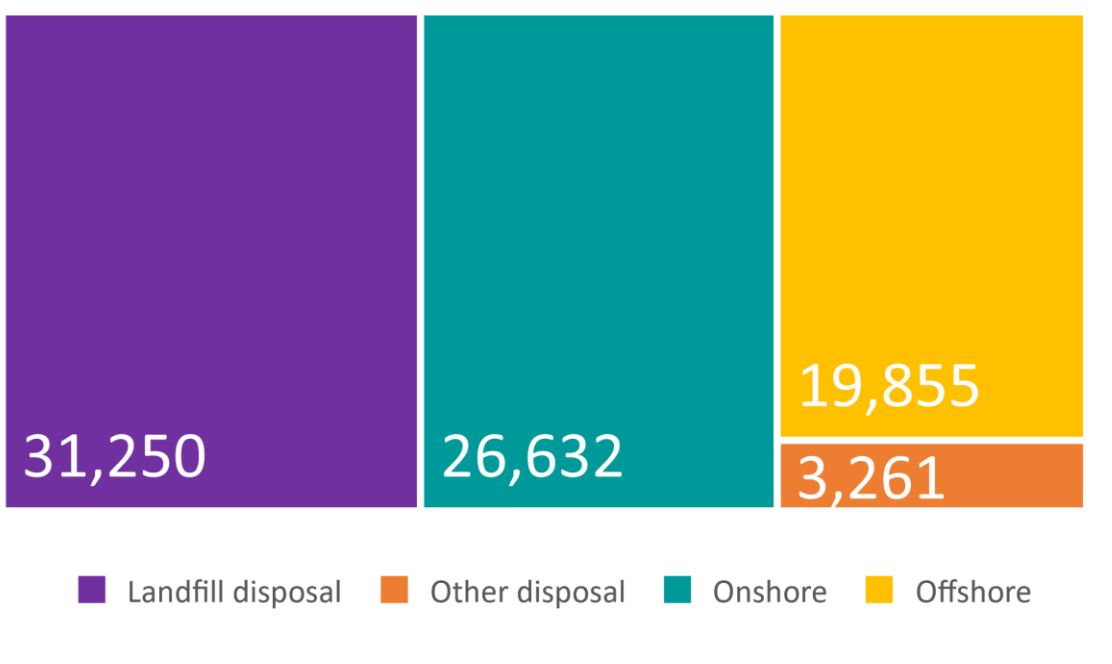
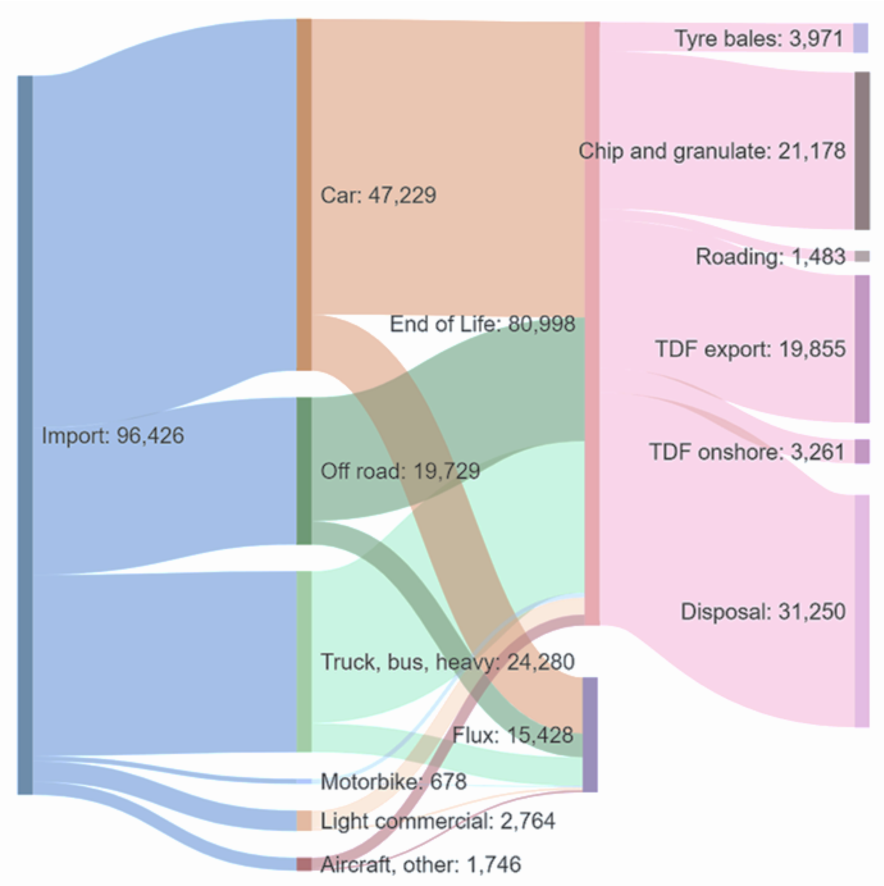


Figure 30: Sankey Diagram of Estimated Flow of Tyres from Import through to End of Life in New Zealand



Figures are based on the Tyrewise 2.0 report data. It should be noted that since the figures were provided, the Golden Bay Cement process, which is reportedly able to accept up to half of NZ's end of life tyres (ELTs), has been commissioned. Recent data suggests that it is currently operating at about 50% of this capacity. This is likely to change the end-of-life outcomes from that shown, but no current data is available on the extent to which tyres going to Golden Bay Cement are diverted from disposal versus other recovery pathways.

12.3 Facility Types

New Zealand has no onshore tyre manufacturing facilities. There are six facilities that manufacture products using tyres as inputs, including three tyre re-treading businesses. There are a further 19 operators who re-process tyres for various purposes (primarily shredding and some producing rubber crumb).

12.4 Regional Distribution

The facilities are distributed across most parts of the North Island (with the exception of Gisborne and Taranaki), but only Canterbury has facilities in the South Island. No regional data was available on the quantities of end-of-life tyres (ELTs) generated. For the purposes of this exercise regional quantities were assumed to be roughly proportional to household/population figures. These quantities are illustrated in Figure 31.

There was little industry data available on cross boundary movement of feedstock however it can be assumed that there will be movement from the points of generation to where re-processing facilities are located.

Figure 31: Quantities by Region (x1,000 tonnes)

12.5 Market Segments and Dynamics

There are currently a wide range of potential uses for the materials from ELTs including:

- Reusing tyres in their original state
- Re-treading tyres
- Civil engineering
- Use on farms
- Fabricated/cut products
- Ambient and cryogenic material recovery/size reduction
- Tyre derived medium (TDM) –essentially rubber crumb which can be used in applications such as:
    - artificial turf, rubber-modified asphalt, moulded rubber products for civil engineering, garden mulch, reinforcing rubber crumb for lawns, landfill engineering, roading applications, or equestrian arenas
    - an additive in a product, including back into the manufacture of tyres, industrial adhesives, moulded products like speed ramps, curb ramps, wheel chocks, mats, cable guards, signalling posts and accessories for equipping cycle tracks, artificial turf and sporting arenas, rubber modified asphalt
    - in a secondary process, particularly pyrolysis
    - in a destructive process, such as a source of fuel for the manufacture of cement, pulp and paper and tyres, or to generate power or operate industrial boils (when used in this way, the material is referred to as Tyre Derived Fuel (TDF); for mining applications like stemming and blasting; or as a source of steel and carbon black (to replace anthracite) in industrial processes like foundries and steel works.
- Devulcanisation (for use back in tyres).

However, to date the markets for ELTs appear to have been driven primarily by attempts to try and seek beneficial end uses for tyres, rather than by a pull-through demand for the products from ELTs. While many of the applications noted above are in use in NZ, they tend to be niche applications, with insufficient demand to process the quantities of ELTs generated in NZ.

12.6 Recent Developments and Future Opportunities

The most significant facility for processing ELTs is Golden Bay Cement in Northland that is permitted to use ELTs as an alternative fuel to run their cement works. At the end of 2020 they commissioned new equipment (called HOTDISC) at their facility that removes the need for tyres to be reduced to a crumb before being used as fuel. The new facility will enable Golden Bay Cement to use up to 3.1 million shredded tyres per year, less than half of all ELTs. It is not clear at this point how much of this material will come from tyres going to disposal as opposed to replacing existing markets for recovered tyres or from stockpiled tyres.

Tyrewise, a report issued by a group of representatives from the tyre industry, highlights a number of gaps in the market, which we highlight here as these may be an appropriate avenue for infrastructure investment. Although not directly stated, our interpretation is that, in the event of mandatory product stewardship, the quantity of recovered tyres is likely to outstrip available re-processing capacity. Key gaps and opportunities noted include:

- A significant gap in processing capacity in the South Island.
- A significant gap in the value-add market.
- Minimal growth in facilities that would use ELT as a secondary raw material onshore to make new products. The Tyrewise report notes that the export market for crumb was still strong until mid-2019. However, we note that the potential of COVID-related market disruptions may justify exploration of onshore uses for recycled crumb.
- Industry research and development projects to develop new applications for ELT derived products are generally funded privately and, given the need for more onshore capacity to manage the sheer quantity of ELTs in New Zealand, this could be an appropriate avenue for government investment.

A further infrastructure gap in New Zealand is the lack of tyre manufacturers, which impacts on waste minimisation outcomes. Tyrewise highlights the relevance of applying the waste hierarchy to managing ELT (from design through to disposal), and notes that "actions at a higher level of the waste hierarchy (e.g. import regulations around higher quality imports, promoting extended life span of tyres and retreading) can reduce the costs of actions at a lower level and the environmental impacts of activity at a higher level are generally less than those at a lower level."

12.7 Gap Analysis – Tyres

A gap analysis exercise was conducted to identify the national, regional and transportation gaps, across the material lifecycle. The results are shown in the table below.

Key:

The gap is analysis is presented using a 'traffic light' grading system as shown below.

No significant gaps/issues	Some/potential gaps/issues	Significant gaps/issues

Table 17: National, Regional and Transportation Gaps Identified within the Tyre Material Stream

Infrastructure Type	National Capacity	Regional Capacity	Transport & Logistics
Collection	Low overall recovery rate and majority of waste stream is landfilled or illegally dumped.	Lack of insight into where unrecovered legacy tyres reside.	Not enough detail in Tyrewise report to discern

Infrastructure Type	National Capacity	Regional Capacity	Transport & Logistics
Sorting	Existing capacity is not sufficient for increased supply (for when one or more relevant policies are activated).	N/A	Not enough detail in Tyrewise report to discern
Re-processing	Lack of processing options higher in the waste hierarchy – about 50% of material collected goes to landfill.	Big regional gaps, with only Gisborne, Taranaki and Canterbury having processing facilities.	N/A
Re-processing		Retreading is a viable option that is only available in 3 regions, all in the North Island.	
Manufacture	No domestic tyre manufacturers – recovered material is applied to niche applications Lack of R&D into tyre manufacture using fewer harmful additives.	N/A	N/A
Quality	Lack of import standards around tyre quality, including tyre wear during use to increase longevity and reduce microplastic contamination	N/A	N/A

12.8 Summary of Value Chain Analysis

Following the gap analysis, a value chain analysis was also conducted. Where the gap analysis focused on infrastructure gaps, the value chain analysis aimed to identify the key parts of the value chain, from consumption through to recovered material markets, where this is opportunity to reduce cost/increase efficiency and add value. The key steps in the value chain for tyres are import; consumption; recovery and end-of life.

12.8.1 Factors Highlighted by the Value Chain Analysis

- Opportunities to reduce costs/increase value exist across the whole tyre value chain.
- The commissioning of the Golden Bay Cement process, and the development of the Tyrewise product stewardship scheme are likely to collectively address the most pressing issues with tyres in New Zealand – specifically providing a mechanism to

ensure they are collected and prevented from entering the environment or ending up in tyre mountains, and that there is a viable beneficial end use.

- There are likely to be cumulative advantages to improving the logistics of tyres collection – such as increasing local and regional bulking capacity and bulk transport. This could potentially improve the economics of tyre recovery.
- However the largest potential impacts may be in addressing the ends of the value chain process – specifically exploring new ways of reducing tyre use (such as through increased public transport, working from home, use of long life tyres, tyres as a service model etc), and investigating the creation of a local circular economy for tyres in NZ where tyres are manufactured locally (potentially utilising recovered materials[38]), to create long-life products, that are provided on a tyres as a service basis.

[38] https://rubberlink.pt/devulcanization/?lang=en.https://cen.acs.org/articles/93/i16/Elusive-Dream-Tire-Recycling.html

13.0 Material Recovery Facility Summary

13.1 Description of Material Stream

Material recovery facilities (MRFs) accept collected waste materials and sort the mixed stream to a point at which the material can be reprocessed, usually by recycling. This description can be applied to facilities that sort a range of materials, including kerbside recycling collections, textiles, and construction and demolition waste. In this section, a 'MRF' is defined as a facility that accepts only materials from kerbside recycling collections and similarly mixed materials from private collections from commercial and industrial customers.

The material from a MRF may be reprocessed within New Zealand or exported. The role of the MRF is to:

- remove gross contamination (items that should not have been in the collected material);
- remove cross-contamination (where one collected item contaminates another, such as glass fines contaminating paper);
- produce sorted material that fits the required maximum contamination levels;
- sort materials into different grades, such as certain types of plastic; and
- prepare material for shipping e.g. baling.

MRFs in New Zealand vary significantly with respect to how much material the facility can process and what inputs are accepted; from simple manual sort lines to fully automated facilities. There is also variation in how they are owned and operated, and who has ownership of the material at various stages. In those cases where the owner and the operator are separate entities, arrangements can vary for ownership of the materials, receipt of the income from material sales, and responsibility for disposal costs.

13.2 Materials & Quantities

The chart below presents estimates of the total tonnes of material processed by MRFs in NZ annually:

MRFs typically accept and sort the following material types:

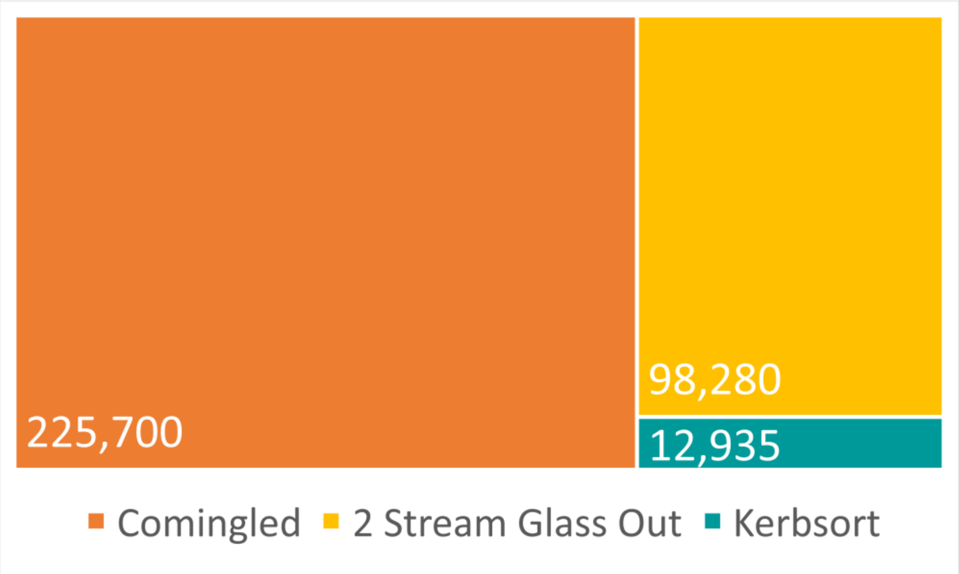
- Fibre
- Plastics
- Steel cans
- Aluminium cans
- Glass (fully comingled MRFs)

These materials may be sorted into a number of different grades depending on the MRF configuration and the markets for the materials. Typical grades include

- Plastics 1
- Plastics 2

- Plastics 5
- Mixed plastics (3 – 7)
- OCC (old corrugated cardboard)
- Mixed paper
- Clear (flint) glass
- Amber glass
- Green glass

Figure 32: Total Tonnes of Material Processed by Collection Type



Of the 336,000 tonnes of material estimated to be processed through MRFs annually approximately 266,000 tonnes is sent to markets in NZ or internationally. The lost proportion of around 21% represents the proportion that is removed as contamination, and any sorted material that for some reason is later landfilled rather than being recycled.

13.3 Facility Types

There are 20 MRFs of significant size in New Zealand[39] that accept mixed kerbside-collected material. These are operated by ten different organisations.

Of these 20 MRFs accepting over 1,000 tonnes of input materials per annum, there are four that accept material from fully comingled kerbside recycling collections:

- Visy in Auckland;
- EcoCentral in Christchurch;

[39] MRFs accepting over 1,000 tonnes of input material per annum. Other MRFs include Raglan and Wanaka.

- WMNZL in Timaru[40]; and
- Southland DisAbility Enterprises in Southland.

Together these facilities process 49% of the tonnage of all domestic kerbside-collected recyclables.

A further fourteen MRFs process material from two-stream, glass-out collections. These are:

- SEL in Kopu, Fielding, Tasman, and Buller;
- WMNZL in Tauranga and Queenstown;
- Metallic Sweepings in Te Awamutu;
- Palmerston North City Council in Palmerston North;
- Earthcare in Masterton (also able to split bales and reprocess mixed plastic);
- OJI in Seaview (Hutt City) and Dunedin; and
- ESL in New Plymouth, Hamilton and Taupo.

In addition, there are two MRFs that process material from kerbside sort collections. Typically, kerbside sort systems separate glass and paper at kerbside and send the mixed plastic and metal containers over a sort line. These MRFs are:

- MetroWaste in Huntly; and
- Metallic Sweepings in Marlborough.

One MRF (SEL in Gray) is currently not in operation following a fire in late 2020.

The sort line removes the metal containers and usually the uncoloured PET and HDPE containers.

It is common for MRFs in New Zealand to report contamination rates of between 10 – 18%. The lower contamination levels will usually be from facilities that accept kerbside sorted material; and it is possible for these facilities to achieve below 10%. Facilities accepting material from two-stream, glass out collections will usually fall around 12 – 16%. Facilities accepting fully comingled material will usually be at the higher end of the range, depending on the level of investment in specialised sorting equipment.

Several MRFs have received investment during 2020 from the COVID-19 Response and Recovery Fund (CRRF). Generally, this investment is not expected to enable the facilities to accept a larger quantity of material; rather, the investment is intended to address issues of contamination in sorted material. For example, Visy received investment, in the order of $16M, from the government's $37M allocation of the $124M COVID-19 CRRF. A particular focus for the investment will be improved fibre quality through the installation of improved and additional optical sorting for fibre. EcoCentral has also recently received government funding, with $16.8 million in funding being provided for

[40] From 1 July 2021 Timaru's kerbside recycling collection will transition to a glass-out collection and a new sorting line is being constructed for this material, so this facility will then move to the second category

EcoCentral to upgrade the optical and mechanical sorting machines used at its Parkhouse Road MRF.

13.4 Market Segments and Dynamics

MRF provision in New Zealand is generally provisioned by the private sector, with the majority of facilities owned and operated by waste companies, and aligned with kerbside recycling collection contracts, this means that MRF provision has tended to evolve over time to meet/suit the requirements of the various contracts held by operators.

Notable exceptions to this are:

- Palmerston North City Council's MRF, that is council owned and operated;
- Visy's Auckland facility which was built under a BOOT contract;
- Queenstown's facility is owned by Council, and operated on their behalf by WMNZL; and
- Christchurch City Council own a majority shareholding in EcoCentral, which operates kerbside services and infrastructure on behalf of council.

There is a known issue with marketing sorted fibre material that has originated from fully comingled domestic kerbside recycling collections. This material is not accepted by any domestic re-processing facility and therefore is exported. Once again, while fibre that is known to have come from a fully comingled collection system is unlikely to receive lower prices in export markets, it is viewed as being lower quality and if supply of recovered fibre exceeds demand, it is the lowest quality material that will lose markets first[41].

This issue has partially been resolved by recent investment in the Visy and EcoCentral MRFs; and may be further addressed should changes be made to domestic kerbside recycling collections in Auckland and Christchurch (as is recommended in the kerbside standardisation study).

There are other MRFs that may benefit from investment, such as the Palmerston North City Council MRF and the Southland DisAbility Enterprises MRF in Invercargill. However, investment at these facilities is likely to be targeted at increasing the capture of target materials, reducing cross-contamination, and enabling a wider range of materials to be collected at kerbside.

Although EnviroNZ will be delivering the new council kerbside collection contracts for Tauranga City and Western Bay of Plenty District Councils from July 2021, the kerbside-collected recyclables will continue to be processed by WMNZL as a sub-contractor.

[41] The Eunomia & TRC (2021) National Resource Recovery Project – Fibre Investigation and Response. Report for Ministry for the Environment

13.5 Gap Analysis – Material Recovery Facilities (MRFs)

A gap analysis exercise was conducted to identify the national, regional and transportation gaps, across the material lifecycle. The results are shown in the table below.

Key:

The gap is analysis is presented using a 'traffic light' grading system as shown below.

No significant gaps/issues	Some/potential gaps/issues	Significant gaps/issues

Table 18: National, Regional and Transportation Gaps Identified within MRFs

Infrastructure Type	National Capacity	Regional Capacity	Transport & Logistics
Location of MRFs - Sorting	There are 20 MRFs across the country. These vary in size from large facilities in the main cities (e.g. Visy in Auckland) to smaller facilities serving one or two small districts (e.g. Buller in the West Coast region)	There are MRFs in every region of New Zealand except Northland, which is transported to various Auckland facilities.	Contractors will strive to minimise transport costs and may establish a MRF facility where new council contracts are won. Transport and logistics can become an issue with MRF outputs, as some sorted material streams have limited reprocessing options and transport to these locations can become extremely expensive for some materials (e.g. glass).
Cost of Haulage - Sorting	Haulage costs vary considerably across the country.	Smaller and more remote communities struggle with cost of haulage.	Cost of hauling sorted materials from South Island and remote areas can be prohibitive, which is a key issue where the only reprocessing facilities are located in Auckland (e.g. glass) In some districts transporting material to a MRF can be a barrier

Infrastructure Type	National Capacity	Regional Capacity	Transport & Logistics
Collection Methodology	Nationally, nearly 50% of households are provided with a fully comingled kerbside collection. This requires MRFs that are capable of processing this material which comes at additional cost, and lower quality outputs. This can become an issue when allocating national funding.	Two regions in New Zealand, Auckland and Christchurch, are served by MRFs that can process fully comingled material (as required by the kerbside collection methodology). Other regions have generally implemented alternative collection methodologies, which reduce or prevent the requirement for expensive sorting technology.	Transport and logistics barriers are minimised as the companies or organisations operating collections will usually also operate the MRFs. There are short term issues in some areas due to transitions in service providers (e.g. Tauranga/Western Bay of Plenty, Napier/Hastings)
Sorting - Private versus Community Led MRFs	Community-led 'MRFs' have generally been excluded from this study as they tend to focus on human resources rather than infrastructure and are not actually MRFs. There is one significant non-profit MRF in the country.	The Southland region is currently served by a non-profit MRF, while the kerbside collections are now provided by a commercial operator. This is currently causing problems in integration between the kerbside collections and the MRF operation. This demonstrates how private ownership of MRFs can create issues in changing contractors, and/or resulting in duplication of infrastructure in some areas	No significant issues identified
Reprocessing of MRF Outputs	Nationally, New Zealand is reasonably well-served in reprocessing infrastructure or has access to (sometimes volatile) export markets. The significant exceptions are fibre originating from fully comingled collections, and glass in some parts of the country such as the lower and southwestern South Island	The Auckland and Canterbury regions are the key ones where kerbside material is collected fully comingled. The fibre from these MRFs cannot be reprocessed domestically, and there may be issues with reliability of export markets. Auckland is the only region with a glass reprocessing facility. The transport and logistics involved in getting glass to this facility dictate what	The transport and logistics involved in getting sorted material, particularly glass, to domestic reprocessing facilities is a key issue. Many South Island councils make use of alternative management options for glass which may not be as environmentally positive.

Infrastructure Type	National Capacity	Regional Capacity	Transport & Logistics
		happens to MRFs outputs in various regions.	

14.0 Collection Services

14.1 Description of Collection Services

The study of collection services focused on domestic kerbside recycling, waste, food scraps and green waste collections, both private and council contracted, as well as commercial recycling collections.

Commercial waste collection service providers were excluded from this research, as these services are provided by numerous small and large organisations across the country, in many cases providing only a freighting service, from a business site to a disposal site.

14.2 Stakeholder interviews

Much of the information was gathered from phone interviews and through a spreadsheet completed by interviewees outlining services provided.

Additional information was gathered from websites, through interviews with council staff, and from council Waste Assessments.

In total, 38 organisations providing collection services were identified, 63% were contacted, and 47% were interviewed. One organisation declined to be interviewed. Most of the organisations that were not interviewed are smaller collection companies offering localised services.

14.3 Type of collections

Overall, 18 commercial recycling collectors were identified, 20 domestic recycling collectors, 26 domestic waste collectors, four domestic food scrap collectors and 11 domestic greenwaste collectors. Several organisations are counted in more than one of the above categories.

Cardboard collections are the most frequently offered commercial collection (14 organisations), followed by comingled recycling (11 organisations) and plastic wrap recycling (8 organisations).

14.4 Services by region

As might be expected, certain regions have more domestic collection contractors operating within their boundaries than others. For example, in Gisborne we only identified one domestic collection contractor, while Waikato and Wellington each have eight domestic waste collection contractors with four domestic recycling contractors in Auckland and six in Waikato. Canterbury also has six domestic recycling collection contractors offering their services across the region and five domestic waste collection contractors.

There are more commercial recycling services available in Auckland, Waikato, Canterbury, and Otago than in other regions. Very few commercial recycling services were identified in the upper South Island or West Coast region.

14.5 Domestic collections

The following table provides a summary of the service providers collecting domestic kerbside recycling and waste in each district and city. This information is subject to regular change.

In the column headed 'Recycling collection system' information has also been provided as to the type of glass collection provided (comingled or separate) and the grades of plastic accepted for recycling. Almost all recycling collections also accept fibre (paper and cardboard), and aluminium and steel cans.

Table 19: Domestic kerbside collections by local authority

Local authority	Recycling collection contractors	Council or private	Recycling collection system	Council waste collection contractors	Council waste collection system
Ashburton	EnviroWaste	Council	Wheelie bin and glass in crate Plastic 1, 2, 5	EnviroWaste	Wheelie bin
Auckland	EnviroWaste, JJ Richards, Smart Environmental, AIMS (inner city), Envirokiwi (and Aotea Contractors) on Great Barrier Island	Council	Wheelie bin Glass comingled Plastic 1-7	Green Gorilla, Waste Management, Northern Environmental (joint venture between Smart Environmental & Northland Waste), AIMS (inner city), Envirokiwi (and Aotea Contractors) on Great Barrier Island	Wheelie bin
Buller	Smart Environmental	Council	Wheelie bin and glass in crate Plastic 1-7	Smart Environmental	Bags
Carterton	EarthCare	Council	Wheelie bin and glass in crate Plastic 1, 2, 5	EarthCare	Bags
Central Hawke's Bay	Smart Environmental	Council	Crate(s) Plastic 1-7	Smart Environmental	Bags
Central Otago	All Waste	Council	Two wheelie bins, one for glass Plastic 1, 2, 5	All Waste	Wheelie bin
Chatham Islands	No collection services			No collection services	

Local authority	Recycling collection contractors	Council or private	Recycling collection system	Council waste collection contractors	Council waste collection system
Christchurch	Waste Management	Council	Wheelie bin Glass comingled Plastic 1, 2, 5	Waste Management	Wheelie bin
Clutha	WasteCo	Council	Wheelie bin No glass Plastic 1, 2, 5	WasteCo	Wheelie bin
Dunedin	EnviroWaste	Council	Wheelie bin and glass in crate Plastic 1, 2, 5	EnviroWaste	Bags
Far North	Northland Waste Waste Management	Private	Crate(s), Bags & crate Plastic 1, 2		
Gisborne	Waste Management	Council	Crate Plastic 1, 2, 5	Waste Management	Bags
Gore	Bond Contracts	Council	Wheelie bin for glass only	Bond Contracts	Wheelie bin
Grey	Smart Environmental	Council	Wheelie bin Glass comingled Plastic 1-7	Smart Environmental	Wheelie bin
Hamilton	EnviroWaste	Council	Wheelie bin and glass in crate Plastic 1-7	EnviroWaste	Wheelie bin
Hastings	Smart Environmental	Council	Crate(s) Plastic 1, 2, 5	JJ's Waste & Recycling	Wheelie bin
Hauraki	Smart Environmental	Council	Wheelie bin and glass in crate Plastic 1, 2	Smart Environmental	Bags
Horowhenua	Northland Waste	Council	Wheelie bin and glass in crate Plastic 1, 2, 5	Northland Waste	Bags
Hurunui	Waste Control NZ	Council	Bags No glass Plastic 1, 2, 5	Waste Control NZ	Bags
Hutt City	Waste Management	Council	Crate(s) Plastic 1, 2	Waste Management	Bags
Invercargill	Bond Contracts	Council	Wheelie bin Glass comingled Plastic 1-7	Bond Contracts	120-litre wheelie bin

Local authority	Recycling collection contractors	Council or private	Recycling collection system	Council waste collection contractors	Council waste collection system
Kaikōura	Innovative Waste Kaikoura	Private	Crate(s) Plastic 1, 2, 5	No council services	
Kaipara	Kaipara Refuse	Private	Bags Glass comingled Plastic 1, 2	No council services	
Kāpiti Coast	Northland Waste Waste Management Lucy's Bins EnviroWaste	Private	Wheelie bin and glass in crate, Crate (s) Plastic 1, 2, 5	No council services	
Kawerau	Waste Management	Council	Crate (s) Plastic 1, 2		Wheelie bin
Mackenzie	EnviroWaste	Council	Wheelie bin and glass in crate Plastic 1, 2, 3, 4, 5, 7	EnviroWaste	Wheelie bin
Manawatu	Smart Environmental	Council	Wheelie bin and glass in crate Plastic 1-7	Smart Environmental	Bags
Marlborough	Metallic Sweepings Waste Management	Council, Private	Crate(s), Plastic 1-7 Wheelie bin Plastic 1, 2	Metallic Sweepings	Bags
Masterton	EarthCare	Council	Wheelie bin and glass in crate Plastic 1, 2, 5	EarthCare	Bags
Matamata-Piako	Smart Environmental	Council	Wheelie bin and glass in crate Plastic 1, 2	Smart Environmental	Bags
Napier	Smart Environmental	Council	Crate(s), glass separate Plastic 1, 2, 5	Waste Management	120-litre wheelie bin
Nelson	Waste Management, Betta Bins	Private	Wheelie bin, glass in crate Plastic 1, 2	No council service	

Local authority	Recycling collection contractors	Council or private	Recycling collection system	Council waste collection contractors	Council waste collection system
New Plymouth	EnviroWaste	Council	Wheelie bin and glass in crate Plastic 1, 2, 5	EnviroWaste	Wheelie bin
Ōpōtiki	Handee Can Services	Council	Crate (s) Plastic 1-7	Handee Can Services	Bag
Ōtorohanga	EnviroWaste	Council	Crate (s) Plastic 1, 2	EnviroWaste	Bag
Palmerston North	Waste Management	Council	Wheelie bin and glass in crate Plastic 1-7	City Enterprises (owned by PCC)	
Porirua	Waste Management	Council	Two wheelie bins, one for glass Plastic 1, 2	Waste Management & Civic Contractors	
Queenstown Lake	Waste Management All Waste	Private	Two wheelie bins, one for glass Wheelie bin comingled glass Plastic 1, 2, 5	Waste Management	120-litre wheelie bin
Rangitīkei	No collection services				
Rotorua Lakes	Smart Environmental	Council	Wheelie bin and glass in crate Plastic 1-7	Smart Environmental	Wheelie bin or bags in specific areas
Ruapehu	EnviroWaste	Council	Crate(s) Plastic 1, 2	EnviroWaste	Bags
Selwyn	Waste Management	Council	Wheelie bin Glass comingled Plastic 1, 2, 5	Waste Management	Wheelie bin
South Taranaki	EnviroWaste	Council	Wheelie bin and glass in crate Plastic 1, 2, 5	EnviroWaste	Wheelie bin
South Waikato	EnviroWaste	Council	Wheelie bin and glass in crate Plastic 1, 2, 5	EnviroWaste	Wheelie bin

Local authority	Recycling collection contractors	Council or private	Recycling collection system	Council waste collection contractors	Council waste collection system
South Wairarapa	EarthCare	Council	Wheelie bin and glass in crate Plastic 1, 2, 5	EarthCare	Bags
Southland	Bond Contracts	Council	Wheelie bin Glass comingled Plastic 1-7	Bond Contracts	240-litre wheelie bin
Stratford	EnviroWaste	Council	Wheelie bin and glass in crate Plastic 1, 2, 5	EnviroWaste	Wheelie bin
Tararua	Smart Environmental	Council	Any container No glass Plastic 1, 2, 3, 5	No council service	
Tasman	Smart Environmental Various	Council Private	Wheelie bin and glass in crate Plastic 1, 2, 5 Wheelie bin Plastic 1, 2	Smart Environmental	Bags
Taupō	EnviroWaste	Council	Crate (s) Plastic 1, 2, 5	EnviroWaste	Bags
Tauranga	EnviroWaste	Council	Crate for glass Wheelie bin Plastic 1, 2	EnviroWaste	Wheelie bin
Thames-Coromandel	Smart Environmental	Council	Wheelie and glass in crate Plastic 1, 2	Smart Environmental	Bags
Timaru	Waste Management	Council	Wheelie bin Glass comingled Plastic 1, 2, 5	Waste Management	Wheelie bin
Upper Hutt	Low Cost Bins, Waste Management	Private	Wheelie bin and glass in crate Plastic 1, 2, 5	Waste Management	Bags
Waikato	Metro Waste Xtreme Zero Waste Smart Environmental	Council	Crate(s) Plastic 1, 2, 5 Crate(s) Plastic 1-7 Crate(s) Plastic 1, 2, 5	Smart Environmental, Metro Waste, Xtreme Zero Waste	Wheelie bin or bags

Local authority	Recycling collection contractors	Council or private	Recycling collection system	Council waste collection contractors	Council waste collection system
Waimakariri	Waste Management	Council	Wheelie bin Glass comingled Plastic 1, 2, 5	Waste Management	Wheelie bin or bags
Waimate	EnviroWaste	Council	Wheelie bin and glass in crate Plastic 1, 2, 5	EnviroWaste	80-litre wheelie bin
Waipa	Metallic Sweepings	Council	Two wheelie bins, one for glass Plastic 1, 2	No council service	Wheelie bins
Wairoa	Smart Environmental	Council	Crate(s) Plastic 1, 2, 5	Smart Environmental	Bags
Waitaki	WasteCo	Private	Wheelie bin Glass comingled Plastic 1, 2, 5	No council service	
Waitomo	EnviroWaste	Council	Crate (s) Plastic 1, 2	EnviroWaste	Bags
Wellington City	EnviroWaste	Council	Bags / crates / wheelie bins Plastic 1, 2, 5	EnviroWaste	Bags
Western Bay of Plenty	EnviroWaste	Private	Wheelie bin and glass in crate Plastic 1, 2	EnviroWaste	Wheelie bin
Westland	EnviroWaste	Council	Wheelie bin No glass Plastic 1, 2, 5	EnviroWaste	Wheelie bin
Whakatāne	Waste Management	Council	Wheelie bin and glass in crate Plastic 1, 2	Waste Management	Wheelie bin
Whanganui	Waste Management	Private	Wheelie bin Glass comingled Plastic 1-7	No council service	
Whangarei	Northland Waste	Council	Crate(s) Plastic 1, 2	Northland Waste	Bags

Twenty recycling collection contractors were identified during this research, with some of the smaller contractors providing recycling collections in only one or two localised areas, and other contractors operating across the country.

Domestic recycling collections vary from wheelie bin collections, collecting all materials combined, to wheelie bins and a separate glass crate or wheelie bin, to crates only. The types of plastics collected also vary from area to area, with some areas accepting plastic grades 1 and 2 only, or 1, 2 and 5, and others accepting all plastic grades 1 to 7. One council collection accepts all plastics except for plastic 6.

In 2020, WasteMINZ published a report for the Ministry for the Environment, entitled *Recommendations for standardisation of kerbside collections in Aotearoa.* In this report it was recommended that the materials collected in kerbside recycling be standardised across the country and include plastic 1, 2, 5, aluminium and steel cans, glass bottles and jars, and fibre (paper and cardboard). It was also recommended that glass be collected separately to other materials. Of the 67 local authorities included in Table 11.1, 43% collect (only) plastics 1, 2, 5, and 75% collect glass either in crates or in a separate wheelie bin. A further 7% do not collect glass.

Domestic waste collections are generally undertaken using wheelie bins (80-, 120-, 140- or 240-litre) or refuse bags. Many councils provide their residents with a regular council waste collection provided by a contactor. In most areas there are also private collection contractors competing for market share with the council collection. Some councils choose to leave waste collections to the private market. A total of 25 domestic waste collection companies were identified (plus two council organisations - AIMS (in Auckland) and City Enterprises (in Palmerston North).

Domestic food scrap collections are available in a small, but growing, number of areas around New Zealand. Some of these collections are food scraps only, while others accept food scraps and garden waste combined (FOGO – Food Organics and Garden organics). Other councils are planning food scrap collections (Auckland) or trialling food scrap collections (Wellington City Council).

Greenwaste (only) collections are provided across much of the country but are generally offered as a private service that householders can subscribe to, with the exception of a handful of councils such as Whakatane and South Taranaki that provide green waste collection services (excluding food scraps).

14.5.1 Planned Capacity

The most common comment from organisations providing collection services was that they were delaying investment in infrastructure due to current uncertainties in the marketplace, mostly with regards to funding. The uncertainty included possible government funding for infrastructure, funding of competition through the Waste Minimisation Fund (WMF), and the potential impacts of container return schemes (CRS) on markets.

Certainty around standardisation of domestic collection services was also being awaited.

14.6 Discission and analysis

Concern over future government investment was expressed by several businesses operating collection services, as well as a general uncertainty over the government's future direction and priorities.

Generally, the larger commercial operators expressed confidence in the market providing the necessary infrastructure and services and expressed concern over intervention in a commercial marketplace.

Community led resource recovery enterprises (members of the Zero Waste Network and other community enterprises) expressed a desire for the government to support more community level education and community services that promote waste reduction, reuse and repair. They implied that local government still relates to waste as an engineering issue, when it is actually part of a larger behaviour change and consumer education issue.

A range of policy responses were recommended by service providers. A desire to see government ban certain packaging materials or at least provide disincentives to their use was mentioned by a majority of interviewees.

Other key recommendations from stakeholders included a need for the government to take bolder action around waste minimisation and urging the government to take stronger leadership to reduce carbon emissions from waste.

A commercial operator mentioned the national shortage of collection drivers as a significant issue and the ageing population of current drivers as a key future risk.

14.7 Future Opportunities

It is expected that future services will adapt to meet business needs, markets for materials, and the direction set by local and central government.

Future drivers for domestic waste and recycling collections are likely to revolve around some standardisation of kerbside collections, and the adoption of these standards by local authorities. The outcomes of current health and safety research into collection methodologies is also likely to influence future collection services.

The implementation of a CRS will likely affect kerbside recycling collections, with certain materials currently collected being diverted to the CRS. This could result in changes to the materials collected, the frequency of collection services, and the financial viability of collection services.

Commercial collections are more likely to be influenced by the availability of markets for materials and the willingness of businesses to meet the costs of recycling.

Product stewardship programmes may increase the provision of commercial collection services for certain materials.

14.8 Gap Analysis – Collection Services

A gap analysis exercise was conducted to identify the national, regional and transportation gaps, across the value chain. The results are shown in the table below.

Key:

The gap is analysis is presented using a 'traffic light' grading system as shown below.

No significant gaps/issues	Some/potential gaps/issues	Significant gaps/issues

Table 20: National, Regional and Transportation Gaps Identified within Collection Services

Infrastructure Type	National Capacity	Regional Capacity	Transport & Logistics
Household Waste Collection	Domestic kerbside waste collections provided to most households, with the exception of some rural areas.	Waste collection services vary across the country – from collections provided in bags or in wheelie bins of various sizes, to be user-paid, rates funded, or private subscription services.	Domestic waste collections are generally disposed of to the closest local disposal facility, though in some regions waste must be transported out of region and over considerable distances.
Household Recycling Collection	Recycling services differ significantly across country, in terms of materials collected and collection services. TAs and collection contractors awaiting outcomes of national kerbside standardisation project.	Recycling services differ across regions, potentially creating householder confusion. Different materials are accepted for recycling by different TAs creating householder confusion. Some councils do not offer kerbside recycling collections (e.g. Kapiti, Upper Hutt, Kaipara)	Transporting materials to markets can make collections uneconomical, especially in the South Island. Transport costs can result in some materials (i.e. glass) not being collected and/or recycled in some areas.
Household Food Scraps Collection	Few TAs currently collecting food scraps. Limited infrastructure currently available to process food scraps.	Infrastructure to process food scraps is only available in 3 regions	Uneconomic to transport food scraps for long distances to processing plants

Commercial Recycling Collection	The availability of commercial recycling collections varies across the country. There is little incentive for businesses to recycle unless it is economically advantageous. Unless the cost of landfill is significantly higher, there is little incentive for businesses to source separate materials for recycling.	Certain regions are much better serviced than others.	Transport costs are passed on to customers, making recycling uncompetitive against landfill costs in some regions.
Quality	The quality of recyclate collected from households varies across the country, based to a great extent on the type of kerbside collection provided.	Contamination tends to be higher in comingled recycling collections (e.g. Auckland, Christchurch, Southland).	While contractors with better quality recyclate may have easier access to markets, the cost of transport can still make it uneconomical.
Education, communication, policy and legislation/regulation	Without standardised kerbside collections it is not possible to run national recycling campaigns. Public confusion is therefore likely to continue and contributing to high levels of contamination. Waste collection services are focused on collecting waste streams, rather than reducing waste. Need to focus on initiatives higher on the waste hierarchy. No central agency to facilitate national education and communications, national data collection, implement national standards or targets etc.	No targets for TAs to reduce waste to landfill, and therefore no incentives for TAs to invest in infrastructure or education to reduce waste	N/A

15.0 Transfer Stations and Resource Recovery Facilities

15.1 Description of Facilities

The terminology used to describe waste and recycling facilities in New Zealand is varied and non-standardised. Services provided at Refuse Transfer Stations, Resource Recovery Centres, Community Recycling Centres vary from site to site, and the names are often used interchangeably. Within this report all of these facilities are being referred to as 'transfer stations and resource recovery facilities'.

The term 'community led resource recovery enterprise' is used in this section to refer to members of the Zero Waste Network and other community enterprises operating facilities. Generally, facility operators are either community-led resource recovery enterprise or profit driven commercial enterprises.

15.2 Stakeholder Mapping

A total of 31 facility operators were identified as part of this research and 81% of these operators were interviewed.

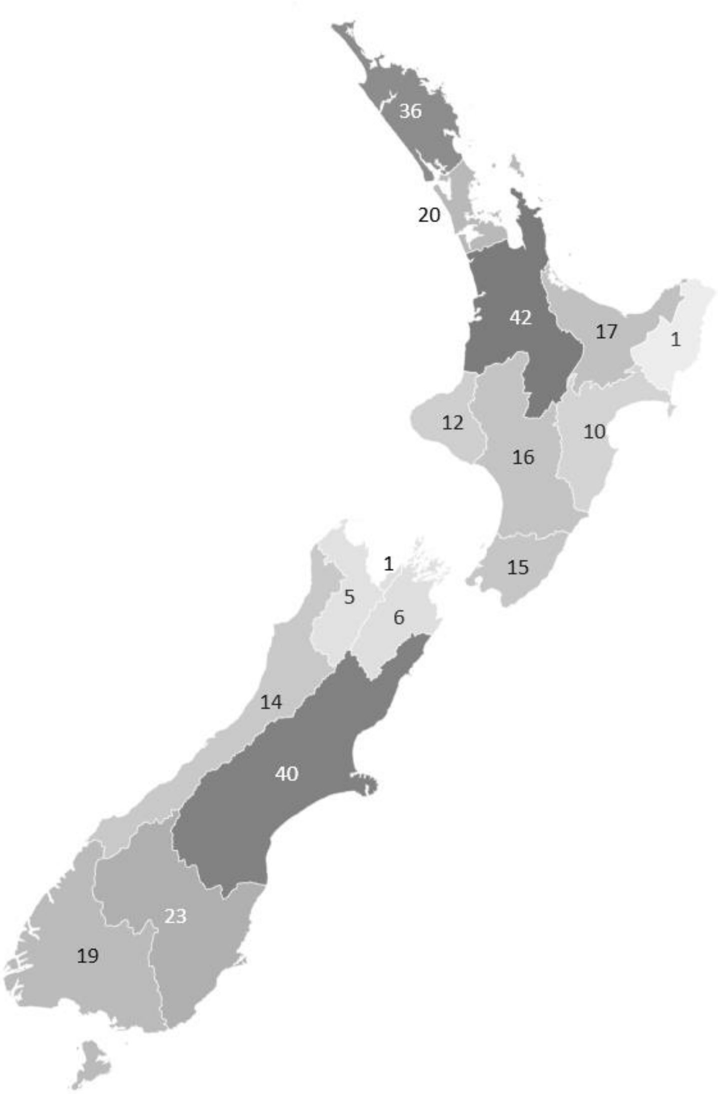
Altogether, 277 separate facilities were identified across the country. Waikato region has the most facilities (42), followed by Canterbury region (40), and Northland region (36).

The types of services provided in each facility varies. Some sites are set up specifically to accept recyclable materials only, or waste only, while other sites provide a range of services. Separated greenwaste is accepted at 70% of sites and scrap metal at 66% of sites.

A further 57% of sites accept tyres and 44% accept e-waste.

Fourteen per cent of sites include a reuse shop.

Map 1: Number of facilities per region



Of the 277 facilities identified, 83% accept waste, 91% accept some recyclable materials, and 70% accept greenwaste. Scrap metal is accepted by a further 66% and tyres by 57%. Fourteen per cent of facilities have a reuse shop.

15.2.1 Planned Capacity

Many of the interviewed operators stated a desire to expand resource recovery opportunities at their sites. One operator discussed increasing capacity to compost, and to recover C&D waste and wood waste. Another spoke of creating 'integrated community facilities' to enable additional upcycling of waste materials.

Auckland Council is planning a further nine Community Recycling Centres across the region to create new jobs and move the region towards a circular economy.

Several of the community led resource recovery enterprises have plans to accept a wider range of materials, including organics, timber, C&D waste materials etc.

Most operators mentioned their desire to be involved in future CRS and product stewardship schemes.

15.3 Barriers

A range of barriers were outlined by operators. These included:

- the economics of long-distance haulage and low commodity prices (and in some instances needing to pay for commodities to be recycled (e.g. fibre)
- a lack of scale in smaller communities, and a lack of regional consolidation facilities
- difficulty in obtaining suitable land and resource consents for sites
- sites being too small to offer additional services, and a lack of covered areas on existing sites
- a lack of incentives for local authorities to invest in facilities
- tension between ongoing economic growth and waste reduction
- lack of funding for ongoing behaviour change and a tendency for local authorities to view waste as an engineering issue rather than a behaviour change issue
- need for more R&D and innovation
- need for government leadership including a ban on non-recyclable packaging, national standardisation, waste minimisation targets, and prioritising specific products to be targeted
- lack of revenue in resource recovery.

15.4 Discussion and Analysis

The majority (84%) of transfer station and resource recovery facilities are owned by local authorities and their operations are contracted out to private businesses or community enterprises. However, there appears to be a move by private waste operators towards operating more private facilities.

It became apparent during the interviews that the role of the traditional transfer station is changing, with larger waste companies investing in reuse shops and more recycling services.

Community led resource recovery enterprises generally voiced a desire to see more support to drill further down into waste minimisation and behaviour change. They also warned against infrastructure that locks you into a certain way of doing things, when what is needed is a move to a new circular economy model, with funding for behaviour change and community engagement alongside infrastructure.

They suggested that using social procurement as a tool provides the ability to generate multiple benefits from the same spend - including regional development, Covid recovery, and jobs in local economies and for marginalised people.

A private operator commented on the difficulty of establishing regional facilities and making them commercially viable as there is often not the scale of material needed.

Another operator suggested that they would like to see a subsidy for the transport of materials to end markets, paid to the buyer rather than the vendor.

15.5 Future opportunities

It appears that owners and/or operators of transfer stations and resource recovery facilities are poised to adapt to the changes they see coming in the industry but are awaiting certainty as to the details of those changes. Many organisations spoke about increasing opportunities within their facilities for resource recovery, and several showed a willingness to invest in infrastructure to do so.

Auckland Council, Para Kore, and the Zero Waste Network are advocating for more community led resource recovery enterprises to ensure true waste reduction, rather than more waste management.

The introduction of product stewardship schemes and of a CRS have the potential to impact on the services offered by transfer stations and resource recovery facilities, and the extent of these impacts are greatly dependent on the design of these new schemes.

Increases to the waste levy are also likely to ensure that more resource recovery can be undertaken at many sites. In particular, several operators mentioned their desire to divert more C&D waste once the waste levy is increased.

15.6 Gap Analysis – Refuse Transfer Station (RTS) and Resource Recovery Facilities (RRF)

A gap analysis exercise was conducted to identify the national, regional and transportation gaps, across the value chain. The results are shown in the table below.

Key:

The gap is analysis is presented using a 'traffic light' grading system as shown below.

No significant gaps/issues	Some/potential gaps/issues	Significant gaps/issues

Table 21: National, Regional and Transportation Gaps Identified RTS & RRF

Infrastructure Type	National Capacity	Regional Capacity	Transport & Logistics
Consumer access	There are over 277 facilities across the country.	Some regions struggle due to lack of scale and the cost of haulage.	Difficulty sourcing land for facilities and obtaining resource consents. Often not enough space to accept separated materials.

Infrastructure Type	National Capacity	Regional Capacity	Transport & Logistics
Consistency of service	No consistency in services, signage, pricing across RTS and RRFs.	No consistency within regions in terms of services provided at sites, charging regimes, site layout, signage etc.	Haulage costs vary considerably across the country. Smaller and more remote communities struggle with cost of haulage. Cost of hauling materials from South Island and remote areas can be prohibitive.
Incentives	Lack of incentives to reduce waste rather than recover it.	No targets for TAs to reduce waste, therefore little incentive to invest in infrastructure. Tendency to replicate current infrastructure instead of investing in innovation.	
Community led facilities	Community led resource recovery facilities generally focus higher up the waste hierarchy than privately run facilities but report a lack of funding for waste minimisation and behaviour change.	Community led resource recovery facilities provide more local employment than private facilities.	

16.0 Class 1 Landfill Analysis

16.1 Definition of 'Class 1 Landfill'

The Waste Minimisation Act 2008 (WMA) definition of a 'disposal facility' aligns closely with the WasteMINZ *Technical Guidelines for the Disposal to Land of Residual Waste and Other Material* definition for 'Class 1 landfill'. The *Guidelines* define a 'Class 1 landfill as 'any site that accepts municipal solid waste'.

Section 6 of the WMA imposes a levy on waste disposed of at a 'disposal facility'. The accompanying regulations require operators of disposal facilities to provide a monthly return of the tonnages of waste entering the facility. Only those facilities that provide a monthly levy return, which represent a very high proportion of disposed tonnages, have been included in the analysis in this section.

16.2 Class 1 landfills - By Ownership

The New Zealand solid waste disposal market is gradually transitioning from local government to private enterprise dominance. Through most of the twentieth century, local government owned all waste infrastructure, such as landfills and transfer stations, and provided rates-funded kerbside rubbish collection services to residential properties.

Local government responsibilities for waste management originated with the Health Act 1956, which *obliged* councils to provide sanitary works for the collection and disposal of waste for the purpose of public health protection. Many of these services were contracted out to private enterprise, but local authorities maintained ownership of the assets.

During this period, solid waste was disposed of at a large number of small, council-owned landfills, which were poorly engineered by modern standards. A 1987 Department of Health survey identified 462 landfills, while MfE's 1995 *National Landfill Census* identified 327 landfills. [42]

The moves towards private ownership began in Auckland, with the opening in 1993 of Redvale Landfill, by Waste Management NZ Ltd (WMNZL), and the sale by local government-controlled Infrastructure Auckland of its share in the other major landfills in the region.

The Resource Management Act 1992 (RMA) also had a significant impact on the expansion of the private waste disposal market. Tighter environmental regulations under the RMA resulted, over a period of a decade, in many of the smaller council-

---

[42] Ministry for the Environment (MfE), *1997 National Waste Data Report*. Ministry for the Environment, Wellington

owned landfills throughout the country closing and being replaced by regional landfills, which are largely privately owned and require significant capital investment to establish.

The tonnages from the 36 Class 1 landfills submitting monthly levy returns in 2018 are analysed in terms of ownership in Table 22.

Table 22: Analysis by Ownership - Class 1 landfills - 2018

Ownership of Class 1 landfills	# of Class 1 landfills	% of Class 1 landfills	Tonnes/ annum	% of tonnes/ annum
Private	6	17%	2,238,201	60%
Private/public	3	8%	627,501	17%
Public	27	75%	839,126	23%
TOTAL	**36**	**100%**	**3,704,828**	**100%**

Nearly three-quarters (75%) of Class 1 landfills were in public ownership in 2018. These landfills accepted 23% of all waste to landfill, by weight, in that year. The six Class 1 landfills that are completely privately owned (17% of landfills) received 60% of all waste to landfill.

16.3 Class 1 landfills - By Tonnage Bands

The 36 Class 1 landfills that submitted monthly levy returns in 2018 are analysed in terms of tonnage bands in Table 23.

Table 23: Analysis by Tonnage Bands - Class 1 landfills - 2018

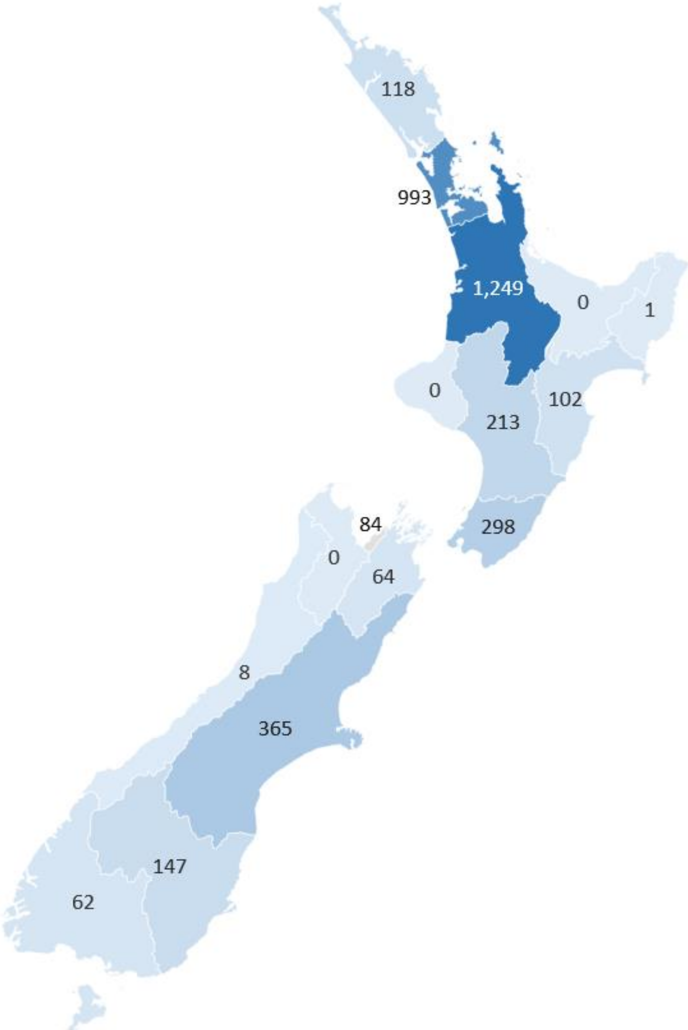
Online Waste Levy System Tonnage 2018	# of Class 1 landfills	% of Class 1 landfills	Tonnes/ annum	% of tonnes/ annum
< 5,000 tonnes/annum	9	25%	15,056	0.4%
5 - 40,000 tonnes/annum	10	28%	163,651	4%
40 - 90,000 tonnes/annum	8	22%	545,115	15%
> 90,000 tonnes/annum	9	25%	2,981,006	80%
TOTAL	**36**	**100%**	**3,704,828**	**100%**

Approximately 20%, by weight, of all waste in 2018 was disposed of at the 75% of Class 1 landfills that are in the lowest three of the four tonnage bands. Over 80% of all waste was disposed of at the 25% of Class 1 landfills that accept over 90,000 tonnes of waste per annum. Subsequent to the closure of five Class 1 landfills between 2018 and 2020, the percentage of waste disposed of at Class 1 landfills that accept over 90,000 tonnes of waste per annum would have risen to 83% by 2020, based on 2018 OWLS tonnages.

16.4 Waste to Class 1 Landfills - Tonnage by Region

The 2018 tonnage of waste disposed of to Class 1 landfills in each region is illustrated in Figure 33. The tonnages do not represent the quantity of waste generated in each region, but, rather, the quantity of waste disposed of in each region. Class 1 landfills in Waikato region, for example, receive significant quantities of waste from Auckland and Bay of Plenty regions. There are no Class 1 landfills in three regions - Taranaki, Bay of Plenty, and Tasman.

Figure 33: Quantities Landfilled Within Each Region -2018 (x 1,000 tonnes)



16.5 Economic Drivers for Waste Flows to Class 1 Landfills

16.5.1 Ownership and/or Control of Assets

In general terms, for any waste operator the most financially beneficial waste flows are likely to be those in which the operator owns or controls all stages of the waste disposal process, from collection from the waste generator, through amalgamation at a transfer station, to disposal at a landfill. This type of vertical integration results in multiple opportunities to derive profit from the waste flow and the ability to compete more aggressively with other companies. The New Zealand waste market is dominated by two companies, Waste Management NZ Ltd and EnviroWaste Services Ltd, with nationwide vertically integrated operations.

16.5.2 Operational Cost of Disposal

Although Class 1 landfills have a nominal disposal charge, this 'gate charge' is not fixed for every customer. In situations where there is a competitive market for landfill disposal, the landfill operator will offer large customers lower prices than they would to a smaller customer to gain their business. Amongst other considerations, the operator may also charge lower gate charges to customers with high transport costs (i.e. longer distances to travel) than customers with lower transport costs.

The price per tonne that a Class 1 landfill operator is able to offer a potential customer is related to the operational cost of disposing of waste at the facility. Based on publicly available data on six landfills, operational costs range from $42 per tonne at Omarunui in Hawke's Bay to $125 per tonne at York Valley Landfill.

16.5.3 Transport Costs

As a majority of waste disposed of at Class 1 landfills is aggregated and transported to the landfill for the disposal, the cost of transport can be a significant component of the total cost of disposal. Based on information from confidential commercial sources, the cost of a 'tonne/km' for transporting waste is generally in the range of $0.30-$0.60 for 20-tonne aggregated loads. At $0.40 per tonne/km, the cost to transport a single 20-tonne load 100 km would be $800, or $40 per tonne.

16.5.4 Emissions Trading Scheme and Waste Levy Expenses

The Climate Change Response Act 2002 requires emitters of greenhouse gases, which includes operators of Class 1 landfills, to surrender one emissions unit for each tonne of emissions from listed activities. With the cost of emissions units currently over $30, the costs imposed upon Class 1 landfill operators with no gas capture by the Emissions Trading Scheme are already substantial, relative to disposal costs, and likely to increase further over time. However, landfills are able to reduce their liabilities by capturing and destroying the methane that is emitted. Under current regulations up to 90% methane capture is allowed to be claimed and high rates of capture are claimed by several of the large modern landfills, which substantially reduces their liabilities from the ETS.

Currently set at $10/tonne, the current government plans to increase the waste levy to $60/tonne by 2024 and expand it to other classes of landfills (to $30 for Class 2 landfills and $10 for Class 3-4 landfills).

16.6 Market Dynamics

Over the last 30 years, ownership and control of Class 1 landfills has changed from complete control by local government to a dominance by private enterprise. This rapid shift is no longer occurring, and the current balance of public/private ownership is likely to be relatively stable in the medium-term.

The rate at which small facilities that no longer meet environmental requirements are closing has slowed, and the remaining facilities in this category represent a very small proportion of all landfilled waste. However, increased costs imposed by the ETS, relative to large landfills, is a concern for some smaller landfills and may make them uneconomic in the medium- to long-term.

Most medium to large council-owned landfills have resource consents that will allow the facilities to remain operative for 15 to 20 years. The only major council-owned landfill that is likely to close in the near-term is Green Island Landfill in Dunedin. Planning for its replacement is well-advanced.

The three landfills that are owned by public/private partnerships received 17% of all waste to Class 1 landfills in 2018. All three landfills are consented for the next 15-20 years and are likely to continue operations for that period.

As of 2020, there are five Class 1 landfills in private ownership, one fewer than in 2018. These five facilities receive over 60% of all levied waste. The only significant change in the near-term will be the closure of Redvale Landfill, north of Auckland, after 30 years of operation. Redvale Landfill is likely to be replaced by another facility further north. The other four privately owned facilities are expected to continue operating for several decades.

The most dynamic environment for waste flows in the near to medium-term is likely to be in the upper North Island. The three large privately owned facilities in the region receive 55% of all levied waste.

The ongoing competition between Redvale Landfill (and its successor) and Hampton Downs Landfill for Auckland region waste flows is likely to continue. Although both facilities are owned by vertically integrated waste companies with their own network of transfer stations, they compete for disposal contracts from large waste generators.

There is similar competition between Hampton Downs Landfill and Tirohia Landfill, which are only 70 km apart in Waikato region. These facilities compete for both council and private waste flows.

Waste flows in the South Island are less dynamic than in the North Island. The only significant competition for waste flows is between privately owned AB Lime Landfill and the council-owned facilities in south Canterbury and Otago.

17.0 Energy Recovery

The potential for recovering energy from waste materials is a theme that cuts across a number of material types, in particular organics, plastics, fibre, tyres, and construction and demolition wood waste.

This section provides a brief overview of the potential for energy recovery from waste materials in New Zealand. This is an area of cross-over with the energy sector and, overall, the future potential of this sector has been well covered by interests in the energy sector.[43]

Energy recovery activity is presented in this section in terms of the fuel type.

- Biogas
- Liquid fuels
- Solid fuels
- Energy from residual waste

The following potential quantities of waste materials that could be used for energy generation have been identified:

Table 24: Biofuel Energy Potential from Waste

	Tonnes	Petajoules (PJ) energy potential*
Wood waste to landfill	267,000	1.88
Orchards	46,398	0.39
Crop residues	121,995	1.04
Municipal biosolids (dry weight)	82,000	1.08
Manures (dry weight)	4,075,000	1.66
Industrial effluents		1.23
MSW	235,000	1.64

[43] It is worth noting that recovery of energy from waste materials is a relatively small subset of the bioenergy sector. Moves towards increased use of biofuels for energy generation may result in new facilities and economies of scale that in turn lead to opportunities for recovery of energy from waste materials where these are not necessarily viable in their own right.

	Tonnes	Petajoules (PJ) energy potential*
Forestry residues	1,240,000	10.55
Tallow	178,000	5.16
TOTAL	**6,245,393**	**24.63**
* Estimated from available data		

Data compiled from: Scion (2018) The New Zealand Biofuels Roadmap Summary Report, Scion (2007) Bioenergy Options for New Zealand, and MBIE (2019) ENERGY IN NEW ZEALAND. Comprehensive information on and analysis of New Zealand's energy supply, demand and prices

As can be seen from the above table, forest harvest residues are the largest potential source of waste materials identified. This is not material that currently goes to landfill. Similarly, tallow is also currently going to other high value uses (e.g. cooking fats), and Scion (2018) notes it would therefore likely be too expensive to play a large role in future biofuel production. Forest residues are seen as the most promising source material for current and future biofuel production. Scion (2018) estimates these could provide up to 4.5% of the equivalent 2015 liquid fuel demand for NZ.

While quantities of other organic wastes are small in energy production terms, they may have increased viability in the future due to new drivers such as the avoiding the waste levy and NZETS, reducing the use of fossil fuels and associated greenhouse gases.

17.1 Biogas

Biogas is essentially methane generated from the decomposition of organic materials and captured for the production of energy. The gas can be used to generate heat and/or electricity or can be cleaned up and used as a vehicle fuel. The most common of these facilities are associated with wastewater treatment plants (13) and landfill gas capture (14). Excluding these and pilot plants there are only 6 operational anaerobic digestion facilities in New Zealand we were able to identify.

The most significant development in the biogas space is the planned EcoGas facility which is due to become operational from early 2022. The plant will have a capacity of 75,000 tonnes per annum. It will take kerbside food waste from Auckland, commercial food waste, and food processing wastes.

The Bioenergy Association suggests there is significant potential for growth in the production of biogas a year from residual organic wastes from food processing, waste water treatment facilities and dairy effluent if supplemented with other organic material.[44] There is also likely potential for increased capture of biogas from waste water treatment plants from the 309 plants that do not have anaerobic digesters but could be converted.[45] The dairy sector could also produce biogas from anaerobic treatment of milking shed effluent but is currently constrained by lack of economies of scale and the alternative of direct dispersal onto pasture.

17.2 Liquid Biofuels

Liquid biofuels are substitutes for liquid fossil fuels and include biodiesel, bioethanol, and bio-oils. Liquid biofuel use makes up less than 0.1% of total liquid fuel sales in New Zealand.

Z Energy built a plant that is able to produce 20 million litres a year of biodiesel from tallow. However recent increases in the price of tallow has reportedly rendered the plant uneconomic. The tallow is now being exported for biofuel production in the USA.[46]

A number of New Zealand companies are or have been exploring the potential to produce biofuels.[47] However there are currently limitations around the quantity of feedstocks which, without expansion, would limit the role they are likely to play. Any such expansion would come primarily from energy crops rather than residual or waste material.

Biocrude can be produced from any organic waste. An interim is to use residual plastic waste to produce a crude oil- then as the use of biomass becomes economic the feedstock can transition from plastic to biomass using the same facilities.

17.3 Wood Waste and Solid Fuels

Wood biomass, primarily from forestry slash and, to a lesser extent, sawmill by-products is the most commonly used biofuel in NZ. The most recent available data suggests that in NZ biomass provides 51.3 Petajoules of energy annually (Approximately 14,250 gigawatts)[48] with residential uses adding a further 7.53PJ.[49] Woody biomass from residuals from the wood processing industry makes the largest contribution to bioenergy currently used in New Zealand. There is around 22.3 PJ per annum from solid wood fuels and a further 12.6 PJ from Black liquor at the two kraft pulp mills in the Central north Island. There is a further resource of in-forest post-harvest residues of 21 to 27PJ that

---

[44] https://www.biogas.org.nz/resource/is47-role-of-biogas-in-transition-to-low-carbon-economy
[45] https://www.waternz.org.nz/WWTPInventory
[46]https://www.stuff.co.nz/environment/climate-news/300010423/z-energy-puts-biofuel-plant-to-sleep-asks-for-govt-money
[47] Scion (2018) New Zealand Biofuels Roadmap Summary Report
[48] For context, NZ's total energy supply is approximately 591 Petajoules annually, and so biomass represents in the order of 8.5% of total energy supply. http://www.mbie.govt.nz/building-and-energy/energy-and-natural-resources/energy-statistics-and-modelling/energy-publications-and-technical-papers/energy-in-new-zealand/

[49] Source: https://tools.eeca.govt.nz/energy-end-use-database/ 2019 data

currently is largely untapped. The use of these in-forest residues may accelerate in the near futures due the Governments focus on eliminating coal from process heat.

Industry sources suggest that NZ is still at bottom end of realising its future potential in terms of biomass. There is room for more use of wood residues from wood processing with current use within the wood processing being around 65 to 70% of the residuals produced. The use of in-forest residues is probably less than 5% of the potential. Future projects in the pipeline (such as dairy factory conversions) could take this as high as 50% to 60%.

Announcement by Government in 2021 to phase out use of fossil fuels for process heat by 2037, and to transition all government owned heating facilities to using low emission fuels (biomass or electricity) by 2030 have provided a strong incentive for investment in biomass fuelled plant.

The 'Wood Energy Industrial Symbiosis' project[50] undertaken by Scion identifies wood processing clusters in regions with significant forestry resources co-located with other industries can make the best use of wood and energy supply and demand. The regions with the greatest potential include Gisborne, Hawkes Bay, Southland and South Otago, and Northland.

The Bioenergy Association, which promotes bioenergy uptake, notes that the use of some waste materials as feedstocks is restricted by regional air plan rules. In their view a more consistent national approach that takes better account of technical capabilities of individual boilers and focuses on outputs rather than inputs could result in greater utilisation of waste timbers.

17.4 Energy from Mixed Residual Waste

Energy from Waste (EfW), also known as Waste to Energy (WtE), and Alternative Treatment Technology (ATT) involves the heating or combustion of waste to extract energy, heat, and potentially other by-products. There are a wide range of technology types including mass-burn incineration, fluidised bed incineration, gasification, pyrolysis, torrefaction, steam reforming, plasma arc, hydrothermal oxidation, autoclaving etc. Within each of these broad technology types there are a large range of variants, hybrid technologies and proprietary processes. Each of these processes have certain strengths and weaknesses and may be more or less suited for different feedstocks and/or scales of operation. The main benefits claimed for EfW technologies are that they generate energy from mixed waste materials and reduce the quantities sent to landfill. It is beyond the scope of the current paper to evaluate the potential role of EfW or the particular technologies.

[50] Scion wood energy industrial symbiosis. From: https://www.scionresearch.com/science/bioenergy/towards-biorefining

There is no large-scale incineration or other forms of energy generation from mixed waste in New Zealand at present, although there have been, and continue to be, a number of efforts to establish EfW facilities.

One of the principal reasons for the lack of EfW facilities for mixed residual waste in NZ up to this point appears to be their relatively high cost compared to large-scale landfill. Internationally EfW facilities are associated with electricity generation which is not an economic proposition in New Zealand where electricity can be produced from other lower cost renewable resources.

17.5 Gap Analysis – Energy Recovery

A gap analysis exercise was conducted to identify the national, regional and transportation gaps, across the value chain. The results are shown in the table below.

Key:

The gap is analysis is presented using a 'traffic light' grading system as shown below.

No significant gaps/issues	Some/potential gaps/issues	Significant gaps/issues

Table 25: National, Regional and Transportation Gaps Identified in Energy Recovery

Infrastructure Type	National Capacity	Regional Capacity	Transport & Logistics
Collection - Household Organics	Household and catering food waste collections are limited. Quality of material from household food waste collections can reduce output quality Limited data supply and quality	Those councils that do collect organic waste are all in the upper half of the North Island or in Canterbury	Development of bulking facilities may be necessary to deliver organic waste collection services
Collection - Commercial Organics	Commercial feedstock collections do not appear to be problematic where there is a demand from an energy recovery facility.	Catering waste collections tend to focus on main centres. Key areas where the service is available includes Auckland, Hamilton, New Plymouth, Wellington, Palmerston North, Napier & Hastings, and Christchurch	Development of bulking facilities may be necessary to deliver organic waste collection services efficiently

Infrastructure Type	National Capacity	Regional Capacity	Transport & Logistics
Collection - Residual Waste	There are no service gaps for residual waste collections	There are no service gaps for residual waste collections	Transport to disposal facilities can involve large distances. This opens up potential for smaller local EfW facilities
Sorting	N/A	N/A	N/A
Re-processing - Tyres, wood wastes	There are adequate re-processing facilities for current uses but there is likely to be a need to scale up if more materials are going to go to energy recovery	There are adequate re-processing facilities for current uses but there is likely to be a need to scale up if more materials are going to go to energy recovery	N/A
Manufacture - Energy from Waste	There are limited numbers of energy recovery facilities, and the clear potential for energy recovery to play a larger role – particularly in substituting for fossil fuels Key waste streams may include tyres, low value plastic, fibre wastes, woody biowastes, mixed municipal waste Limited data supply and quality.	There is potential to expand capacity in parts of the country where there is good feedstock supply. Areas noted for solid fuels include Gisborne, Hawkes Bay, Northland, and Southland and Otago. Biogas has potential around NZ utilising household food waste and primary processing wastes. Gaps in the processing capacity for some streams such as household food waste.	Depending on the plant type there is a balance between transport distances and plant scale. Biogas plants receiving material from offsite require minimum of around 25,000 tonnes for economic scale

18.0 Cross-Cutting Themes

18.1 Introduction

While compiling this report, it became clear that the boundaries between the different material/activity types used for the stocktake were sometimes arbitrary (e.g. organics and energy recovery, or glass and reusable containers). Furthermore, various issues and responses recurred across material streams. This section collates and elaborates on some of these key themes.

This section, while informed by the stakeholders, represents Eunomia's analysis of key dynamics and themes that emerged from the stocktake. Our observations are offered to assist the Ministry in deepening its understanding of the sector but are not necessarily the only lens that could be placed on the information. These observations are not intended to constitute advice or recommendations.

18.2 Material Management Dynamics

Perhaps the most obvious theme is that a number of key materials, in particular the commodities of plastic, paper, metal, and glass - often follow the same pathways from production/import, consumption, collection, and recovery, and may be substitutable in their functions. Key themes in this respect are noted below.

18.2.1 Packaging

Packaging can be made of a range of materials, but most commonly plastic, paper, metal, and glass. For example, beverages can be packaged in glass bottles, plastic bottles, aluminium cans, or paper (e.g. liquid paper board containers). Sometimes a packaging type will be a composite of different materials (such as tetrapak, which includes plastic, paper and metal). The dynamics of one type of packaging material can affect others.

The configuration of initiatives such as CRS, restricting the use of certain polymer types, and product stewardship schemes for specific packaging types could therefore affect not only the products and materials implicitly covered, but also those which could subsequently be used as alternatives. Without a thorough appreciation and addressing of these dynamics, there is the potential for policy initiatives to result in unintended consequences - such as product packaging moving from plastic to less recyclable multi-material packaging.

The interrelated impacts of the different packaging materials suggests that a material-agnostic approach to addressing packaging waste, could be a valid approach. For example, a CRS design may include all beverage containers within the design scope, regardless of material composition. On the flipside, attempts to formulate policy approaches to packaging through the lens of one material may reduce the flexibility needed to develop a comprehensive and coherent approach across the packaging system. For example, the decision to declare only plastic packaging a priority product, rather than all packaging.

Focusing on material streams rather than product types can also obscure possible opportunities for waste reduction within a product category. This becomes more obvious when looking at the systems through which a particular product, like packaging flows. For example, most packaging currently follows a linear pathway, regardless of the material it is made from. Our analysis of reusable packaging, which is not focused on a particular material stream, provides one example of how a material agnostic view of packaging can bring to the fore new, more circular, approaches to addressing packaging waste, while highlighting infrastructural gaps that have previously received less attention.

18.2.2 Collections

A common theme across the commodity materials was how recycling collection methodologies can affect material quality. The standardisation of kerbside collection was put forward as a key initiative across the recycling and organic material streams. Standardisation of collections is expected to not only lead to a more consistent set of materials being collected, which could potentially improve economies of scale for those materials, but also result in better material quality by reducing consumer confusion and lowering contamination rates. In some cases, the introduction of kerbside standardisation could have a very significant impact on infrastructure recommendations for certain materials, such as fibre.

Other means of reducing contamination while also lifting recovery rates were raised by various stakeholders. These included deposit/return systems (for example, for beverage containers), ongoing efforts to phase-out hard-to-recycle contaminants (such as PVC in consumer packaging), or the establishing a coordinated approach that can deliver more regular and consistent communications to the public about what is and what is not recyclable.

18.2.3 Material Recovery Facilities

Material recovery facilities (MRFs) handle a range of material types (e.g. paper/plastic/glass/metal). How MRFs are operated therefore has potential impacts across these material streams. The operation of MRFs includes decisions around variables such as whether sorts are positive or negative for particular grades, line speed, technology, facility sizing and staffing levels, screening for contamination, and accepted contamination levels for particular markets. These can all affect the viability of operations (particularly under different market conditions) and the quality of material produced.

Decisions made in respect of investment in MRF infrastructure (for example providing funding for upgrades, or seeking development of regional facilities), will also impact decisions across other parts of the material value chain – such as collection methodologies, householder education, material acceptance, standardisation of services etc.

18.2.4 Waste to Energy

Waste to energy (WtE) covers a wide range of technologies that generally use some form of thermal process to extract energy (and potentially other by-products) from waste materials. WtE processes were put forward by a number of stakeholders as an alternative to landfill and as a potential way to extract value from lower quality feedstocks, which may not have viable recycling or recovery markets. Potential feedstocks that were noted include low-value plastics, tyres, mixed paper, and woody organic materials (for example, to produce biochar).

It is, however, beyond the scope of the present work to assess the viability of these proposals. As these types of processes could potentially accept a range of feedstocks, conducting a comprehensive assessment of their potential would be of relevance to a number of material areas. There are a range of factors that need to be taken into consideration (such as cost, technology type, feedstocks, alternatives, carbon and other environmental impacts etc.), and any such proposals are likely going need to be considered on an individual basis.

18.3 Waste Sector Market Dynamics

A vital dimension to understanding how each of the sectors operates and how infrastructure investment provision may be viewed, is to understand how the waste sector currently operates in practical and commercial terms. This section provides a high-level overview of these dynamics.

18.3.1 The Rise of Complexity and the Private Sector

Activity within the waste sector is predominantly undertaken by three different types of organisations – territorial authorities, the private sector, and the community sector. Each type of organisation tends to play different roles, which have evolved over time in response to changing market environments.

18.3.2 Territorial Authorities

Territorial authorities (TAs) have statutory responsibilities for waste management and planning. However, beyond the need to plan for waste management and minimisation (as provided under the WMA), the methods used to meet these obligations vary. A small number of TAs elect to provide no waste or recycling collections, leaving this function to the private sector. The majority of TAs however do provide household rubbish and recycling services, with a growing number also providing some form of organic waste collection. Many TAs also own some waste infrastructure, such as transfer stations, composting operations, and landfills. With only a few exceptions, operation of these services and facilities are contracted out to external organisations – once again, usually the private sector.

TAs' actions in the waste sector are driven by two key considerations – the need to fulfil their statutory obligations in respect of waste, and the need to meet the expectations of their communities which relate to service levels, but also cost. TAs therefore tend to have a locally focused view of waste issues and, even where individual officers may take a wider view, the mandate (and budgets) of officers (or indeed the council generally) usually only extends to ensuring these local considerations are met. Furthermore, many councils have a focus on waste minimisation and are expected to develop Waste Management and Minimisation Plans that at least consider the waste hierarchy (s 44). However, in practice, TAs do not have the relevant regulatory powers, legislative mandate nor resources to achieve policy or infrastructural outcomes at the top of the waste hierarchy.

A further factor is that TAs can often be resource-constrained in their ability to take a proactive role in waste minimisation. While there is a growing recognition of the need for specialist waste minimisation roles within councils, for many of the smaller TAs, waste is still one part of a council engineer's or contract manager's role. Consequently, technical knowledge around waste and resource recovery (e.g. MRF or transfer station design) increasingly resides outside of council. This situation is exacerbated by the drive towards increasing waste minimisation, which is making the sector more complex.

In terms of infrastructure provision, these factors have generally meant that, except where TAs have historical assets, TAs' role in infrastructure, particularly in developing new infrastructure, is limited, and has been diminishing. TAs may own infrastructure (or enter into some form of partnership arrangement) related to delivery of council services, such as a MRF or a composting facility, but the assets are likely to be limited to these roles. A particular issue is that many smaller councils do not have the scale, capital, or capacity to develop infrastructure on their own, and there are few existing structures or mechanisms that enable effective joint-working and the sharing of assets.

18.3.3 Private Sector

Not only is the private sector the primary provider of council-contracted services, but it also provides services to industry and business and, in many cases, competes with council services for the household rubbish collection market. It is a critical factor in waste market dynamics that the vast majority of the waste and recovered material in New Zealand is controlled by the private sector.[51]

The main motivating factor for the private sector is the need to be commercially viable. This has both positive and negative impacts in the context of waste and resource recovery. The positive impacts are the ongoing drive for efficiency and innovation, which has been responsible for many recent advances in resource recovery (e.g. MRF

[51] For example, in 2009 it was estimated that the private sector controlled 90% of all waste and recovered materials in Auckland. [Eunomia, SKM, Waste Not (2009) *Auckland Region Waste Stocktake. & Strategic Assessment*, Report for Auckland Regional Council]

technology, container types, finding new markets for materials), and increased consumer access to a wide range of services. The private sector's access to substantial capital has resulted in investment in new resource recovery technology, improved environmental performance of landfills, and increased work across council boundaries.

On the downside, the private sector's incentive to divert material is limited by its need for commercial viability. Where it is marginal or unprofitable to divert material, this generally won't be undertaken by the private sector without some form of public subsidy. The private sector also tends to invest in infrastructure and deliver services where it makes sense within their business model - which is not necessarily the same as where it makes sense overall. This has led to both duplication and service/infrastructure gaps and a range of different approaches and levels of service across the country.

Another emerging theme is that a larger proportion of the private sector is involved in waste minimisation than may be obvious, but many of these businesses are not included or involved as stakeholders in the development of waste policy or infrastructure. Traditionally, conversations around waste and the private sector have focused on businesses that collect and re-process waste and recyclate or who control or run waste and resource recovery facilities. However, this is a narrow view of the private sector's role as the circular economy and zero waste continue to grow in prominence. A growing number of businesses are operating in the 'reuse economy', with the specific aim of preventing or reducing waste. This suggests there could be benefit in widening the range of private sector stakeholders that TAs and government liaise with when developing waste policy and infrastructure This is further discussed in 18.3.6 below).

18.3.4 Community Sector

In terms of the quantity of materials handled, the community sector plays a minor role in the waste sector in NZ, although this varies across material streams and product categories. For example, the community sector is well-represented in the re-processing of electrical and electronic goods. While a range of community sector organisations deliver services around NZ, with some exceptions, most of these groups are focused on reuse and community-scale resource recovery. However, in terms of leadership and community engagement, the role of the community sector has been vital. The sector has led the way in terms of recovered material quality (particularly through the promotion of the source separation of materials), the ability to generate high rates of resource recovery, and continuing to advocate for interventions at the top of the waste hierarchy.

The motivation of the community sector is usually two-fold: to reduce environmental impacts through maximising resource recovery; and to generate community benefit through employment, upskilling of the workforce, raising awareness, and providing access to low-cost consumer items. This approach has allowed the community sector to 'dig deeper' into the waste stream. However, the community sector is usually resource-constrained and lacks the capital to invest in infrastructure. This has limited the role of the community sector, and hence the ability for what it offers to be applied more widely.

18.3.5 Market Dominance

Within the private sector itself, there is a further dynamic that is worth exploring - the market dominance of the two large waste companies: Waste Management NZ Ltd and EnviroWaste Services Ltd. It is difficult to calculate their share of the sector (as it depends largely on how this is defined). However, we estimate that across the core waste and recycling activities, the companies together control in the order of two-thirds of all material at any stage of the process from collections to disposal. They are involved across most areas of activity in the sector, including household collections, commercial collections, transfer stations, disposal, MRFs, organic waste processing, and hazardous wastes.

This level of market influence is a significant factor in the dynamics of the industry. In essence, the plans and strategies of these two companies will, by their nature, have a significant impact on the sector. For example, if they decide to invest for a circular economy future, this could drive significant change, or conversely, if they decide to favour a linear economy model, this could be an impediment to this type of change.

A key feature of these companies is that they are 'vertically integrated'. In other words, they provide a full range of services across the waste and resource recovery processes from collection, bulking, sorting, re-processing, and sale of commodities, through to disposal. This vertical integration affords them advantages in the marketplace, as they are able to design services efficiently as end-to-end processes and determine where the cumulative profit centres are (i.e. they don't have to be profitable at each step as long as they are able to maximise profit overall).

In the disposal market this becomes a particular factor. The construction of large landfills requires high levels of capital investment. The landfills represent significant assets, which must generate a return on investment. Because fixed costs expand at a lower rate relative to the landfill airspace, the larger the landfill the lower the capex cost per cubic metre of airspace will be.

Once the initial construction phase of a large landfill is completed, the marginal costs of disposal per tonne are low. The need to provide a return on investment for the landfill asset incentivises landfill owners to fill up their landfills as quickly as possible.[52]

Combined with low capex and opex costs per tonne, large landfill owners are able to vary their pricing to maintain flows of material into their facilities. The ability to access low landfill costs internally also means they can utilise the landfill asset to compete aggressively in collection and transfer station markets.

[52] This incentive, however, may be reduced by the owner's need to complete a new landfill when an existing facility is nearing the end of its operational life. For example, Waste Management needs to extend the life of its Redvale Landfill, north of Auckland, until a replacement facility, currently planned for Dome Valley, is operational.

18.3.6 Sector Innovation

A further theme to emerge from the stocktake was that a lot of the innovation in the sector appears to be coming from outside the sector – i.e. not from waste and resource recovery businesses and organisations, but from other types of businesses. At present, because these businesses are not traditionally viewed as relevant to waste and resource recovery, their perspectives, infrastructural needs, and possible circular solutions to critical waste problems are not often heard, recognised or considered in the development of waste policy or investment decisions, which may signal a missed opportunity in light of the growing importance of the circular economy in national and international policy.

Waste and resource recovery organisations tend to view waste materials from the perspective of supply – in other words, they identify a quantity of waste/scrap material that must be managed and look for options for recovery or disposal. The options for recovery or disposal tend to be existing markets, facilities, or processes.

Businesses outside of the waste sector that are successfully driving innovation in waste minimisation tend to focus on the market or customer for the product or service. These businesses identify a potential demand for a product or service, then develop the product or service. In these situations, waste materials are simply a readily available source of feedstock (at a usually low -, no -, or negative cost), or alternatively their business model may avoid waste through reuse, providing less material intensive products, or replacing products with services. Rather than disposing of waste, these businesses are meeting a consumer demand in the most economic manner possible.[53]

In addition, change is also being driven by large corporates looking at their environmental footprint and taking steps to address waste generation and sustainability through their own internal processes.

18.3.7 Community and Local vs Large Scale

A theme that emerged across almost all parts of the sector was a tension between local community-scale organisations and large operators. Many community -scale operators tend to be focused not just on waste minimisation but also on local benefits such as local employment, sustainability - including reducing transport emissions, providing high quality (e.g. artisan) products, and personal service. Larger scale operators on the other hand tend to focus on the total quantities, achieving economies of scale, and increasing standardisation. Community scale operators view their approach as more aligned with a circular economy model, while the large operators tend to hold the view that to make a big difference in terms of waste minimisation large tonnages are required. The question of the degree to which small scale type approaches can 'scale-up' to make a difference

---

[53] It should be noted that innovation does not necessarily lead to waste minimisation. For example, multi-material products and packaging, single use, products, waste disposal technologies,

at a national level is one that would be worthwhile examining further in the circular economy context.

18.3.8 Tackling the Hierarchy & Circular Economy

When considering waste infrastructure, the primary focus in the study has been on recycling and recovery (e.g. composting), with relatively niche consideration of waste reduction and reuse. However, higher in hierarchy actions did emerge as a consistent theme and are important to consider in the context of waste infrastructure.

The potential of implementing higher in hierarchy solutions was particularly noted in the fibre, electrical and electronic goods, reusable packaging, and resource recovery centre sections. However, the challenges of widescale adoption of these types of solutions was also evident. These challenges include establishment costs (such as purchasing a fleet of reusable bottles), lower in hierarchy options being able to externalise their costs (such as the cost of disposal or recycling), a lack of consumer awareness and acceptance, scale, and finding appropriate business models.

Higher in hierarchy activities, while often requiring some infrastructure themselves (e.g. reuse stores, bottle washing plants, repair and refurbishment shops etc.) have a potential impact on other infrastructure through reducing the quantity of material in the system that needs to be recovered or recycled. It will be important to consider the balance of infrastructure that is required if the economy shifts to a more circular model, where there may be less material requiring recycling or recovery. Large recycling or re-processing facilities, sized for current or expanding amounts of material, could be oversized or stranded assets if circular economy outcomes are achieved. If a more circular economy approach is ultimately favoured it will be necessary to attempt to calculate and map these impacts and plan an appropriate transition pathway.

18.4 Material Markets

The viability of markets was a common theme across all material types. Resource recovery activity can be placed on a continuum, from those that are most readily recovered to those that are less recoverable:

- The most readily recovered materials are those that have high value and are generally seen as by-products rather than waste (for example abattoir wastes or offcuts from aluminium manufacturing).
- Next are materials that generally have a stable, long-term value that can support a recovery industry on purely commercial terms (e.g. metals, cardboard),
- There is a range of materials that have some value, but the value is not necessarily stable or is insufficient to support an industry without charges. This includes most of the ‘commodities’, such as plastic, glass, paper, and most organic waste. The charges are either in the form of public subsidies, such as council funded recycling collections, or charges to the customer.
- A number of materials have little, no, or negative value and require charges for recovery (if recovery is possible) or disposal. These materials include hazardous wastes, contaminated soils, and mixed municipal wastes.

For a material to be able to be recovered viably, there needs to be a stable market that at least matches the supply of that material. The existence of viable markets is therefore the key to resource recovery, as material value will enable and drive material recovery. Development of markets for the less valuable materials was a theme that emerged from the research as an important way to stimulate further recovery. This could include policy initiatives, such as material and recycled product standards, mandatory recycled content, and procurement policies. In other cases, phase outs of low value and difficult to recycle materials and exploration of alternatives, such as reusables, may be most appropriate.

A common theme across the main commodity types was the debate between the merits of local versus export markets. As has been well-documented, New Zealand's reliance on export markets for many grades of recovered material was highlighted by China's National Sword import restrictions. For a number of materials, in particular fibre and plastics, the potential for greater levels of onshore re-processing to add value to materials is under careful consideration. The expectation is not necessarily that there will be more end uses found for recycled materials in NZ, but that recovered material will be re-processed to a higher standard and therefore able to find end markets, whether local or export, more readily.

18.5 Climate Change

The impacts of climate change and climate change policy on the different material sectors was one of areas where stakeholder feedback was sought. Responses varied, from some seeing it as having little direct impact on their operations to others seeing direct potential impacts through things like increased transport and material costs, to others seeing it as an opportunity to promote the carbon benefits of their product or service.

Looking forward, it will be important to understand in detail the potential carbon impacts of different materials in relation to waste reduction, recycling and disposal. This will in turn impact decisions on where infrastructure investment should be made for maximum carbon benefit.

In our experience, because different materials have different carbon intensities through their life cycle, putting a climate change lens on waste activities can result in a different set of priorities from a waste minimisation approach that tends to focus on quantities of materials. Broadly speaking however, higher in hierarchy options tend to be favoured as they can achieve a multiplier of benefit through the value chain. Put simply, not producing a product or material avoids the emissions associated with its production, packaging, transport and logistics, use, and end of life management.

Solutions that seek to reduce end of life climate impacts (for example energy recovery, mechanical biological treatment, landfill gas capture etc.) can, by their nature, only affect the end-of-life phase, and are therefore limited in their ability to reduce overall emissions.

Work undertaken by Eunomia in 2019 on marginal abatement cost curves (MACC) for reducing carbon impacts from waste found that food waste prevention is the most cost-effective abatement measure, whilst implementing a biostabilisation phase prior to disposal to landfill has the greatest potential to cut sectoral emissions.[54]

18.6 Other Themes

Other, less prevalent themes but ones still worth noting included:

- **Data.** A lack of adequate data, the difficulty of gathering data, and the importance of data for planning and evaluation were noted by a range of stakeholders across the different areas. The fact that this stocktake is being undertaken is a recognition of the lack of data, and its importance for future planning – in particular around infrastructure. While the stocktake has provided a more comprehensive picture than has previously been available, it has also highlighted the difficulties in gathering data (differences in measurement, record keeping, definitions, commercial sensitivity, what should be included or not etc.) It is also clear that the ability to gather consistent, regular data will be a key tool going forward.
- **Consents.** The time, costs, and difficulty in obtaining consents for waste infrastructure was raised as a barrier to infrastructure investment by a number of operators. It was seen to increase risk, (for example land needs to be purchased or leased before consents can be obtained but there is no guarantee this will be possible, or the time or cost involved), cost, and make the business case more difficult.

18.7 Common Policy Levers

While there are a diversity of material types and issues unique to each sector, many of the policy solutions put forward by stakeholders were similar. Key solutions that were noted include (in no particular order):

- **Standards** - Introducing standards for material quality or processes was seen as a potential tool to improve consumer confidence and grow markets. Examples put forward were compost products, recycled aggregate, recycled content requirements for plastic products, right to repair for electronic items, and use of tyre-derived products.
- **Landfill bans** - The straightforward banning of a material type from landfill was raised as a potential tool to stimulate recovery for a number of materials including organics, e-waste, non-recyclable packaging materials, and tyres.
- **Levy** - The raising and extending of the landfill levy could potentially impact all waste streams. Raising and extending the levy will tend to have the greatest

[54] Eunomia (2019) Waste MACC - An analysis of greenhouse gas abatement options for New Zealand's waste sector. Report for Ministry for the Environment

impact on the heaviest and most common materials, but a reduced impact on less common, but still potentially problematic, materials, such as e-waste and hazardous wastes.

- **Reduction** - Virtually all sectors noted the potential to reduce the levels of residual waste by addressing the production of the materials in the first place. This was noted particularly strongly in relation to packaging and the potential for reusable packaging systems to assist in reducing to quantity of disposable packaging.
- **Product stewardship** - As with waste reduction, the introduction of product stewardship as a policy response was widely noted. Key materials included e-waste, farm plastics, glass, paper, plastic, and tyres.
- **Kerbside standardisation** - The potential to standardise kerbside collection systems and improve the quality and quantity of material collected was raised in relation to organics, paper, glass, plastic and cans, as well as being noted in relation to collections.
- **Regional infrastructure bodies** - Establishing an effective mechanism for delivery of infrastructure at a regional level (or similar) would address the question of scale and offer a planned approach to infrastructure provision. This could apply to resource recovery facilities and transfer stations, organic waste processing facilities, MRFs, and construction and demolition sorting facilities.
- **Central delivery agency** - A delivery focused quasi-government agency (such as EECA in the energy sector, or WRAP from the UK), that could coordinate behaviour change, kerbside standardisation, recovered material markets research etc. could have a role across a range of material streams.
- **Purchasing policies** - The public sector can potentially play a role in stimulating the demand for products made from recovered materials. This was noted in relation to organics, plastics, paper, and C&D waste streams.

18.8 Everything Works as a System

The overarching theme to emerge from the research is that the different elements of the waste sector, and, for that matter, waste infrastructure, are difficult to separate in reality.

This came through strongly when considering infrastructure gaps. For example, a lack of onshore re-processing capacity may be identified as an infrastructure gap. However, the options to address this gap are not necessarily solely infrastructure options (such as developing more onshore re-processing capacity). Options could include reducing the quantity of material placed on the market (e.g. through banning junk mail or eliminating the use of certain polymer types in plastic packaging), developing less material intensive packaging systems (i.e. reusable and refillable packaging systems, where appropriate), improving collection systems to generate higher grades of material (which would then have wider market access), improving sorting infrastructure (again to produce higher grades of material), or seeking alternative markets or uses for material (for example, energy recovery).

Similarly, material types often co-exist in systems, such as through kerbside collections, transfer stations, MRFs or energy recovery processes, which have been considered separately in this research. As a result, initiatives that relate to one of these systems will affect a range of material types.

Another way in which materials are related is through substitution. For example, packaging can be manufactured from a range of materials including paper, plastic, metal, and glass. Attempts to control or promote one type of packaging could lead to impacts on other types of packaging.

Understanding material stocks and flows within a system is essential for converting linear resource flows into circular flows. Regions and cities are key partners in achieving the circular economy and require more knowledge on how to map and understand material flows. The next chapters in this report proposes that investment in waste and resource recovery can be organised around the concept of developing a ‘circular resource network’.

19.0 Prioritisation Workshop Outcomes

This phase involved engaging with key stakeholders to identify and prioritise options for addressing infrastructure gaps. It reflects the views of the Infrastructure Working Group (IWG) which comprised 18 subject matter experts representing a cross section of the industry as well as central government.

A series of three workshops were conducted with the IWG over approximately four months to develop and identify the priority options. A summary of the key outcomes of the workshop process is provided in this section.

189 options were identified by the project team prior to the workshops. These emerged primarily from consultation with stakeholders during the stocktake process and through engagement with the TRGs. In this context an 'option' refers to a specific action or set of actions, for example, 'Develop a network of construction and demolition waste sorting facilities' or 'expand processing capacity for household and commercial food waste'). Most options were targeted at particular material or activity stream, but a number cut across material streams (for example material recovery facilities).

It was recognised that priorities for addressing gaps will be highly dependent on the intended objective and approach for infrastructure development. To this end, priorities were identified within five possible future 'scenarios':

- Business as Usual (BaU)
- High-performing linear system
- 'Zero' Carbon
- Slow Transition to Circular Economy
- Fast Transition to Full Circular Economy

The final rankings focused on three of the scenarios: Circular Economy (Fast Transition), Zero Carbon and High Performing Linear.[55]

The workshop participants prioritised the different infrastructure options that had been identified within each scenario. Supporting actions were noted but not prioritised for two reasons: the focus of the project is on infrastructure rather than policy or other supporting actions; and the sheer number of supporting actions identified would have taken more time than was available.

---

[55] Circular Economy (Fast Transition) and Zero Carbon were taken forward as they were the two highest rated options. It was decided to include High Performing Linear instead of Circular Economy (Slow Transition) because all of the options in the slow transition scenario were also in the fast transition scenario (which would have resulted in duplication of effort) and because the High Performing Linear represented a different – and potentially likely – approach.

The infrastructure options were broadly characterised by waste stream (although a number cut across different waste streams).

The outcome of the prioritisation exercise was to identify, within each scenario, what the most important options are to direct investment towards. The exercise resulted in a range of different options across materials and network and processing type options being identified for each scenario. The top ten options for each scenario are shown in the table below.

Note: *For the purpose of this exercise, infrastructure options were characterised by whether they were 'network options' – i.e., focused on sorting and logistics, or 'processing options' i.e., concerned with processing or manufacture of recovered materials. In the table below amber denotes network options while teal denotes processing options.*

Table 26: Top Ten Priority Options by Scenario

	Circular Economy	**Zero Carbon**	**High Performing Linear**
1	C&D: network of sorting facilities	C&D: network of sorting facilities	C&D: network of sorting facilities
2	ORGANICS: processing (household and commercial food waste)	ORGANICS: processing (household and commercial food waste)	ENERGY: biomass fuel utilisation (timber, wood wastes)
3	RTS: national resource recovery networks	RTS: national resource recovery networks	C&D: Reprocessing plasterboard to new plasterboard
4	ORGANICS: Processing – agricultural organic waste	ORGANICS: Processing – agricultural organic waste	ORGANICS: processing (household and commercial food waste)
5	RTS: change focus to reduce, reuse	RTS: change focus to reduce, reuse	RTS: national resource recovery networks
6	REUSE: Pools of reuse fleets and network of washing/sanitation facilities	ORGANICS: Household food waste collections	ORGANICS: Manufacturing biomass fuel (timber, wood wastes)
7	REUSE: collection and return infrastructure (including monitoring, tracking)	ORGANICS: Commercial food waste collections	ORGANICS: Household food waste collections
8	REUSE: expand domestic capacity for manufacture	ORGANICS: Manufacturing biomass fuel (timber, wood wastes)	E-WASTE: Enable safe transport/logistics through equipment

	Circular Economy	Zero Carbon	High Performing Linear
9	ORGANICS: Processing for sludges	ENERGY: biomass fuel utilisation (timber, wood wastes)	E-WASTE: Enable processing, reuse, resale through increased warehousing
10	C&D: collections	REUSE: Pools of reuse fleets and network of washing/sanitation facilities	E-WASTE: More automated dismantling

Across the scenarios there were common sets of options that related to three key activity streams and that proved to be high priorities, whichever scenario was involved. These were: construction and demolition waste, food waste, and a resource recovery network. Plastic processing and e-waste also featured consistently strongly across all three scenarios.

Overall, the key priority actions identified across the scenarios were:

- Networks of sorting facilities for construction and demolition waste
- Resource recovery facilities and networks for household and commercial waste
- Organic waste processing facilities
- Manufacturing and utilisation of biomass (timber and wood waste)
- Improved logistics and facilities for e-waste
- Reprocessing and domestic use of waste plastic

The top priority actions across the scenarios tend to reflect the perceived importance of addressing key waste streams, in particular construction and demolition waste, organic, e-waste and plastics. The above outcomes reflect a synthesis of input from a wide cross-section of the waste and resource recovery sector and provide a robust foundation for further identification and prioritisation of specific facilities as part of an infrastructure investment plan for the sector.

20.0 ‘Blue-Sky Thinking – A Circular Resource Network

20.1 Introduction

Historically, our economic system has operated primarily on the basis of linear processes. This system involves extraction, processing, manufacturing, consumption and disposal (end-of-life). This system is not sustainable as it involves systematically using up non-renewable raw materials (such as minerals and fossil fuels) and degrading the natural environment, which is necessary to support life, through unsustainable agricultural and extractive activities (such as logging of native forests), and the creation of waste and pollution. To address this, a paradigm shift is needed. This requires a change in how the economic system produces, assembles, sells and uses products in order to minimise waste and maximise the value of materials in use. The circular economy is a model that enables resources to be kept in use for as long as possible, extract maximum value from them, and then recover and regenerate materials at end-of-life.

Within the context of enabling a circular economy, it is proposed to re-organise how the recovery of materials in the economy occurs by establish a **‘circular resource network’**.

The key organising principle behind the concept of a circular resource network is that the resource recovery system should be consciously designed to facilitate the circular flow of materials through the economy, by ‘completing the circle’. To date, the ‘reverse logistics’ aspect of the economy that is responsible for collecting widely dispersed and mixed materials has been a poor relation to the ‘logistics’ part of the economy that is responsible for the dispersion.

To create a functional reverse logistics network, materials need to be viewed through the lens of value. For materials to be properly reintegrated into the economy they have to have value – in other words they have to have a valued use and be fit for purpose (otherwise they will simply not get used). Therefore, the question is: how to design a reverse logistics system that delivers this functionality (i.e. valuable materials)?

In our analysis of the flow of materials through a circular economy we have identified 3 key parts:

- The need to control the materials in the system so only those that are necessary are used, and that materials that are used all have a valued recovery pathway
- The need to have a reverse logistics infrastructure that is consciously designed to retain/increase the value of materials and minimise cost/maximise efficiency
- Support and enable markets and manufacturing, so there are valuable end uses for recovered materials to provide a pull-through.

The first and the third parts primarily will require a policy and legislative/regulatory approach to create the conditions to enable the circular economy. While this is noted in our research, the policy and legislative framework is not the focus for this report (which is on infrastructure).

The key focus for infrastructure investment is logically on creating the reverse logistics infrastructure that can maintain/enhance the value of materials, with some investment also potentially required in supporting the development of manufacturing of high value products that utilise recovered materials.

It is our view that a potentially useful way to characterise what the reverse logistics infrastructure could look like is through the concept of a ‘circular resource network’.

In the following subsections we expand on what a circular resource network concept that is designed for the circular economy could entail, and what support for manufacturing could mean in this context. The circular resource network concept borrows from and builds on the existing concept of a resource recovery network (RRN).

20.2 Conventional Resource Recovery Network (RRN)

The concept of a RRN is a longstanding one with various examples including Auckland Council working to develop a network of community run facilities in partnership with the Zero Waste Network[56], the development of a Māori and Pasifika Eco Park, in South Auckland[57] and Selwyn District Council recently announcing their resource recovery park concept[58].

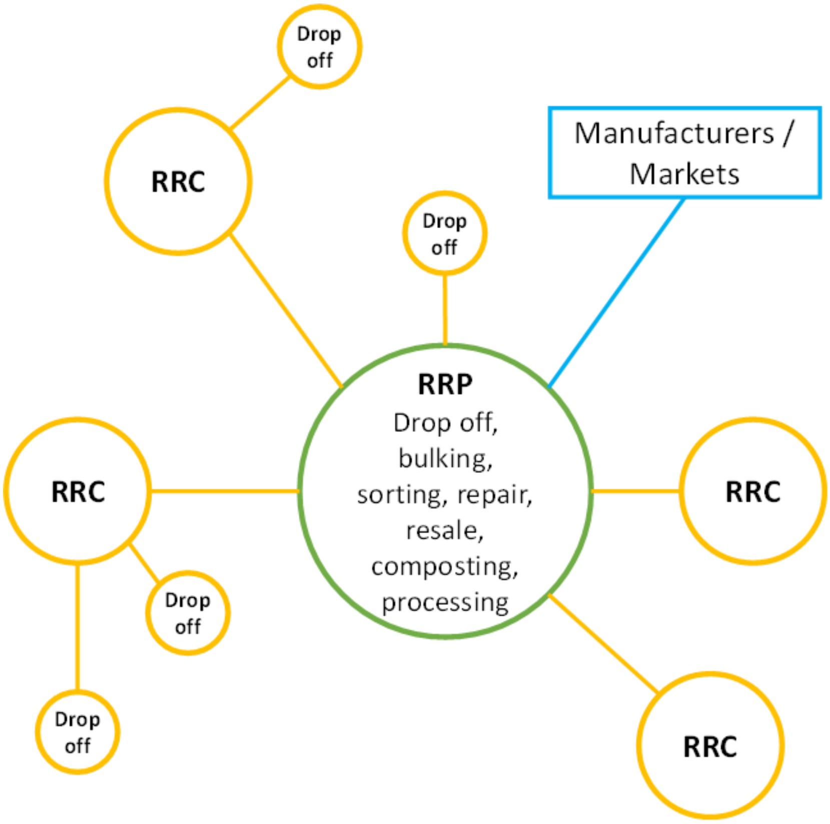
Building on these examples (which all have different approaches), we propose to develop a nationwide state of the art network of resource recovery parks (RR Parks) which consist of linked (sub) regional hubs, with smaller satellite facilities (resource recovery centres or RR Centres) feeding recovered materials into the hub for processing and sale, and these potentially further supplemented by local drop off sites that feed the satellite facilities. This concept is illustrated in the figure below.

[56] https://www.makethemostofwaste.co.nz/resource-recovery-network/

[57] https://www.stuff.co.nz/business/126810349/the-1-billion-plan-to-lift-mori-and-pasifika-prosperity-in-aucklands-south-and-west

[58] https://www.selwyn.govt.nz/services/rubbish,-recycling-And-organics/recovery-park/reconnect-project

Figure 34: Network of Resource Recovery Centres Linked to Resource Recovery Parks



The functions that are performed by the RR Park consolidate a range of resource recovery functions into a single site. The intent is both to provide a 'one stop shop', but also to take advantage of economies of scale and sharing of infrastructure, services, and overheads, and optimising transport of materials to reduce costs. Furthermore, by co-locating functions there can arise the possibility of synergies between the different functions. For example, reclaimed timber and building materials can provide materials for a 'Community Shed' type operation[59], or items salvaged from the waste stream can be sold at low cost to the public. The proposed form of a resource recovery network is to have a series of sites with physically co-located functions, and for these to be operated by or overseen by a single entity.

20.3 Expanding the Resource Recovery Network

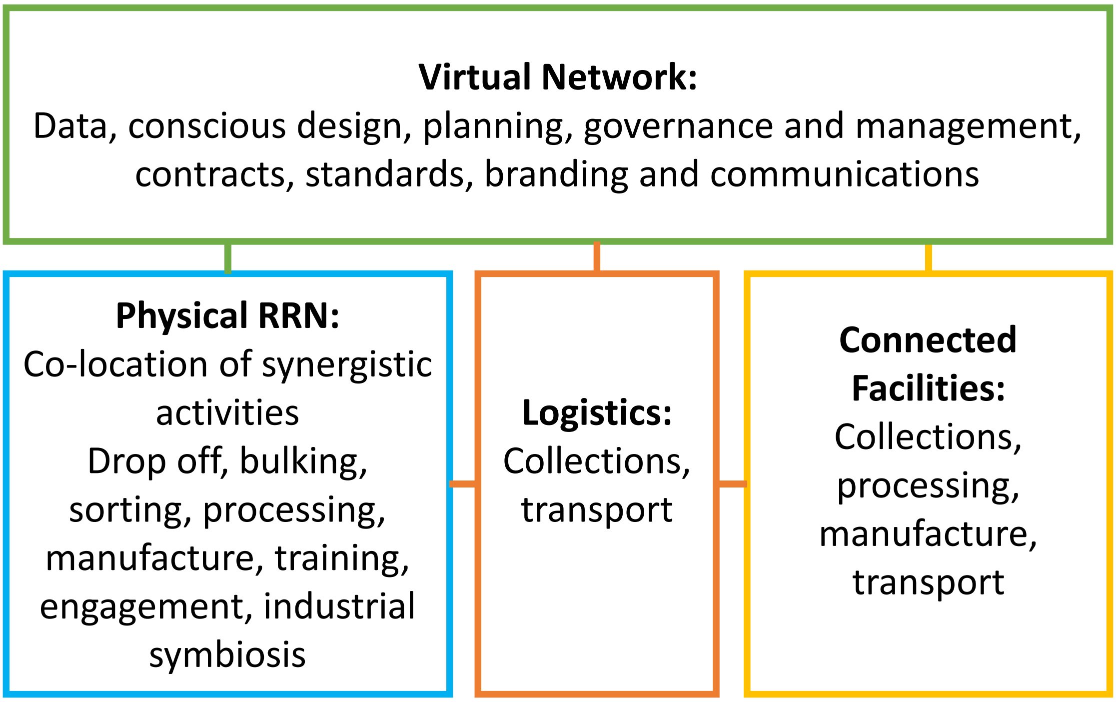
While the conventional concept of a resource recovery network has much to recommend it, in our view there is potential to evolve it further to create the core functionality needed to enable the circular economy.

[59] https://menzshed.org.nz/about-us/what-is-a-shed/

It is proposed to evolve the concept of physical co-location of synergistic activities to encompass a virtual and holistic network of sites, some co-located (where this provides efficiency gains, and is practical), but also including other sites that may be physically stand-alone sites, but which are connected to the circular resource network. The method of connection would be through supplying and receiving material, utilising network transport arrangements, operating to agreed performance standards, utilising standardised signage and specifications, providing and receiving data, and being linked through virtual directories.

The idea is that the physical network of sites and logistic is replicated virtually in an information management system. This nation-wide virtual circular resource network could, eventually, track and/or manage the flow or materials through the entire resource recovery sector in Aotearoa, and enable the optimisation of infrastructure, logistics, and services. Underpinning the virtual network is a physical network of sites and facilities that operate to agreed standards (akin to the traditional RRN concept), supplemented by standalone sites that are connected to the network. Connecting the physical network and standalone sites is a highly efficient, flexible, and low carbon logistics network. The high-level structure of the network is illustrated in the figure below:

Figure 35: Circular Recovery Aotearoa High-Level Structure



20.3.1 Spatial Representation

Figure 36 below shows a high-level visual representation of a national resource recovery network.

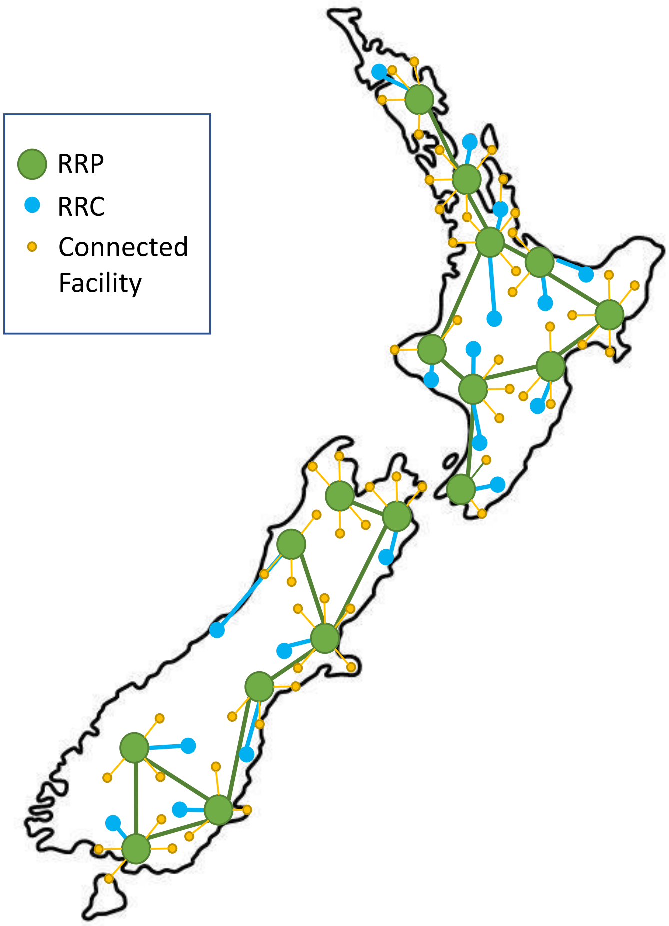
The large green dots represent regional RR Parks that consolidate and process material at a regional level. Depending on the material stream, materials could also be transported between the regional hubs (for example glass being consolidated in

Christchurch for shipping to Auckland for manufacture). Regional hubs could also specialise in processing certain materials and swap materials accordingly.

The mid-sized blue dots represent local RR Centres that accept a full range of materials and send to the regional RR Parks for bulking (or to Connected Facilities for local processing). Not shown are smaller drop off sites.

The small yellow dots represent the potentially hundreds of facilities that are not co-located at an RR Park or RR Centre but are linked and operate to the standards of the network. These facilities could accept materials from the RR Park or RR Centres for processing, or supply materials to these sites.

Figure 36: Concept Map of Circular Resource Network



20.3.2 Virtual Network

The core of the concept is that the reverse logistics system is actively planned and optimised to 'close the circle' and enable a circular economy. This requires planning, analysis, and data gathering and analysis functions, alongside the active ongoing management of material flows. This is what is covered by the 'virtual network' element. There are a number of ways this could be structured. What is presented in this section is by no means the only model but is preferred by Eunomia as it provides flexibility for organic growth and evolution and enables valuable roles for all stakeholders by creating the 'playing field' for circular resource recovery activity.

The core elements of this approach are as follows:

- There is a government agency to oversee the network 'Resource Recovery Aotearoa'.
- The agency does not necessarily own the infrastructure, although it could own (parts of) the network.
- Regional bodies are established to oversee each region. These regional bodies could be branches of the national organisation or separate entities such as Council Controlled Organisations, community enterprise, or iwi organisations. The intent is that these entities would own or control key sites in the regional network (principally the RR Park sites) which they would lease to private and community operators to undertake the actual work of recovery.
- The central agency would set standards for circular resource network operation – like a franchise model and ensuring consistency of services throughout the nation.
- The central agency gathers, and analyses flows of materials and constantly optimises material flows and planning.
- The agency also provides online material exchange/ marketplaces.

The roles of the key organisations involved in the circular resource network are shown in the figure below:

Figure 37: Key Agents and Roles in the Resource Recovery Network

National Network Agency
- Design and oversight of the RRN
- Developing forecasts, identifying gaps and planning
- Setting of standards for operation
- Licensing/accreditation
- Funding and investment
- Regulation and consents for nationally significant infrastructure
- Data gathering, monitoring, dissemination, and reporting
- Operates/oversees national logistics

Regional Network Operators
- Oversees operation of key regional facilities (RR Parks and RR Centers)
- Owns/secures sites and leases to tenants to perform network compatible functions
- Planning and oversight of regional RRN
- Operates/oversees regional logistics
- Actively works to link regional stand-alone infrastructure to the network

Facility Operators
- Lease sites and operate resource recovery facilities (including some RR Parks and RR Centers)
- Undertake key functions on contract (e.g. MRFs, education, logistics etc.)
- Provides material to other network operators
- Receives material from public and other network operators
- Provides data to regional and national network agencies

20.3.2.1 Governance and Management Structures

It will be necessary to have appropriate structures in place to oversee the development and ongoing management of the circular resource network. While the concept could be initiated by the Ministry for the Environment, it is likely to be most appropriate for it to be operated by a central government agency with an operational focus. This could be an organisation established for the purpose, or it could be assigned or contracted to an existing agency.

Because there are going to be a range of stakeholders directly affected by the circular resource network, it will be important to have appropriate governance and advisory arrangements in place to ensure it is responsive to the needs of stakeholders, while remaining focused on delivering on the intent of the circular resource network.

20.3.2.2 Planning and Oversight

A core function of the central agency will be planning and oversight of the network. This will involve consultation, developing and communicating strategic plans, identifying, securing and providing appropriate funding to enable the development of the network, and ensuring ongoing optimisation of the infrastructure.

20.3.2.3 Digital Model

The concept is to develop a digital model of the key material flows within the resource recovery sector (ideally this would ultimately encompass a mass balance of materials through the economy, although this is likely to be more difficult to achieve and therefore a more long-term aspiration).

By digitally mapping material flows nationally, across both core facilities and connected facilities, potential gaps and issues could be quickly identified and planning undertaken to ensure the system remains optimised and is resilient and adaptive in the face of change.

The digital model would include current material flows and allow for projections and modelling of new facilities, changes to material types and quantities, logistics etc. This would enable the potential impact of new facilities and options to be investigated before implementation.

20.3.2.4 Standards

The core of the circular resource network is the establishment of a set of standards of operation that all facilities that form part of the circular resource network operate to. These standards would apply to both operations co-located at an RR Park or RR Centre, as well as connected facilities. In this regard what is proposed is similar to a franchise model: As well as designing the overall system the government (or its agents) set the basis by which the circular resource network would function.

20.3.3 Physical RRN – Structure

The 'Physical RRN' is the aspect of the system that is most recognisable interface of the network. For the purposes of presenting this concept it is proposed that a national network is made up of regional nodes (circular resource networks) that are linked but that can operate as independent regional entities.[60] This would enable planning with a national perspective (as noted above) but empower the governance and management at a regional level to enable agile response to regional and local requirements. It should be noted, however, that there could be a number of different models.

20.3.3.1 Governance and Management

The regional networks are operated by separate regional entities but work under a franchise type model that is overseen by a national government agency.[61] This model allows for regional differentiation, as well as enabling a mix of collaboration, and competition and creating the ability to test and evolve operating models and apply learnings across the network.

Regional networks can be managed by a range of different types of entities – such as regional or local government-controlled organisations, community enterprises, iwi, private sector, or partnerships between these groups.

The role of the regional networks is primarily as follows:

- Site ownership, management, development, and leasing.
- Operating region-wide logistics to consolidate materials from RR Centres and Connected Facilities at the regional RR Park for bulking, sorting, processing and bulk transport or local manufacture.
- Overseeing and applying the operating standards for the network
- Advocating for the development of the network and working with operators and stakeholders to facilitate it’s continued development.
- Promotion and communication with users.

20.3.3.2 Site Management

The regional entities either own or lease land for RR Park and in some cases RR Centre or Connected Facilities, and oversee its’ development, and the leasing of the spaces to appropriate operators required for the function of the network. The regional entities generally hold the consents and are responsible for ensuring the supply of services to the sites and the construction/provision of generic infrastructure (e.g. roading and paving, generic buildings, water, sewerage, electricity, and internet, landscaping, signage).

---

[60] For the purposes of this exercise, it should be assumed that ‘regional’ broadly corresponds to current regional council and unitary council boundaries.

[61] This model has been assumed for the purposes of this scenario. However other models are possible, such as a centrally owned network.

20.3.3.3 Standards

The regional networks operate to national standards that include the following (as noted above):

- Branding and communications
- Core materials accepted and material acceptance criteria
- Output material quality standards and contamination levels (referencing existing market specifications or official standards where appropriate)
- Customer service levels
- Appropriate employment conditions
- Standard contracts and agreements for supply of services, provision or sale of materials, leases etc.
- Access to and participation in online marketplaces for recovered materials generated by network participants.

The regional network operators in turn would be responsible for applying and enforcing these standards for local and connected facilities.

20.3.4 RR Parks – Regional Hubs

The heart of each regional network consists of one or two large RR Parks, where a range of key functions are co-located. The purpose of the RR Park is to provide a 'hub' for the efficient regional consolidation of a wide range of materials collected at the RR Centre and Connected Facilities, as well as those that may be collected at the RR Park itself.

The core of the concept is to have regional consolidation of materials and provide a hub for the regional network. In addition, these sites could provide a 'flagship' centre with a full range of services for drop-off and community engagement etc.

20.3.4.1 Features

The RR Park all can have different mixes of facilities depending on local requirements. The logistics and flagship public facing operations could be co-located or at different sites depending on local situations.

Typical facilities may include:

- Material Recovery Facilities for sorting of collected co-mingled materials.
- Anaerobic Digestion facilities to process putrescible wastes and generate biogas that is used to fuel the regional logistics collection fleet.
- Logistics sorting centre for managing the inputs and outputs of a range of facilities.
- Construction and demolition waste sorting facility
- Wash plants and fleet management facilities for reusable containers

- Regional consolidation and logistics for a range of product steward ships scheme such as:
  - E-waste dismantling and processing operations.
  - Used large battery (EV and stationary storage) assessment and consolidation centres.
  - Farm plastics and agrichemical containers
  - Tyres
  - Mattresses
- Education centre
- Reuse stores/mall
- Food rescue
- Manufacturing businesses utilising recovered materials. In some instances, these businesses are co-located to utilise others' discarded materials and surplus process heat, with ongoing work to develop industrial symbiosis models.
- Research on material reuse/recovery
- Drop off facilities for a full range of materials.

20.3.5 Local RR Centres

While the RR Parks are the hub of the regional networks, the RR Centre form the primary nodes, where the majority of material is dropped off and consolidated locally. Many RR Centres will start off as local transfer station sites that are upgraded and re-purposed to have a predominant focus on resource recovery. The RR Centres are the local centre for community activity, with many run by community enterprises or iwi, and serve to engage, educate and empower the local communities to not only recover materials but extract and apply the value of those materials for community benefit.

20.3.5.1 Features

There are a range of different services and facilities at each site, but a set of core facilities could include the following:

- Drop off facilities for a standard range of materials (nominally as follows):
  - Cardboard
  - Metals
  - Paper
  - Glass
  - Plastics 1,2,5
  - Shrink-wrap
  - Garden waste
  - DIY construction and demolition waste
- Dropoff/consolidation sites for current and future product stewardship schemes, for example:

    - Reusable containers
    - Single use containers
    - E-waste and batteries
    - Farm plastics and chemical containers
    - Tyres
    - Mattresses
    - Textiles
    - Paint and household chemicals
- Reuse drop off, refurbishment and resale (furniture, household items, furnishings and clothing, toys, books, tools).

Optional services and facilities could include:

- Café
- Construction and bulky materials sales yard
- Education, training
- Workshops/refurbishment
- Food rescue
- Cooking oil – biodiesel/soap manufacture
- Reusable nappies
- Mattress recycling
- Business incubator space.

20.3.6 Logistics

A core feature of the network is the establishment of an efficient logistics network that is able to consolidate and transport materials as efficiently as possible, including utilising back-loading, bulk transport, and using flexible methodologies to facilitate bulk transport of smaller volume materials (for example, modular bins transported on side loaders).

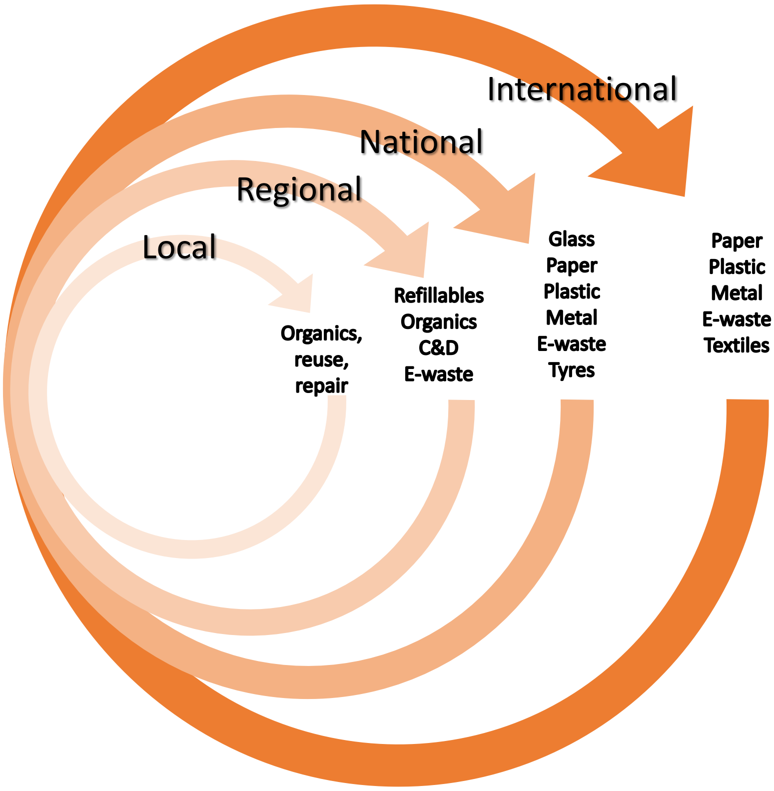
Vehicles utilised by the network could take advantage of low-carbon and waste-based technologies to minimise the carbon footprint of materials managed by the network. For example:

- Vehicles could be powered by gas/energy generated from anaerobic digestion of organic waste.
- Battery electric vehicles could utilise second-life batteries or charging infrastructure built using second life batteries.
- Bulk transport using rail (ideally electrified).

Materials are dealt with in the most appropriate manner through the network with some materials manged locally or regionally, and other materials utilising the logistics capabilities of the network to be delivered to national end uses at low cost.

The figure below illustrates how certain materials are likely to be managed locally, regionally, nationally, or internationally.

Figure 38:Geographical Circulation of Material Types



In the above indicative representation, organics such as garden waste, reusable and repairable items are likely to be utilised in local communities; refillables, organics that require more capital intensive processes (such as food waste or sludges), construction and demolition waste, and e-waste dismantling are likely to be undertaken on a regional level; processing and manufacture of products from glass, paper, plastic, metal, e-waste, and tyres are likely to be processed at national or sub-national scale facilities. Finally, there will be a range of materials that are sold into international commodity markets. These are likely to include paper, plastics, metals, e-waste, and textiles.

The above is intended purely for the purposes of illustration – as markets, material types, and processing technologies evolve these circles of re-integration into the economy are likely to change. The key point is that the network will involve a redistribution of different products and materials to different points and designing this redistribution to be as efficient and effective as possible will be critical to the functioning of the circular economy.

20.3.6.1 Local Logistics

A key part of the concept is to facilitate the ability to capture the wideset possible range of materials by taking advantage of economies of scale to capture economic quantities. This can be achieved through a standardised modular approach to material separation and collection. An example of this is the system deployed in Upper Austria, which utilised

1 cubic metre stackable bins that can be moved using forklifts and transported on curtainsider trucks (see Figure 39).

Figure 39: Standardised Bins Being Loaded onto Curtainsider Truck

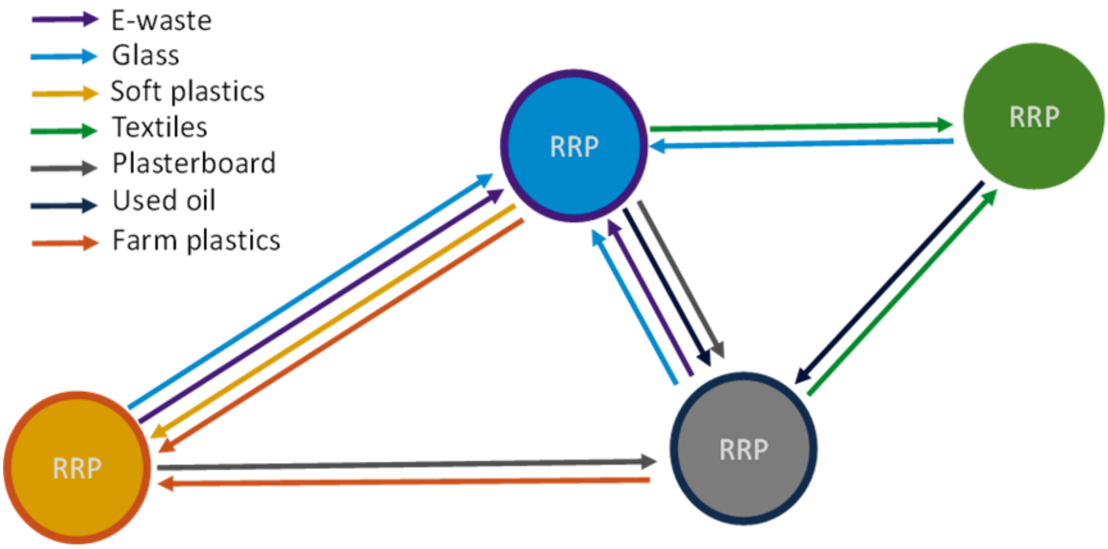
The system collects 80 different types of separated material. The problem of it taking time to gather economic quantities of less common material types is minimised as economic quantities can be achieved across the whole region, and the systems components are low cost and have proven efficiency.

The use of the same bins the same types of materials and common signage provides standardisation across the network, despite a wide range of operators being responsible for the individual resource recovery sites.

20.3.6.2 Inter-Regional Logistics

There is also potential to optimise the flows of materials between regional/sub regional hubs. For example, each regional hub could specialise in processing of one or more material types, with flows of materials then able to be balanced between sites, optimising logistics through backloading, as well as creating economies of scale. A hypothetical illustration is provided in the figure below.

Figure 40: Inter-Regional Logistics Model

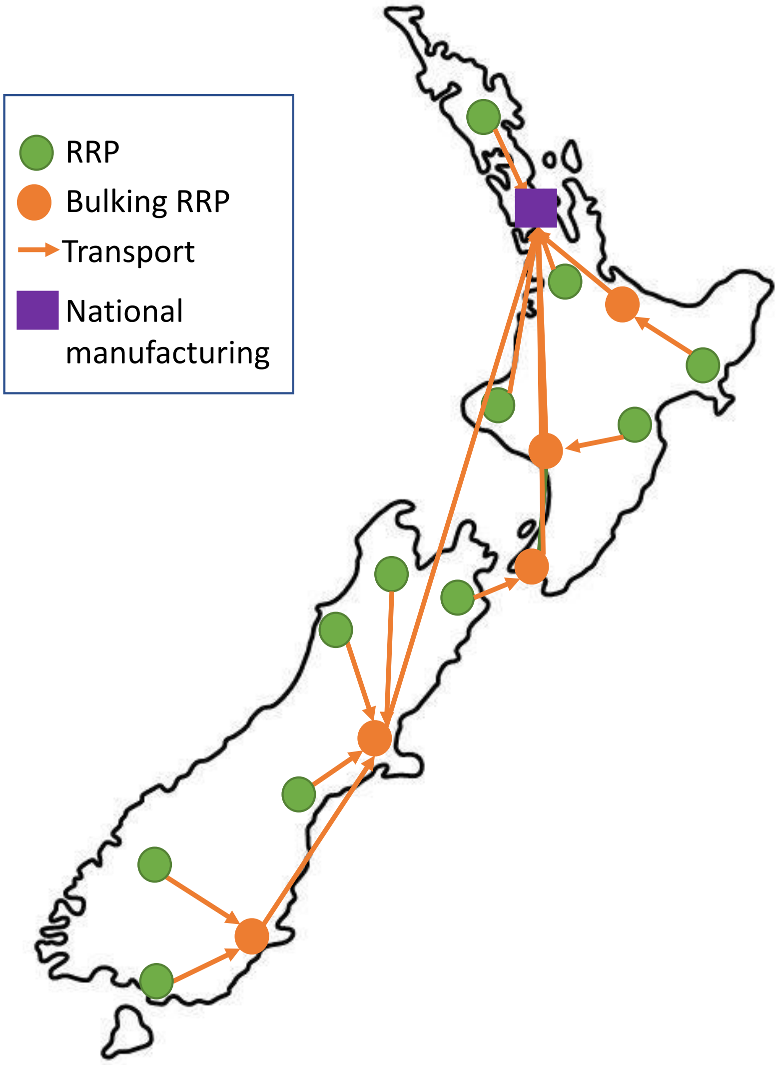


In the above hypothetical illustration, the blue RR Park processes e-waste and glass from other proximate RR Parks, while sending other materials such as soft plastics, farm plastics, textiles, plasterboard and used oil to other proximate RR Parks. This is repeated across the RR Parks, so that the quantities and movements of material are approximately balanced. The location of specialised processing and balancing of logistics would be part of the design and planning role of the national level Virtual Network.

20.3.6.3 National Logistics

In addition to the local and inter-regional flows of materials, a range of materials handled by the network would need to go to national scale processing/manufacturing facilities (e.g. glass, paper, plastics). Logistics across the network could be optimised to take advantage of bulk transport through strategic bulking points, and there is even the possibility of constructing new national scale facilities in locations to balance national materials flows. The figure below illustrates how materials could be consolidated through regional networks to key bulking points for long-haul transport.

Figure 41: National Logistics Illustration



20.3.7 Connected Facilities

20.3.7.1 Description

While the heart of the circular resource network is the RR Park and RR Centre, a key feature of the circular resource network concept is the connection of potentially all resource recovery operations to the network. A range of resource recovery businesses that are not/do not need to be co-located at a network site are connected virtually. The facilities could be owned or operated by regional or national agencies, Territorial Authorities, private sector, iwi, or community sector or through partnerships. As noted earlier, these facilities would operate to the same standards as co-located facilities and could participate in the logistics and virtual network arrangements.

While there is significant new infrastructure that is likely to be required to realise the circular resource network concept, there is also already substantial existing infrastructure in operation. Much of this existing infrastructure will not necessarily form part of a RR Park or RR Centre where functions are co-located. Indeed, one of the features of the proposed concept for the circular resource network is the idea that many facilities can be connected virtually, and do not have to physically co-locate. In fact, many instances there may be good reasons not to co-locate (for example where an organic waste processing facility is located in a rural area to alleviate odour issues, where space requirements are significant, or where there are other significant considerations such as proximity to a port).

20.3.7.2 Features

Typical operations that are located at independent sites could include:

- Manufacturing facilities
- Composting operations
- Recovery operations that require a lot of space, or generate noise or odour, or that is otherwise not compatible with co-location
- Industrial symbiosis parks
- Metal scrapyards and auto-dismantlers
- Materials that have excellent single-stream logistics and do not benefit from co-location
- Existing resource recovery operations that operate at independent sites.

Generally speaking, independent facilities would have a main primary function, but there could be multiple functions on a single site. For example, an industrial symbiosis park may be run independently from the network but still be connected.

20.3.8 Roles

Key to the proposed concept is the idea that all different types of stakeholders have a role to play, and that existing infrastructure and services can be integrated into the system. In essence it is proposed that the circular resource network is planned and overseen by central government (or a central government agency), but that delivery is provided by the private and community sectors, industry, councils, and iwi. Indicative roles are set out in the subsections below.

20.3.8.1 Central Government (or Agencies)

Central and local government infrastructure investment is suggested to be directed at providing the platform for private and community sector activity to take place – e.g. the land and buildings. This is supported by contracts (where appropriate), leases, performance standards, regulation, consents, coordination, and oversight. Where a key value-add is in enabling the production of a new, viable, product, or creating industrial symbiosis through linking of manufacturing and processing industries there could be a case for investment in manufacturing. Key aspects of central government’s role would include:

- Design and oversight of the circular resource network
- Developing forecasts, identifying gaps and planning
- Setting of standards for operation
- Licensing/accreditation
- Funding
- Regulation and consents for nationally significant infrastructure
- Ownership, or partial or transitional ownership of nationally significant infrastructure
- Data gathering, monitoring, dissemination, and reporting

20.3.8.2 Local/Regional Government

Local government have historically had a major role in waste management planning and service delivery, and this is likely and desirable to continue. Local government own a significant proportion of the existing transfer station sites, and well as processing infrastructure sites and are familiar with local circumstances. Many councils are already in the process of developing resource recovery parks or local networks. These existing and planned sites could form a starting point for the physical circular resource network. It would primarily be a matter of collaborating to establish consistency and linkages across the existing and planned sites as well as promoting the development of new sites by local government.

In addition, there may be a vital role for regional entities. One of the key issues identified in the stocktake work was a lack of appropriate delivery structures for regional level infrastructure. Some facilities require a regional level approach to achieve appropriate economies of scale (for example processing of food waste, MRFs, regional bulking for key materials such as glass etc.). The proposed circular resource network concept is centred around a regional approach, with one or two regional scale RR Parks that form the core hubs for collecting and consolidating material from the RR Centre sites, and undertaking processing and, potentially, manufacture. Key aspects of the roles for regional and local government could include:

- Service operation/contracting
- Local and regional expertise and coordination
- Local infrastructure investment and operation
- Identification and provision of appropriate sites
- Local consents monitoring, and enforcement
- Gathering and analysis of data

20.3.8.3 Iwi

Iwi also have an important role to play in the co-development of the circular resource network. The concept of resource recovery is aligned with the te ao Maori principle of kaitiakitanga, and the Para Kore programme is already in place in 476 marae across the country[62]. In addition to performing a similar role to the private and community sectors in service delivery, iwi have a role as kaitiaki of the land and people, and where resources are available, iwi can contribute financial investment and sites to the network and provide leadership in the development of the network. Key aspects of the roles for iwi could include:

- Service operations
- Infrastructure investment and operation
- Guardians / developers of RR Park and RR Centre sites
- Recovering value from materials
- Ownership and sale of recovered materials
- Utilising recovered value to leverage other community outcomes (e.g. employment, training, rehabilitation)

20.3.8.4 Private Sector Operators

Private sector operators currently manage the vast majority of waste materials recovered and disposed of in NZ, whether via private commercial arrangements or under contract to the public sector, and this would be expected to continue under the proposed model. The expectation is that, for the operation of the physical circular resource network, the public sector would generally own the land and generic infrastructure (such as buildings or, concrete pads, roading etc.) but would lease the sites or contract out for the delivery and operation of the circular resource network sites (such as separation of materials, composting, processing, manufacture). Sites could have

[62] https://www.parakore.maori.nz/our-story/

a range of private and community sector operators involved (see below). Key aspects of the roles for private sector operators could include:

- Service operations
- Infrastructure investment and operation (either privately or under contract)
- Recovering value from materials (including repair and reuse)
- Ownership and sale of recovered materials

20.3.8.5 Community Sector

Although the community sector is a minor player in terms of the total quantity of waste materials managed in New Zealand, they have had a significant role in the industry in terms of community engagement, innovating around recovery, and extracting value from waste materials to apply to social and community outcomes. The community sector role can potentially be further embedded and given added importance in the delivery of the circular resource network concept. Community groups could not only provide services such as reuse and repair across multiple sites but could also be empowered to deliver all services on sites (as has been demonstrated in Auckland). Key aspects of the roles for community sector operators could include:

- Service operations
- Infrastructure operation
- Recovering value from materials (including repair and reuse)
- Ownership and sale of recovered materials
- Utilising recovered value to leverage other community outcomes (e.g. employment, training, rehabilitation)

20.3.8.6 Product Stewardship Schemes

Product stewardship schemes have a potentially significant role to play in enabling circularity as well as in the development of the circular resource network. Product stewardship broadly places the responsibility for the end of life/end of use management of products on the ‘producers’ (in practice a combination of the manufacturers/importers/retailers). This requires producers to have appropriate systems in place for the take back and recovery of end-of-life product (typically funded by an up-front charge placed on the product at the time of import or sale). If there are only a few product types that require stewardship schemes to be in place, individual schemes represent a functional approach. However, if the number of schemes starts to multiply, this could result in duplication of systems and infrastructure across multiple locations, and confusion and a lack of convenience for consumers (for example having to go to different sites to drop off e-waste, plastic packaging, reusables, paint). One solution is to co-locate product return and processing infrastructure as an integral aspect to the circular resource network to provide ‘one stop shop’ type services for consumers and scheme operators. A circular resource network would provide an ideal platform for this. Conversely, product stewardship schemes could provide ideal 'anchor tenants' for circular resource network sites, as they would be adequately funded and require a universal and widespread network. Key aspects of the role would include:

- Investment in infrastructure and services for product take back
- Operation of product stewardship schemes

20.3.8.7 Manufacturers

As noted earlier in this report, the key dynamic for enabling increased recovery of materials is to ensure there is sufficient value preserved and created through the reverse logistics value chain. The value of materials, however, is ultimately one that is determined by manufacturers. There needs to be demand for the recovered materials, and this demand is in turn driven by the demand for the products made from recovered materials. This is the source of value that cascades through the reverse logistics value chain. The ability and need to create commercially viable products with recovered materials is therefore central. Within the circular resource network, manufactures will play a key role, not only by providing a market for recovered materials, but also by working with the supply chain to ensure material quality requirements are clearly understood and managed.

There is potential for manufacturers to co-locate on RR Park sites where they can efficiently access the raw materials required. In addition, there is also potential to create industrial symbiosis models, where multiple compatible industries are co-located and where the unwanted outputs (or by-products) of one process become the inputs for another process. Industrial Symbiosis Kawerau is a local example of an industrial symbiosis project[63] Industrial Symbiosis is discussed in a bit more detail in another section (see 7.7).

Key aspects of the manufacturer's role in a RNN would include:

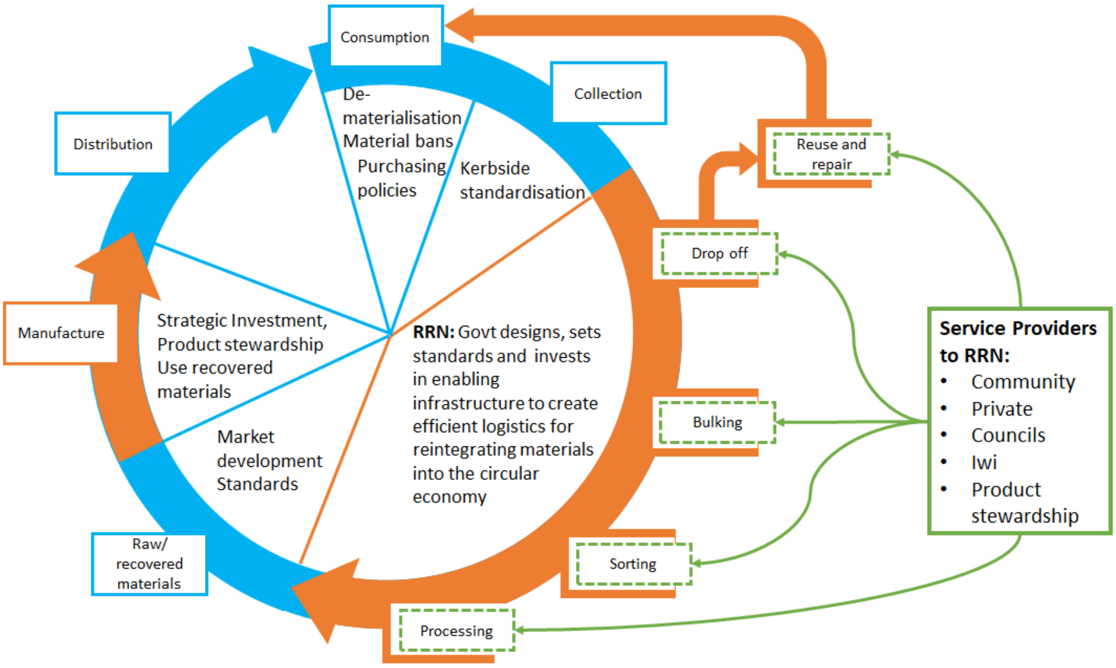
- Manufacture of products using recovered materials
- Design and supply of products consistent with circular economy principles
- Establishment of/participation in industrial symbiosis initiatives.

20.3.8.8 Summary

The figure below illustrates how the roles and functions of a national resource recovery network could integrate to provide key reverse logistics functions in the circular economy. The orange elements of the circle are the parts that form the circular resource network.

[63] https://isk.nz/

Figure 42: Roles and Functions of a Circular Recovery Network in the Circular Economy



In the above chart material flows around in a clockwise direction. The arrows represent the material flows. The boxes indicate the key steps within the value chain. The graphic shows how different providers to the can deliver all of the key functions, but within an overall connected framework (that is established and overseen by central/regional/local government).

20.4 Ownership of Materials

There are a range of possible models for the ownership of materials. It pays to bear in mind that the key purpose of the network is to re-integrate materials and products into the economy as efficiently as possible. The ownership model that should be applied is the one that will best enable this. This means it could be different for different materials or parts of the network, or that a mix of arrangements could be in place simultaneously.

The most efficient model is likely to be where there is a direct supply of discarded material from the generator to a manufacturer utilising the materials. Only where there is a need to process or consolidate materials from a range of sources, do materials need to go through specialised waste operators (private or public).

It is expected that materials collected through the regional networks would mostly be owned by the operators collecting, processing, and utilising the materials. In some instances, this may be done under contract arrangements with risk-sharing around material ownership, but this is on a case-by-case basis. Where appropriate, the regional entities invest in, partner with other organisations, or own specific infrastructure critical to the functioning of the network (for example a MRF). The network would however also provide a platform for consolidation and bulking of materials into economic amounts that could be sold into markets or to buyers. In these instances, the network operators (national or regional) could act as brokers for material or could be an intermediate buyer (or could contract these functions out).[64]

This is an aspect of the network that could be allowed to evolve over time as operators and participants seek out the most efficient business models. Further work is suggested however, to better understand the options for ownership of materials and their implications.

20.5 Investment Criteria

The overarching aim with the circular resource network is to develop a state-of-the-art reverse logistics network for harvesting materials from all parts of the economy. A circular resource network is not just about providing a standardised drop off network, it is about removing key constraints on being able to recover value from materials and enable circularity. The intent is to consciously design the most efficient system for (re)harvesting materials, which lowers the cost of their recovery, and thereby unlocks economic opportunity, which in turn delivers positive environmental outcomes.

This therefore provides a clear framework for why to invest in particular infrastructure or not – the question becomes how does the infrastructure in question add to the total system's ability to more efficiently harvest (and extract value from) materials?

Potentially all types of infrastructure, from the RR Park themselves, to reuse operations, composting or AD facilities, MRFs, or manufacturing facilities could meet this criterion.

Previously, the case for taking action in the waste sector has mainly focused on metrics such as tonnage diversion from landfill, reduction of environmental harm, and, increasingly, the potential for reduction in GHG emissions. What is proposed is an enhanced set of criteria that focus on optimising the circular flow of materials through the economy while also achieving diversion from landfill and reduction of GHG emissions. The key metric for this is actually net material value. The proposition is that if net material value can be optimised across the entire value chain, then this will facilitate the following outcomes:

- Higher rates of reuse and recovery across all recoverable materials
- Higher quality recovered materials resulting in greater re-integration of materials into high value products
- Avoidance of virgin raw material extraction, with associated GHG reduction through the value chain
- Increased efficiency of material collection, consolidation and movement resulting in GHG reductions

[64] Care would need to be taken that this is not anti-competitive behaviour and is in line with Commerce Commission requirements. For this reason, it is not proposed that selling materials into or through the network be mandated.

- Decrease in materials to landfill resulting in GHG reductions
- Enhanced economic activity from the recovery of value from waste materials potentially leading to job creation and economic development
- Reduction in environmental harm through higher recovery and reduced losses to the environment (e.g. less littering or dumping of materials that have value)

In other words, the way to achieve environmental outcomes most effectively for the sector is likely to be to focus on optimising economic outcomes within a circular economy model - as opposed to optimising economic outcomes within a linear economy model, which does not lead to positive environmental outcomes.

20.6 Benefits of Circular Resource Network Approach

The proposed approach would have a range of benefits. These include:

- **Consistent with the Waste Strategy.** At its core the approach is about enabling the circular economy by building out the infrastructure required for the circular flow of materials in the economy. The circular resource network concept synthesises this into a practical approach with wide ranging applications.
- **A practical, easily articulated, investment strategy**. Because the core component of the circular resource network concept is an arrangement of physical infrastructure it is intuitively easy to communicate the intent.
- **Improved efficiency and value.** By focusing on how value can be preserved and enhanced through the resource recovery value chain rather than purely on environmental and social outcomes, it is possible to unlock the potential value of recovered materials and unleash the innovative power of the sector to achieve environmental and social outcomes.
- **Future flexibility.** Flows of materials will change over time. By government investing in the skeleton structures that enable functions, then investment is not locked into a time-limited solution. As materials, markets and processes change over time existing infrastructure and governance can be efficiently and nationally adapted for the new functions.
- **Data harvesting.** The development of the digital model circular resource network will enable an unprecedented level of insight into recovered material flows and enable effective and intelligent planning and nimble responses by the sector to evolving situations.
- **Baskets of materials.** By co-locating and handling of a range of material and product types at single locations this enables efficiencies through the sharing of support structures and cross subsidisation, and hence the viable recovery of a wider range of materials.
- **Builds on existing infrastructure.** As noted, existing infrastructure (such as existing and planned RR Parks, and transfer stations) would form the foundation of the circular resource network, and these could be progressively integrated.

- **Provides valuable roles for all stakeholders.** The circular resource network will be significant in scale and scope, and it will require the input, collaboration, innovation, and power of all parts of the sector to fully realise its' potential.
- **'No regrets' approach.** The circular resource network concept proposed here is potentially far reaching in its scope and what it could eventually encompass. However, whatever level the concept is implemented to, it will still have multiple benefits. At a minimum it would result in the creation of a number of RR Parks or regional circular resource networks, which will still be positive outcomes.
- **Scalability.** The network can be "right"-sized in a flexible manner with the ability to effectively respond to changing circumstances.

20.7 Industrial Symbiosis

Industrial symbiosis can be defined as "…the use by one company or sector of underutilised resources broadly defined (including waste, by-products, residues, energy, water, logistics, capacity, expertise, equipment and materials) from another, with the result of keeping resources in productive use for longer."[65] A key feature of industrial symbiosis is that the systems of interrelationship are deliberately designed to optimise the efficiencies. Industrial symbiosis can involve the physical co-location of businesses in 'eco-industrial parks' or similar, but it can also encompass the design of resource optimisation across different sites and sectors.

Industrial symbiosis is widely utilised and applied to different degrees internationally. Industrial symbiosis was incorporated into EU law in 2018, and member states are now required to promote replicable practices of industrial symbiosis. It is also a key component of the EU's Circular Economy Action Plan.[66] Similarly China has a substantial number of eco-industrial parks where infrastructure, energy and materials is exchanged between tenants.

20.8 Areas Necessitating Further Investigation

It is acknowledged that the concept put forward in this report will require significant further work to enable implementation. Questions around implementation are essentially beyond the scope of the current work and are understood to form part of the proposed infrastructure investment plan. Some of the key questions which will need to be addressed (along with some commentary) include:

- **How would existing players likely respond?** This is potentially a significant issue. If existing players are focused on controlling the waste stream and continuing to operate their own value chains, then any central government initiative may only have limited impact. The concept has been designed not to constitute a 'government take-

---

[65] https://standards.iteh.ai/catalog/standards/cen/e193aac6-2c81-442d-9309-ecdcdd62b24f/cwa-17354-2018
[66] https://www.weforum.org/agenda/2021/03/industrial-symbiosis-clusters/

over' but as an approach to re-orient the sector towards the circular economy which could have substantial ongoing roles for existing players. By offering opportunities to access materials, improved logistics, operate to consistent standards, branding etc. the intent is that this would provide an incentive to participate. Furthermore, it is envisaged that existing recovery activity would largely continue, but that new activity would be catalysed and optimised which would provide commercial and community opportunities. It is anticipated that there will need to be substantial engagement with the sector to ensure support for the concept, and to refine it to ensure it is practical.

- **Where are facilities required?** The stocktake identified, to the extent possible, key gaps in each sector, including regional gaps. However, the identification of precise locations for facilities is beyond the scope of this work.
- **What would it cost?** Some high-level indications of cost were canvased during the stocktake work, but due to the highly variable assumptions around what might be delivered, these were too variable to be useful. Calculating potential costs is outside of the current scope and would be part of the proposed infrastructure investment plan.
- **What quantities are involved in each investment?** High level indications of tonnage diversion for each option were also canvassed during the stocktake work. These have been used to provide some high-level indications of potential impact of the circular resource network proposal.
- **What is possible under current policy and legislative settings?** This is within the Ministry for the Environment's domain of expertise to answer more precisely. An initial review would suggest that the detailed planning and analysis, identifying potential sites, working with a region (or several) to begin to develop a model, funding of infrastructure that is compatible with the network, and beginning on the design of the virtual network are all possible within the current policy and legislative settings.

21.0 Roadmap to a National Circular Resource Network

21.1 Overview

A detailed programme for developing and implementing a national circular resource network will need to be developed and put in place. This is beyond the scope of the current work and will likely require a range of specialist input including legal, governance, economic, information management, tangata whenua, and private and community sectors. However, key aspects of what will be required to implement the proposed circular resource network system are outlined in this section.

21.2 Research and Planning

- Undertake detailed value chain analyses to understand precisely where the key interventions are for each material streams and activity type.
- Construct a high-level plan that identifies all the infrastructure required for a fully functioning reverse logistics model within the circular economy.
- Utilise the inventory work undertaken in this stocktake study to understand and map the existing infrastructure onto the future plan.
- Complete a gap analysis between existing and future infrastructure at local/regional levels.
- Identify and implement necessary legislative/regulatory tools to enable aspects of the circular resource network concept.
- Consult with stakeholders to gauge support and refine concept.
- Map a pathway for prioritising and sequencing the construction of the circular resource network.

21.3 Establish a Central Government Operating Entity

21.3.1 Structure

- Scope out the potential roles and functions of the entity and powers required
- Review potential operating models
- Evaluate whether existing entities are fit for purpose
- Establish resourcing and funding streams/budgets
- Commission entity.

21.3.2 Establish Operating Standards and Model

- Develop branding and communications
- Research and agree core materials accepted and material acceptance criteria
- Establish output material quality standards and contamination levels (referencing existing market specifications or official standards where appropriate)
- Establish customer service levels
- Develop employment conditions
- Develop standard contracts and agreements for supply of services, provision or sale of materials, leases etc.
- Research/establish online marketplaces for recovered materials generated by network participations (for example apps such as civilshare[67]), as well as other aspects of the sharing economy.

21.3.3 Develop and Operate the Virtual Circular Resource Network

- Research functional requirements for data model
- Develop specifications.
- Procure data model.
- Commission and test data model.
- Develop data entry and operational protocols (data security, data access, handling of commercially sensitive data, data reconciliation).
- Resource operations.

21.4 Establish Regional Management Entities

- Scope out the potential roles and functions of the entity and powers required.
- Review potential operating models.
- Evaluate whether existing entities are fit for purpose.
- Establish resourcing and funding streams/budgets.
- Commission entities.

---

[67] http://civilshare.co.nz/

21.5 Develop a Model Regional Network

It is suggested that developing a model regional network to test and refine concepts and provide an operating example for other regions to adopt could be advantageous. Key steps will include:

- Identify potential regional candidates (this could involve working with regions that already have certain network elements in place).
- Establish operating model and terms of Government assistance.
- Develop implementation plan.
- Provide funding/resources.
- Establish baseline data and monitoring and measurement systems.

21.6 Connect Key Operators to the Virtual Network

Once key elements of the virtual network are established it will be possible to begin connecting operators. Developing the Connected Facilities aspect of the circular resource network could consist of the following steps:

- Formulating a clear package of benefits for operators and businesses to participate in the circular resource network. This could include:
    - Ability to use network branding and leverage communications and promotional programmes.
    - Quality assurance to give confidence to customers and suppliers.
    - Priority access to materials from other participants in the network.
    - Access to data generated by the network.
    - Access to funding.
    - Pre-qualification for contracts or leases issued by the government or other network participants.
- Establishing appropriate entities to govern and manage the Connected Facilities (This could be regional circular resource network entities or a central agency)
- Evaluate applications, issue licences/contracts/accreditation and manage on-boarding, renewals and compliance.
- Work with ‘cornerstone’ operators to get them on board and refine package.
- Promote the advantages of becoming a Connected Facility to key operators.
- Provide funding for establishing or upgrading facilities.
- Monitoring, data gathering and dissemination, reporting and continuous improvement.

21.7 Invest in Key Processors

Ensuring valuable end uses for collected materials is key. Where this has been identified it may be important to invest in key processors to catalyse the establishment of viable end markets for collected materials. The stocktake value chain analysis identified putrescible organics, plastics, plastics from e-waste, and farm plastics as key potential areas. Further and more detailed research will be required to identify specific facilities and processes where investment could catalyse increased recovery through the value chain.

21.8 Invest/Partner to Establish Regional Networks

To roll out the network nationally it will be necessary to establish regional hub sites (RR Parks) and local feeder sites (RR Centres). This may involve the following:

- Assessing existing sites/operations that could form regional hubs.
- Work with local/regional entities, private or iwi owners to identify appropriate sites.
- If necessary, acquiring sites for regional resource recovery parks (RR Park), and/or local resource recovery centres (RR Centre).
- Consenting and planning permissions.
- Establish operating model and terms of Government assistance.
- Establishing appropriate entities to govern and manage the regional circular resource networks.
- Identifying and scoping appropriate facilities and functions for each site.
- Develop implementation plan.
- Provide funding/resources. This is expected to primarily focus on funding of generic infrastructure on sites (e.g. buildings, concrete pads, drainage, roading).
- Issuing leases/service contracts in line with the standards noted above.
- Establish baseline data and monitoring and measurement systems.

21.9 Invest in Cornerstone Operations

In order for regional networks to be viable cornerstone operations/anchor tenants are likely to be key. These may differ by region (for example if specialist processing operations are allocated to different regional sites to improve logistics and economies of scale, or to accommodate local needs). Based on the stocktake analysis cornerstone operations may include (but not be limited to):

- C&D processing.
- Organics processing.
- Product stewardship drop-off, bulking and processing facilities.

- Reuse wash plants and fleets.

Key actions to enable this will include:

- Map national network requirements.
- Determine regional requirements.
- Negotiate with potential cornerstone operations and establish terms of investment/support.

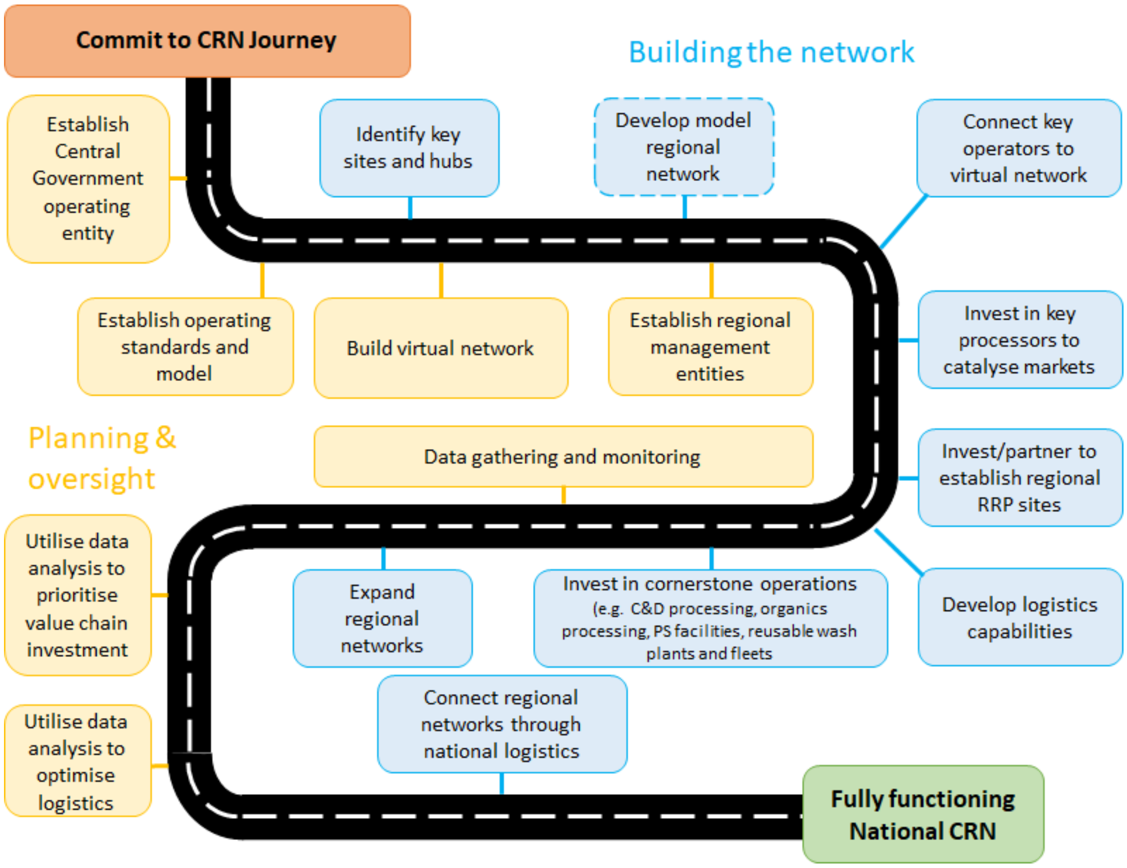
21.10 Develop Logistics Capabilities

- Research and determine local, regional, and national logistics operating models.
- Establish low carbon fleets (direct investment or service contracts).
- Establish supporting infrastructure (refuelling/charging infrastructure, standardised modular containment, bulking, warehousing and logistics management).
- Establish centralised and regional fleet optimisation.

21.11 Roadmap

The graphic below sets out the key steps required to implement a national circular resource network that would enable the reverse logistics.

Figure 43: Circular Resource Network Roadmap Graphic



22.0 Conclusions

Overall, the stocktake work has identified key issues and gaps in relation to resource recovery infrastructure provision. It also identified inadequacies in infrastructure planning, and in the functioning of the sector in being positioned to deliver a circular economy future.

Work with sector stakeholders was valuable and identified a consensus around enhanced resource recovery and climate change outcomes. Key priority areas for infrastructure investment emerged which are applicable in any future scenario. These are organics, construction and demolition, and reuse.

Analysis conducted for the project identified that a key concept across all materials is the need to 'close the circle' – that a circular economy will only be able to function in a circular fashion to the degree allowed by the weakest part of the circle.

Closing the circle will ultimately involve restricting material inputs where these have no practical pathway for further use or recovery, developing markets to create pull through value for recovered materials, and re-designing the reverse material flows to optimise value.

Optimising value through the reverse logistics value chain is the role of the resource recovery sector. In order to optimise value, it will be necessary to consciously re-design recovered material flows, which will entail working across materials, optimising logistics, working at the right scale for each product or material, and networking and linking resource recovery operations.

The proposed circular resource network concept outlined in this report will address these requirements and provide a cohesive framework for investing in enabling the circular economy.

This report sets out a way forward that aims to balance a number of – often conflicting – considerations (such as the need for centralised planning versus the need to allow the market to innovate and find the most effective solutions). However, it is acknowledged that many of these elements will need to continue to be refined and that new solutions or models could evolve and develop over time. The key to the proposal put forward is that it is aiming to be, at the end of the day, pragmatic. If there are better ways of doing things that will deliver circular economy outcomes more effectively or faster, then these should be explored and adopted where appropriate. The model is, at its core, designed to be adaptable, as this is the necessary reality of what it will take to transition to a circular economy.

Finally, waste arises as part of a larger system of human activity. It is almost impossible to isolate what happens in the waste sector from national and international forces and trends. The impact of China National Sword and the changes resulting from Covid-19 nationally and globally are recent examples. Technological changes and societal expectations, such as sustainability or the desire for convenience, are other trends that will continue to shape the sector, as are political considerations, such as employment and developing regional economies.