Rethinking Plastics in Aotearoa New Zealand

Draft sent for peer review

PROJECT OVERVIEW

Aotearoa New Zealand is at a pivotal point where we must rethink our relationship with plastic. Increasing public concern over the harmful effects of plastic pollution on our environment and health, and a growing appreciation of what we can learn from te ao Māori values such as kaitiakitanga, make it an opportune time to initiate change to mitigate the harmful effects of plastic and preserve our natural environment for generations to come.

A key part of that change is taking responsibility for our own plastic waste. This is spurred by China's significantly reduced intake of plastic waste for recycling and the recent amendment to the Basel Convention[1] that will restrict sending difficult-to-recycle plastic waste to developing countries.

There is an urgent need for Aotearoa New Zealand to establish onshore processing capabilities and to develop a national recycling framework that is simple to use for individuals, communities and businesses, so that recyclable plastic is not landfilled here.

The evidence base to guide change is lacking. The Rethinking Plastics in Aotearoa project aims to collate and synthesise information and expert opinion to provide government with a rigorous system-wide overview of plastic in Aotearoa New Zealand, in the context of international best practice.

Figure 1 Waste on Aotearoa New Zealand's shores.

There is an urgent need for Aotearoa New Zealand to deal with our own plastic waste. The evidence base to guide this change is lacking.

[1] The amendment to the Basel Convention to restrict waste plastic being shipped from developed to developing countries was signed by 187 countries and will begin to be enforced in 2020. Emily Holden, "Nearly All Countries Agree to Stem Flow of Plastic Waste into Poor Nations," *The Guardian*, 11 May 2019.

In order to provide this information ahead of the timeframe of the Government's work programme to take action on Aotearoa New Zealand's waste, we present in this draft document the first workstream from the Rethinking Plastics project, ahead of the complete report:

- **Chapter 1: To what extent can we quantify Aotearoa's plastics footprint? New Zealand's data challenge.** A current snapshot of the available data for plastic material flow through Aotearoa New Zealand. *Note that this chapter may evolve as the remainder of the project progresses and further data comes to light, and will be finalised when the full report is complete*.

Further workstreams that are not yet complete will supplement this section to enable evidence-informed decisions for rethinking plastic use in Aotearoa New Zealand. These include:

- **Chapter 2: Life cycle assessment of product systems.** This chapter will explain the role of life cycle assessment to measure the environmental impacts of plastics and summarise the currently available evidence through case studies.
- **Chapter 3: Innovation solutions.** This chapter will synthesise and prioritise the opportunities available to mitigate our overuse and waste of plastics, including materials recovery, bio-plastics, alternative materials, logistics innovation and system redesign.
- **Chapter 4: Changing our relationship with plastics.** This chapter will identify the methods that will be most effective to galvanise change at different levels, from individuals to communities, businesses, local and central government.

RETHINKING PLASTICS RESOURCES

A key issue met during preparation of this report is the lack of a central resource for information on plastics across the entire value chain, including the effects of plastic pollution. In response, we are developing a resource portal, available at https://www.pmcsa.ac.nz/2019/04/18/rethinkplastic-resources/[2]

[2] Reports included in the Rethinking Plastics portal are listed in Appendix 1.

Global use of plastics

Since the 1950s, 8.3 billion tonnes of plastic have been produced globally and the majority of that (79%) has gone to landfill or leaked into the environment.[3] It's difficult to comprehend the scale – but that's the same as 800,000 Eiffel Towers or 1 billion elephants. Approximately 42% of that production has been for short-term or single-use plastics used for packaging that should have been recycled, but is more likely to have been landfilled, incinerated or leaked into the environment.

We do not know Aotearoa New Zealand's contribution to this global problem. What we do know is collated in this first section of the report, and gaps in our data are highlighted.

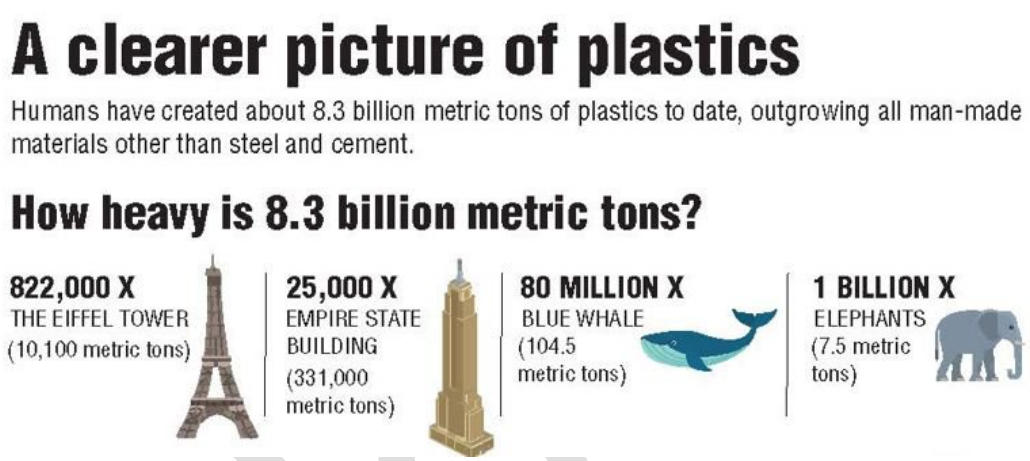

Figure 2 The scale of plastic production. Credit: University of Georgia / Janet A Beckley

[3] R. Geyer, J. R. Jambeck, and K. L. Law, "Production, Use, and Fate of All Plastics Ever Made," *Science Advances* 3, no. 7 (2017).

PART 1 EXECUTIVE SUMMARY

In response to the demand for urgent action on plastics in Aotearoa New Zealand, we have assessed the evidence for categorisation and labelling of plastics and quantifying our use of plastics, ahead of other workstreams. These findings are presented as Part 1 of Rethinking Plastics in Aotearoa New Zealand.

We need a standardised approach to naming & labelling plastic

The current approach to categorisation and labelling of plastics in Aotearoa New Zealand relies on voluntary implementation by industry, without national standards or mandatory labelling. This has contributed to public confusion about how to dispose of plastic products, leading to low rates of recycling and high rates of contamination in recycling streams.

In particular, there is much public confusion surrounding biodegradable plastics – many people incorrectly assume they are always made from bio-based sources and that all plastics made from bio-based sources are biodegradable.

Compostable plastics are particularly problematic, as almost all can only decompose in commercial composting environments not home composts due to commerical facilities being able to consistently reach higher temperatures, but that is not communicated clearly. Lack of regulatory standards mean that plastics advertised as compostable do not have to be certified in New Zealand's commercial composting environments or by any international standard.

The resin identification system, which has been relied on as a recycling label for many years, does not actually tell people whether a plastic product can or will be recycled, or whether it contains recycled content.

There is a need for a simple recycling label that tells people whether to recycle or dispose of a product.

Plastic use in Aotearoa New Zealand: Major data gaps identified

A pivotal step to enable Aotearoa New Zealand to reduce our use and mismanagement of plastic is to understand how much plastic we currently use and discard. A baseline material flow analysis is essential to inform and prioritise policy changes and to hold us accountable by measuring improvements over time.

There is currently no coordinated or standardised approach to measure or report plastic use and disposal by material type in Aotearoa New Zealand. As a result, there are large gaps in our understanding of the material flows of plastic through the country.

Our analysis has identified how plastics flow through Aotearoa New Zealand, and where data is or should be captured. The data we report here was obtained from existing databases or published reports. Where data was not available or only partially representative of the national use of plastics, case studies

were used. Given the variety of sources and methods, there were varying levels of confidence in the estimates.

By collating currently accessible data on the amount and types of plastic used and discarded in Aotearoa New Zealand, we have highlighed major gaps in our understanding of plastic material flow through the country, underpinned by the lack of a framework to report plastic use and disposal by material type. The findings are summarised below, and in Figure 3 and Table 1.

Plastic imports

For material flow of plastic into Aotearoa New Zealand, we have a clear understanding of the quantity of raw plastic resin imported for onshore manufacture into products as the tonnages and material type are captured by Customs New Zealand and available via Statistics New Zealand. The plastics manufacturing industry (perhaps via the industry body Plastics NZ), should be able to provide comprehensive data on what products are manufactured from imported resin and which sectors are serviced.

In contrast, we are very limited in our understanding of the volume and types of plastic that are imported as finished products and packaged goods, including the quantity of plastic used for secondary and tertiary packaging along the supply chain (e.g. carry packs and pallet wraps). It is likely that the volume of plastic imported in these products is significant, but with current methods we have no real idea of the scale. Importers of a product should be responsible for reporting weight and types of plastic associated with their imports.

Plastic exports

Our understanding of the quantity of plastic that leaves Aotearoa New Zealand is similarly limited. While there is accurate data on exported tonnes of raw resin and plastic materials or waste plastic, as this is captured by Customs New Zealand, there is no aggregated data on the amount or types of plastic that are exported from Aotearoa New Zealand as products or packaging.

A framework for disclosing plastic use at a company or sector level, could begin to address the knowledge gaps we have for both import and export data, particularly for finished products and packaged goods.

Plastic in use

We consider the plastic that has been imported into Aotearoa New Zealand and not yet discarded as being in the 'in use' phase. There is little data to draw on to estimate the amount or types of plastic currently in use in Aotearoa New Zealand. Due to the differenes in lifetime distribution of how a product is used – i.e. most packaging is single-use but a pipe used by the construction industry may be in use for 50 years – it is pertinent to consider this by sector. Estimates for the scale of plastic packaging consumed nationwide in one year have been made, but not for any other sector such as construction.

PLASTIC KIWIS

On average, each New Zealander uses 30 kg of plastic packaging per year, including 242 plastic drink bottles.

Plastic waste

Once products leave the 'in use' phase they are collected as waste. In Aotearoa New Zealand, the end-of-life options for plastic are recycling or landfill. The vast majority of waste plastic goes to landfill. Various reports have attempted to quantify the amount of plastic collected for recycling and landfill. Most of the data is limited to tonnage values and does not provide detail on the type of plastic.

Estimates of the national amount of plastic collected for recycling have been made drawing on various sources, but are limited by commercial sensitivities and the voluntary nature of reporting. The available data on recycled plastics does not capture the material types, weight, volumes and key product groups of plastic that are recovered through kerbside recycling collection across the country, nor does it tell us which types of plastic commonly contaminate the recycling stream and are then sent to landfill. Accurate and standardised reporting of the amount and material type of plastic collected for recycling requires commercial entities (such as material recovery facilities and recyclers) to disclose data.

There is data on the tonnages of waste to levied landfills, but this doesn't specifically measure the volume and types of plastic waste, and therefore doesn't tell us how much could be diverted for recycling. Data for non-levied landfills are sparse, including on-farm disposal and illegal dumping. The amount of plastic waste generated by construction is unknown. This will be partly addressed by a study undertaken by Unitec to quantifying plastic from construction waste, pending the project's funding.

Plastic in the environment

We are particularly limited in our understanding of the quantity of macro and microplastic pollution leaking into our environment, and from which sources. A national framework to coordinate and report this data could build on existing research and citizen science efforts.

Limitations in our understanding

There are several limitations that currently hinder our understanding of Aotearoa New Zealand's plastics footprint. In many instances data is not collected at all or at a level useful to inform policy decisions. Data is in silos, making it difficult to understand the flows from product design and use to disposal. Where data has been captured, it is not in a standardised or consistent way, and often measurement is not ongoing.

Further limitations are related to accessibility of data. Many commerical entities do have some level of data collection, but most of it is not in the public domain due to commerical sensitivities. Where data has been shared, it has relied on the goodwill of the organisation and has not been independently verified by a third party, and therefore lacks transparency.

Finally, even when data is available, much of it does not provide the level of detail that would be most beneficial to inform policy, such as specifying resin type, additives, or recycled content. That level of data will be crucial for identifying the products and material types where we should prioritise changes around use or end-of-life solutions.

We need data on plastics

Going forward, data collection is a crucial step towards understanding and reducing Aotearoa New Zealand's plastics footprint. To be most effective, we need agreement at a national level to define the problem; prioritise what is recorded and by whom; how this is integrated with other data sets; and how results should drive actions.

A considered, systematic approach to nationwide data collection for plastic is necessary to:

- Establish and hold ourselves accountable to targets related to plastic use and waste (such as those in the NZ packaging declaration signed by the Ministry for the Environment)
- Develop appropriate infrastructure to deal with plastics (e.g. recycling facilities)
- Highlight opportunities for the substitution of plastics
- Determine how much plastic is lost to the environment and use this to help build public awareness of the need to prevent plastic pollution
- Provide accurate market information to encourage entrepreneurship in this area
- Determine the environmental impacts across the full life cycle, to support manufacturers and brand owners to make informed decisions around product design
- Enable accurate declaration of waste data to the OECD and other international organisations, to improve our ranking as a wasteful nation and thus protect our reputation.

Going forward, data collection is a crucial step towards understanding and reducing Aotearoa New Zealand's plastics footprint.

Excerpt from the Ministry for the Environment's 'Our regulatory stewardship strategy 2018'

Monitoring the effectiveness of the levy and other areas of the waste regulatory system is challenging, due to the lack of access to data for most of New Zealand's landfills and waste. The Ministry only has access to data from 11% of all landfills, which represents 30% of all waste disposed of. Limited resourcing and information are barriers to carrying out this work. The Resource Efficiency and Innovation team's work programme, agreed to by the Associate Minister for the Environment in early 2018, will help address these issues. The Ministry will work on a national data collection and evaluation framework, and will explore options to expand the waste levy to other classes of landfill.

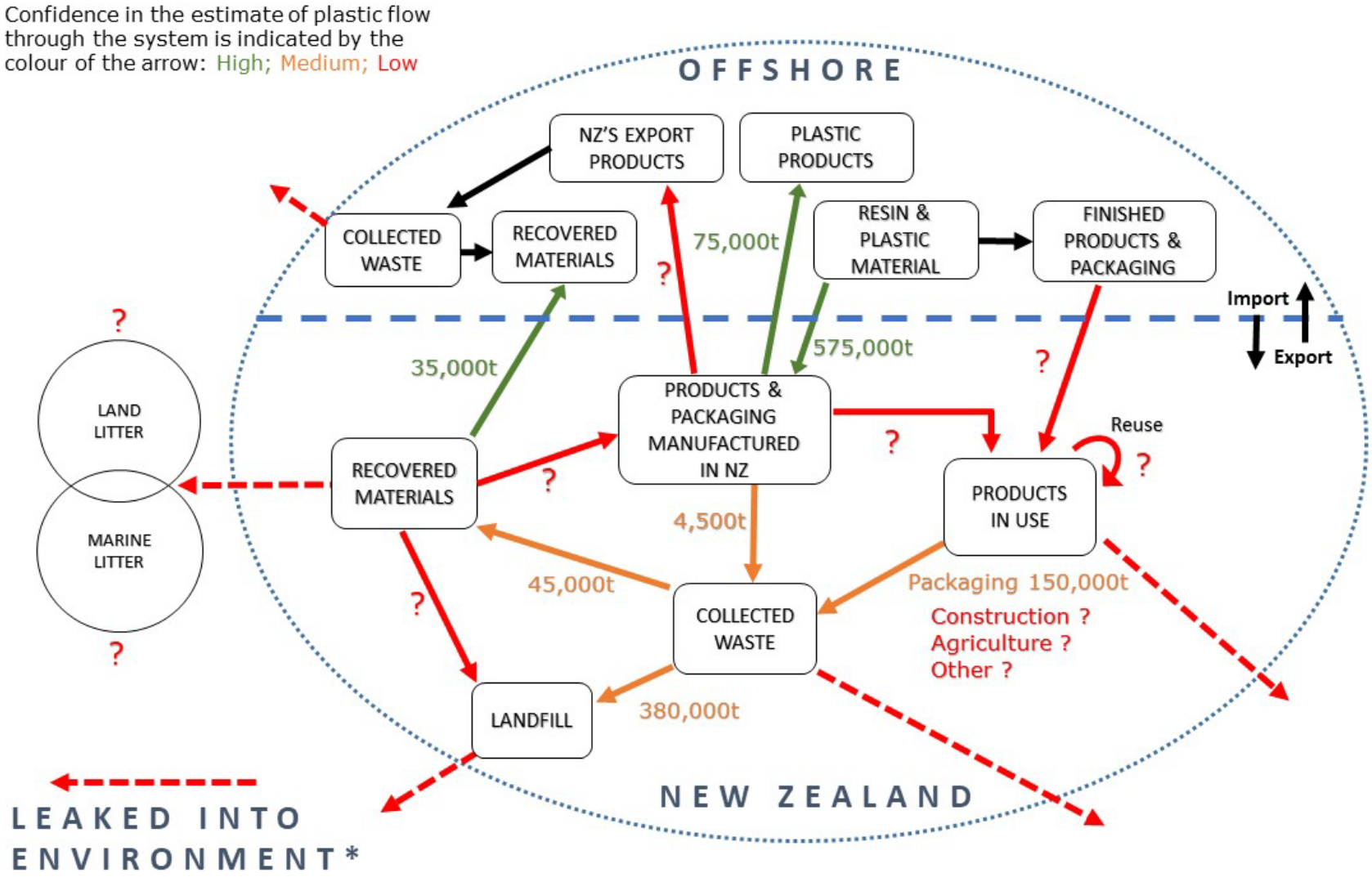

Figure 3 Flows of plastic into and out of Aotearoa New Zealand, including leakage into the environment.
**Plastic leaking into the environment includes macro and microplastics, and affects land, marine and air environments. It also includes waste that is burned or buried in unregulated landfill.*

Table 1 Summary of what we don't know about the amount of plastic in Aotearoa New Zealand

		Tonnes/year	Confidence	Source (year)	Partial data
IMPORT	Raw resin and plastic material	575,000	High	Statistics NZ (2018)~	
	Finished products or packaged goods	?	?		Synthetic textiles - 13,000 tonnes
EXPORT	Raw resin and plastic material	75,000	High	Statistics NZ (2018)~	
	Finished products or packaged goods	?	?		
	Waste plastic	35,000	High	Statistics NZ (2018)~	
IN USE	Packaging	150,000	Medium	Packaging NZ (2015)#	Plastic drink bottles - 25,000 tonnes
	Construction	?	?		350m^2 residential development – 80 kg mixed plastic waste
	Agriculture	?	?		Waikato & BOP rural properties - 5900 tonnes wraps, covers, films; 1500 tonnes containers, drums
	Other	?	?		
WASTE	Plastic collected for recycling	45,000	Medium	NRRT* (2018)	
	Plastic waste landfilled	380,000	Medium	Eunomia (2015) Perrot et al.^ (2018)	
	Pre-consumer industrial waste	4,500	Medium~	Plastics NZ (2005)**	
LEAKED INTO ENVIRONMENT	Marine litter	?	?		Sustainable Coastlines – 37.3. kg from 95 beach cleanups

~ Harmonised trade data from Statistics New Zealand Infoshare

Estimates based on export waste and population/GDP data, not accounting for imported finished products, packaged goods, secondary and tertiary packaging.

* National Resource Recovery Taskforce estimates based on voluntary reporting.

^ Conservative estimate for landfills based on data for class 1 landfills: 12% (Perrot et al. 2018) by tonnes (Eunomia Consulting).

**Based on voluntary manufacturer surveys from 2005.

CONTENTS

CATEGORISATION & LABELLING OF PLASTICS IN AOTEAROA NEW ZEALAND

1 WE NEED CLEARER LANGUAGE FOR PLASTICS

To maximise opportunities for resource recovery and reuse at end-of-life, we need to ensure firstly that all types of plastics can be identified at end-of-life. If a plastic product can be recycled, it needs to end up in the right recycling bin. If a plastic product can only be composted in a commercial composting facility, it must not end up contaminating the recycling stream or a domestic compost heap where it will not decompose. Using standard nomenclature and having clear labelling is key to facilitating best practice.

1.1 How are plastics categorised?

Plastic can be identified by the type of plastic (defined by its physical properties or chemical composition), the source of the material from which plastic is made (biological sources vs fossil fuels) and/or how the plastic can break down (degraded by microbes or not, and whether this is at a standard rate or faster due to chemical additives). Plastic can also be identified by the whether it is made from recycled content.

1.1.1 Physical properties

Plastics are either defined as thermoplastic or thermoset. The key difference between these classes is how the plastic responds to heat. Thermoplastic polymers can be reheated and moulded with no or minimal change to their chemical or physical properties. A level of degradation occurs with each cycle and depends on the type of thermoplastic. In contrast, thermoset plastics cannot be reshaped or recycled once they have been moulded or hardened. This feature allows thermoset plastics to withstand higher temperatures without loss of structural integrity.

These different properties lend thermoplastics and thermosets to different applications.

- Thermoplastics are flexible and used for packaging and other applications. In theory, these plastics can all be recycled and they are identified by their resin type according to the code described below.
- Thermosets are very rigid plastics that are used for products such as electronics. They do not have a resin identification code and cannot be recycled.

1.1.2 Chemical composition or resin type

This tells you what the plastic is made from. Each resin type has different chemical properties that meet the requirements for specific types of packaging or products (see Figure 4). It is standard practice is to code plastic-manufactured articles by their resin type (the chemical substance used as the basis of a plastic product). The ASTM

International standard ASTM D7611/D7611M is widely accepted as the global identification system.[4]

The resin identification tells people what the plastic is made from, but not whether it can or will be recycled. Whether a product is recyclable depends on the type of plastic, but also the colour of the plastic and chemical additives, which is not captured by the code.

The resin identification system, which has been relied on as a recycling label for many years, does not actually tell people whether a plastic product can or will be recycled.

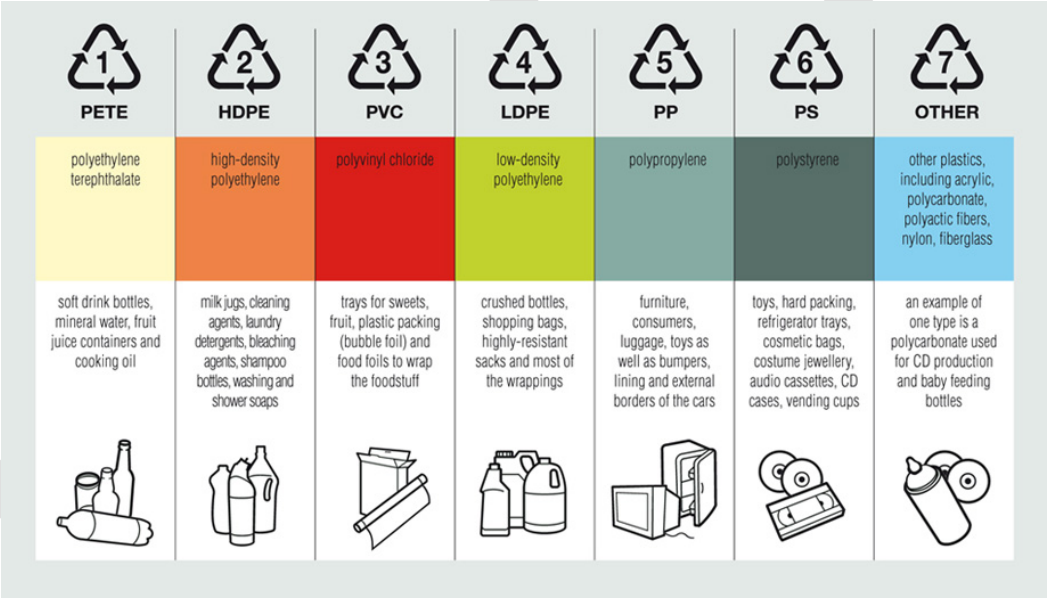

Figure 4 Categorisation of plastics based on the resin identification code and common products for each resin type. Placeholder figure: to align with RSNZ report once published.

1.1.3 Feedstock

Plastic can be made from different raw materials known as feedstock. The vast majority of plastic raw material comes from fossil fuel. The remaining plastic is made from renewable biologically produced compounds such as corn starch and vegetable oils.

- Fossil-fuel-based: Plastics derived from petroleum or natural gas, a non-renewable source.

[4] ASTM International, "Astm D7611/D7611m-18 Standard Practice for Coding Plastic Manufactured Articles for Resin Identification," (West Conshohocken, PA2018).

- Bio-based: Plastics derived from biomass sources, which are renewable. For a plastic to be classified as bio-based, the source material is not necessarily 100% biomass. Bio-plastic refers to bio-based plastics, but is sometimes incorrectly used to refer to bio-degradable plastics. Not all plastic made from bio-based materials is biodegradable.

Some bio-based plastics are identical to their fossil-fuel-based counterparts, but not all are. These are referred to as 'drop-in' vs 'non-drop-in', respectively. An example of when this would matter is during the recycling process, as a 'non-drop-in' plastic could contaminate the recycling streams of an apparently equivalent type.

There is a growing global effort to reduce fossil fuel consumption, which has led to a greater interest in plastics that can be made from renewable resources. As a result, many researchers are trying to develop plastics from a variety of plant-based sources that can match the fossil-fuel-based plastics that dominate the market (further detail to follow in Chapter 3: Innovation Solutions, not yet complete).

Not all plastic made from bio-based materials is biodegradable.

1.1.4 Additives

Both bio- and fossil-based plastics can have additives included in their production. The European Chemicals Agency (ECHA) has worked with industry to map out the range of over 400 functional additives or pigments currently used in plastic production.[5]

One function of additives is to speed up oxygenation and therefore degradation. These plastics are referred to as oxo-degradable plastic. Though oxo-degradable plastics degrade faster, they are almost always not actually biodegradable – rather, they break down to tiny pieces of plastic called microplastics which persist in the environment. Because oxo-degradable plastics contribute to harmful microplastic pollution, the European Parliament has announced a plan to ban their use.[6]

1.1.5 Degradation

All plastic will break down eventually, but it may take thousands of years. How it will break down and how long that will take depends on its chemical properties and disposal conditions.

[5] European Chemicals Agency list of additives or pigments; Available at https://www.echa.europa.eu/mapping-exercise-plastic-additives-initiative.

[6] European Commission Statement: Circular Economy: Commission welcomes European Parliament adoption of new rules on single-use plastics to reduce marine litter http://europa.eu/rapid/press-release_STATEMENT-19-1873_en.htm

Traditionally, plastics were non-biodegradable – the polymers that make up the plastic cannot be degraded by living organisms (microbes), but they gradually break down due to the effects of sunlight, heat and friction. Non-biodegradable plastic fragments into microplastics and is likely to take centuries to break down completely.

Biodegradable plastics are an alternative type of plastic that can be degraded by microbes into simple chemical elements – ultimately CO_2, methane and water. Disposal conditions dictate whether biodegradable plastic actually breaks down into these elements. In the right environment (usually commercial composting facilities) the plastic can be biodegraded and fully break down. In the wrong environment (i.e. landfill), biodegradable plastic acts like non-biodegradable plastic and breaks down to microplastics. It is a common misconception that biodegradable plastic is only made from bio-based feedstock. Biodegradable plastic can also be made from fossil-fuel sources (see Figure 5).

It is a common misconception that biodegradable plastic is only made from bio-based feedstock. Biodegradable plastic can also be made from fossil-fuel sources.

A subset of biodegradable plastics are compostable. The polymers that make up compostable plastic can be broken down by microbes in a composting environment and fully return to nature. Most compostable plastics won't do this in a home composting bin, only in a commercial-standard compost with specific conditions. Like all biodegradable plastics, compostable plastics are not necessarily bio-based and the disposal conditions dictate how they actually break down.

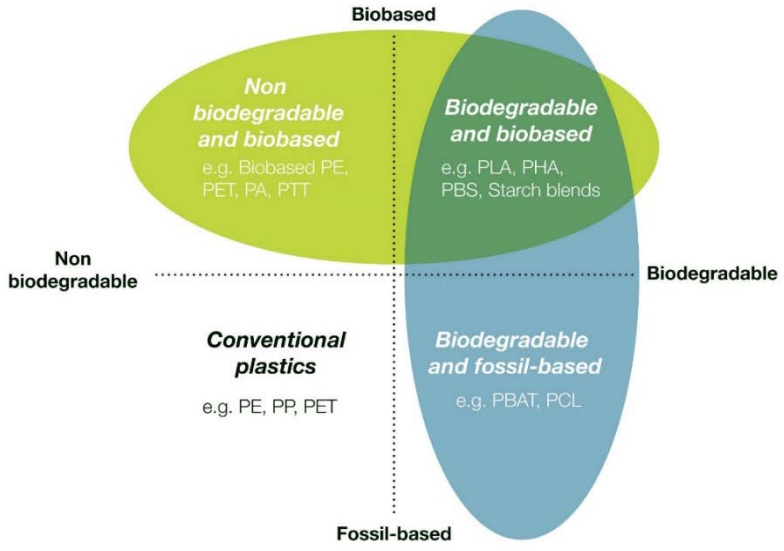

Figure 5 Material coordinate system of bioplastics. Source: www.european-bioplastics.org

1.2 Plastic categorisation in Aotearoa New Zealand

At the time of publication, there were no national standards on how to categorise or label plastics in Aotearoa New Zealand. Current approaches to identifying plastics include:

- **Voluntary use of global identification system for resin type:** New Zealand's plastic industry uses the ASTM International standard ASTM D7611/D7611M[7], *but this is not a regulated requirement*. In 2009, Plastics NZ developed a resource to guide the voluntary labelling of plastics in Aotearoa New Zealand.[8]
- **Voluntary use of ISO standards:** There are several ISO (International Organization for Standardization) standards related to plastics that organisations may use for accreditation, identification and marking, and symbols and abbreviated terms.[9]
- **Use of harmonised trade codes for import and export goods:** Raw resin must be categorised according to the Harmonised Trade System trade commodity 39, 'Plastics and articles thereof'.[10] Some other articles are captured as being made 'of plastic' within other commodity codes.
- **Industry-led guidance on terminology:** To aid consistent use and understanding of terminology, Plastics NZ provided definitions and terms for degradable plastics in 2009.[11] More recently, WasteMINZ developed resources on terminology for compostable, biodegradable and oxo-degradable plastic products.[12]
- **Voluntary labelling programme:** Environmental Choice New Zealand has published specifications for recycled plastic products to meet the requirements for the Ecolabel, but no products or services are associated with it yet[13]. This labelling system cannot be used for single-use plastics.

[7] ASTM International (2018). ASTM D7611/D7611M-18 Standard Practice for Coding Plastic Manufactured Articles for Resin Identification. West Conshohocken, PA.
[8] Plastics New Zealand, "The Plastic Identification Code - Label Your Plastics," (2009).
[9] Further details around ISO standards related to plastic are available at: https://www.iso.org/home.html
[10] Details of the New Zealand Harmonised System Classification 2017 (NZHSC) are available at: http://archive.stats.govt.nz/methods/classifications-and-standards/classification-related-stats-standards/harmonised-system-2017.aspx.
[11] Plastics New Zealand, "Managing the Transition: Degradable Plastics in New Zealand " (2009).
[12] WasteMINZ Organic Materials Sector Group, "Guides to Terminology for Compostable; Biodegradable, and Oxo-Degradable Products," https://www.wasteminz.org.nz/pubs/guides-to-compostable-packaging-terminology/.
[13] The New Zealand Ecolabelling Trust, "Licence Criteria for Recycled Plastic Products Ec-06-15 " (2015).

In response to the confusion surrounding degradable plastics, the Parliamentary Commissioner for the Environment (PCE) developed a comprehensive resource defining biodegradable and compostable plastic.[14] The Royal Society Te Apārangi is developing a review of the impacts of plastics on the environment.

The Parliamentary Commissioner for the Environment (PCE) developed a comprehensive resource defining biodegradable and compostable plastic which is available at www.pce.parliament.nz.

The Royal Society Te Apārangi is developing a review of the impacts of plastics on the environment. Once published, it will be available at royalsociety.org.nz.

Building on the work of the PCE and Royal Society Te Apārangi, we have identified several limitations in the current approaches for identifying plastics.

The lack of national standards for labelling plastics has led to inconsistent labelling of products (see Figure 6) and public confusion over which types of plastic people are buying and what this means for the product's downstream fate – whether it can be recycled or will end up as waste.

The resin ID code is an important label within the industry. However, the resin ID is limited in the level of detail it provides for plastics outside of the key resin groups. For example, biodegradable plastics (including compostable plastics) are grouped along with other less common plastics under the resin ID #7 ('Other'), but the appropriate way to dispose of plastics that fall into the 'other' category may be different.

The resin ID code is also not sufficient to inform people about recyclability of a product. There is a need for a simple recycling label that tells people whether to recycle or dispose of a product to improve the efficacy of recycling streams, by reducing contamination of recycling streams with non-recyclable plastics, and reducing the amount of recyclable plastics ending up in landfill.

The coding used for import/export data (harmonised trade code) does not capture the amount and types of all plastic imported and exported into the country. While it

[14] Parliamentary Commissioner for the Environment, "Biodegradable and Compostable Plastics in the Environment," (2018).

captures comprehensive data for raw resin, it is limited in how it captures plastic within finished products and packaged goods (see 3.2: Knowledge gaps).

There is a need for a simple recycling label that tells people whether to recycle or dispose of a product.

Figure 6 Example of plastic packaging with and without labelling according to the resin identification code.

1.3 Case study: The Australasian Recycling Label

The Australasian Recycling Label is an evidence-based standardised system that provides easy to understand disposal instructions for each part of a product's packaging.[15] The Australian Packaging Covenant Organisation (APCO) developed labelling standards with Planet Ark and PREP Design.

The label includes:

- The name of the package component the label is referring to
- Symbols to identify whether the component is recyclable, conditionally recyclable or not recyclable
- Recyclable label has filled recycling symbol
- Conditionally recyclable label has clear recycling symbol with written instructions (e.g. return to store)
- Non-recyclable label has clear bin symbol

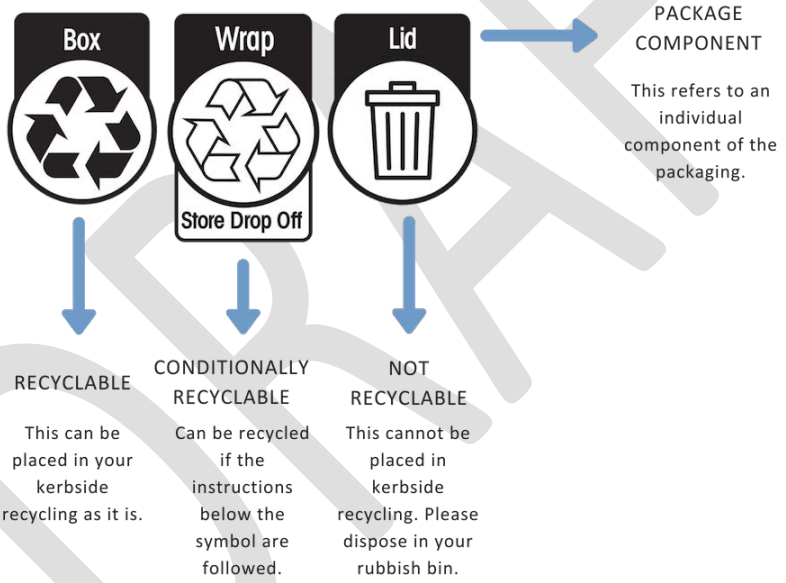

Figure 7 Breakdown of components of the Australasian Recycling Label. Source: www.arl.org.au.

Organisations including Australia Post, Blackmores, Nestlé, Officeworks, Unilever, Coles and Woolworths have pledged their commitment to using the label. It was introduced in September 2018 and has since been adopted by more than 200 Australian organisations.

Underpinning the Australasian Recycling Label is the Packaging Recyclability Evaluation Portal (PREP). This analysis tool allows businesses to assess whether their product is recyclable through Australia's kerbside recycling system.

By evaluating the materials used, their associated environmental impacts and local access to recycling capability, the tool allows businesses to address problematic materials

[15] Further details on the Australasian Recycling Label are available at: www.arl.org.au.

throughout the supply chain and shift to packaging that is recyclable during product development and redesign. Any business that pledges their commitment to the Australasian Recycling Label gains access to the PREP.

The Australasian Recycling Label and PREP have been designed to allow for their introduction into Aotearoa New Zealand, through Packaging New Zealand's partnership with APCO.

Because part of the standard relates to recycling accessibility, implementation in Aotearoa New Zealand would require localisation of labels. The current variation in kerbside recycling across the country would need to be addressed in order to design and label products using PREP and ARL.

PREP is an analysis tool that helps businesses assess whether their product is recyclable through Australia's kerbside recycling system.

1.4 Best practice: The on-pack recycling label

The UK's on-pack recycling label (OPRL) has been recognised by the UN Environment Programme as international best practice. It delivers a simple, consistent and UK-wide recycling message on consumer packaging that is recognised by more than 7 in 10 consumers.[16]

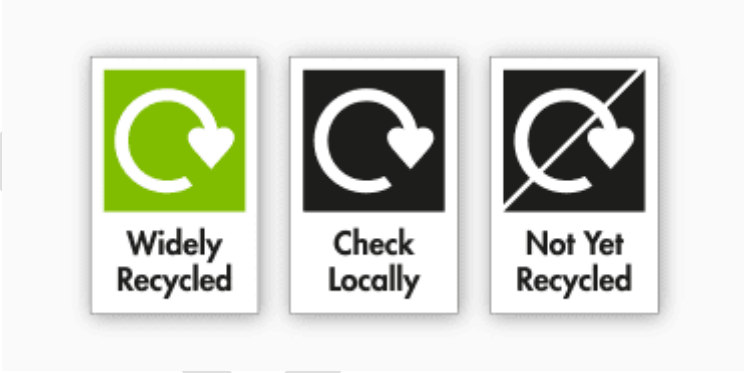

Figure 8 Symbols used by the UK's on-pack recycling label. Source: www.oprl.org.uk.

1.5 Recommendation

See recommendation 2a – to be finalised with completion of full report.

[16] More information on the OPRL is available at: https://www.oprl.org.uk/.

TO WHAT EXTENT CAN WE QUANTIFY AOTEAROA'S PLASTICS FOOTPRINT? NEW ZEALAND'S DATA CHALLENGE

"We lack a full national picture of what is going to landfill, and what is being recovered or recycled. Knowing this is critical if we are to make informed decisions." Minister Eugenie Sage, August 2018[17]

[17] Speech by Minister Eugenie Sage at the Green Party 2018 AGM; Available at: https://www.greens.org.nz/news/speech/speech-green-party-2018-agm-eugenie-sage-associate-environment-minister

2 A SNAPSHOT OF PLASTIC IN AOTEAROA NEW ZEALAND

Measuring the amount and types of plastic we use and discard is a prerequisite for appropriate management and monitoring – it is a vital step in allowing us to make evidence-informed decisions around where we direct resources to improve our use and management of plastic, and to track their effectiveness. We need to understand the scale of plastic use and the types of plastic that are most problematic to inform what changes to implement and their relative priorities. It is necessary not only to consider which plastics are used most often, but also how long the products are used for and whether appropriate end-of-life solutions are available.

Throughout our consultations with various stakeholders along the plastics value chain (see 10: Consultations), the need for accurate and thorough data collection has been unanimously cited as a priority area. And with the Ministry for the Environment and numerous businesses signing the New Plastics Economy Global Commitment[18], it is a critical time to initiate the collection of high-quality data on plastics so that we have a solid understanding of the baseline from which we must improve.

It is a critical time to initiate the collection of high-quality data on plastics so that we have a solid understanding of the baseline from which we must improve.

[18] The New Plastics Economy Global Commitment is an initiative led by the Ellen MacArthur Foundation and UN Environment where signatories commit to transitioning to a circular economy for plastics by eliminating unnecessary use of plastic, innovating to discontinue use of problematic plastics, and circulating all other plastics through reuse and recycling, and preventing environmental leakage; details available at: http://www.mfe.govt.nz/news-events/new-zealand-signs-international-declaration-cut-plastic-waste.

3 HOW MUCH PLASTIC DO WE IMPORT?

In Aotearoa New Zealand, plastic is imported as resin which is then manufactured into products and packaging, or imported as part of a finished product and/or packaging (including non-fibre and fibre plastics). To gain a complete understanding of the amount and types of plastic entering the country, we need to be able to capture metrics for both the resin and finished products.

3.1 Imports of raw resin and plastic products

3.1.1 Tonnages of imported plastic material

Currently, the weight (and $NZD value) of raw resin imports and some plastic products are captured under trade commodity 39, 'Plastics and articles thereof', within the Harmonised Trade System.[19] The data is obtained from export and import entry documents lodged with the New Zealand Customs Service, and provided via Statistics New Zealand.[20]

Imports have increased from roughly 400,000 to 575,000 tonnes in the past 10 years (see Figure 9), with an associated increase in value of $845 million. Of the amount imported, over half is identified as 'in primary forms' (including resins) and the remainder are products, many of which are used in manufacturing such as plates, sheets, film, foil and strip. Some other plastic products are captured in these imports, but it is not exhaustive. The proportion of imports that are in primary form versus other products has decreased from 63% in 2009 to 53% in 2019 (See Appendix 2 for detail).

In 2018, around 575,000 tonnes of plastic resin and products were imported to Aotearoa New Zealand.

[19] Details of the New Zealand Harmonised System Classification 2017 (NZHSC) available at: http://archive.stats.govt.nz/methods/classifications-and-standards/classification-related-stats-standards/harmonised-system-2017.aspx.

[20] Data from Harmonised Trade data from Statistics New Zealand Infoshare available at: http://archive.stats.govt.nz/infoshare/

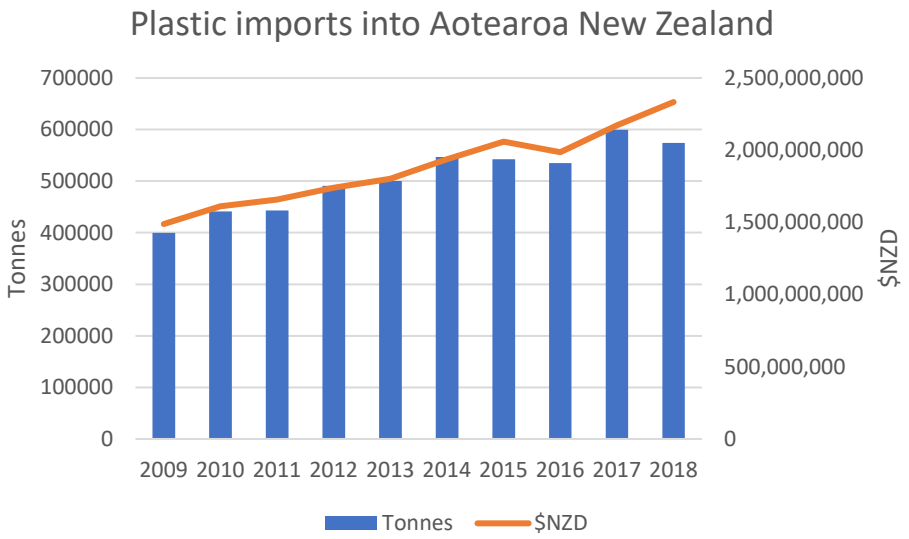

Figure 9 Plastic imports captured by 'plastics and articles thereof' by tonnes and $NZD for the past 10 years.

3.1.2 Types of plastic imported

The type of plastic that a product is made out of essentially dictates the best outcome for what happens at its end-of-life. Therefore, to invest in the right technology and infrastructure so that we can manage our own plastic waste onshore, we need to understand the proportion and amount of each type of plastic imported. The breakdown of material types imported as raw resin can be used as a starting point, but because this does not capture the material type of all plastic imported as finished products or packaging, it is limited in its accuracy.

Import data for resin types 1-7 shows that HDPE (#2) is the most common type of plastic imported in raw resin form (see Table 2) (see Appendix 2 for details of specific trade codes included in this analysis). The proportions of each resin are roughly in line with global estimates for plastic use.

Table 2 Breakdown of resin types 1-7 imported into Aotearoa New Zealand in 2018 in raw resin form

Type	% of plastic in NZ	% from global estimates[21]
1 (PET)	7	<10
2 (HDPE)	26	*with LDPE 36
3 (PVC)	12	12
4 (LDPE)	31	*
5 (PP)	18	21%
6 (PS)	4	<10
7 (other)	3	<10

[21] Geyer, Jambeck, and Law, "Production, Use, and Fate of All Plastics Ever Made."

Only 33% of raw resin imports are considered to be easily recyclable plastic with good end markets (7% PET (#1) and 26% HDPE (#2))

Between 2009 and 2018, the volume of raw resin imported into Aotearoa New Zealand has fluctuated, particularly for HDPE (#2) (see Figure 10). There has been a steady increase in the tonnes of imported LDPE (#4), which is used for hard to recycle products such as soft plastic packaging. The tonnes of imported PP (#5) has also increased – this type of plastic is recyclable but is often limited by the infrastructure to do so. There appears to be a sharp dropoff in the tonnes of PS (#6) imported. The reason for this is unknown and could be due to changes in trade coding as the weight for expansible polystyrene dropped from over 10,000 tonnes to 0 in one year.

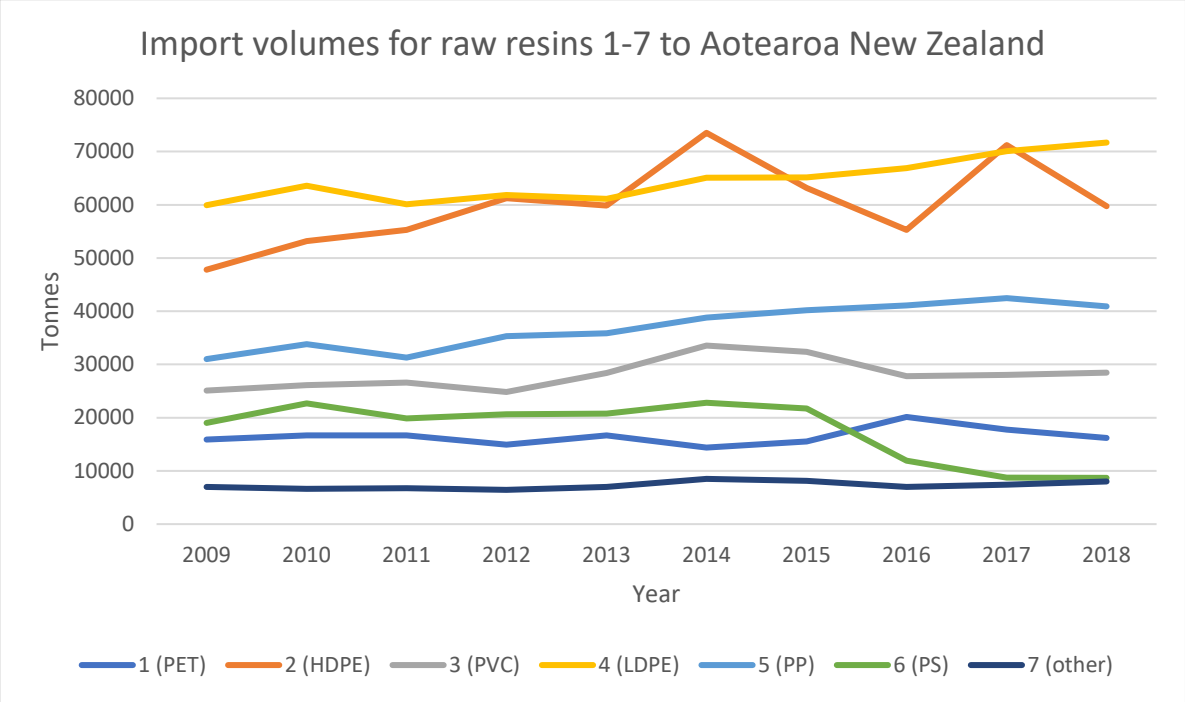

Figure 10 Tonnes of raw resin (types 1-7) imported into Aotearoa New Zealand from 2009 to 2018.

3.1.3 Sources of imported plastics

Plastic resin and products captured by trade data under 'Plastics and articles thereof' are mainly imported from Asia, Australia and North America (see Figure 11).[22] The

[22] Data from Harmonised Trade data from Statistics New Zealand Infoshare available at: http://archive.stats.govt.nz/infoshare/

volumes of imports by country in Figure 11 do not distinguish between bio- and fossil-based plastics.

Negligible amounts of PLA bioplastic are manufactured onshore for research purposes, but not for production, and are ignored for the current snapshot (further detail on developments in the field of bioplastics to follow in Chapter 3: Innovation solutions, not yet complete).

The data does not illustrate which countries are the biggest suppliers of imported finished products made of or containing plastics, including plastic packaging (excluding the few products captured by the trade data).

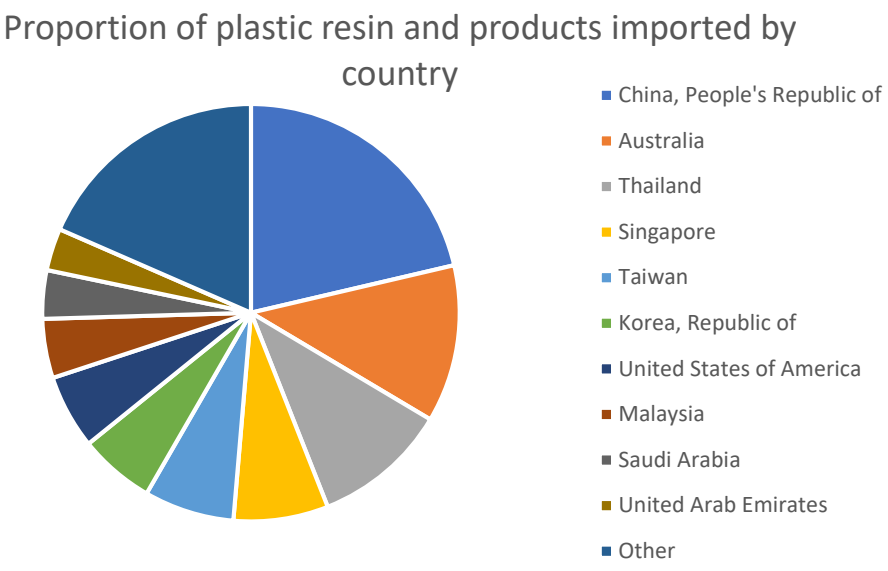

Figure 11 Proportion of resin and plastic product imports captured by trade data for 2018, by country of origin.

3.2 Knowledge gaps

3.2.1 Plastics in finished products or packaged goods

Import data does not currently capture the volume of all plastic entering the country within finished products or packaged goods. Finished products may be completely or partly made of plastic, but this data is not necessarily captured within the categorisation 'Plastics and articles thereof'. This is because a finished product is often not defined by what it is made from.

Examples of finished products that contain plastic but are not included under the category 'Plastics and articles thereof' in import data include:

- Toys
- Appliances
- Clothing
- Electronics
- Food and beverages (packaging)
- Teabags
- Cars
- Cigarettes
- Building materials.

Figure 12 A range of finished products contain plastic. Placeholder figure: to be updated with image montage of finished products containing plastics.

The total weight and types of plastic that are imported into Aotearoa New Zealand in finished products and/or associated packaging is unknown. Rough estimates could be made by calculating approximate quantities of plastic per product and multiplying this by the number of those products that are imported via Statistics NZ data.[23]

Further, secondary and tertiary plastic packaging is used throughout different stages of the supply chain and is also not captured in import data. An example of this is stretch film used to wrap pallets.

[23] Data from Harmonised Trade data from Statistics New Zealand Infoshare available at: http://archive.stats.govt.nz/infoshare/

The different types of packaging that need to be considered are:

- **Primary packaging:** in direct contact with the product itself and usually what the consumer receives and has to dispose of. It's main purpose is to protect the product and inform the consumer via labelling. E.g. a milk bottle.
- **Secondary packaging:** used to group individual product units, for branding display or for logistical purposes. Sometimes retailers remove this packaging or leave it to sell grouped products, so who needs to dispose of it varies. E.g. plastic wrap to group a pack of tinned food.
- **Tertiary packaging:** used to group and protect product units during transit through the supply chain. It is almost always disposed of by the retailer. E.g. pallet wrap.

3.2.2 Hard to capture plastics

Even after considering both imported raw resin and finished products, we are likely to still be missing some plastic entering the country for two main reasons.

Firstly, some products have 'hidden' plastics – it may not be obvious that there is plastic in the product at all. For example, an aluminium can of drink is actually lined with a plastic resin and the base ingredient of chewing gum is a type of plastic. However, hidden products are unlikely to account for a large proportion of plastic imported into Aotearoa New Zealand.

Other data simply may not be captured, including consignments valued under $1000,[24] which will include individual products purchased online and received via international shipping and the packaging around imported products. Again, this is likely to be relatively small in volume although increasing with the popularity of internet shopping.

[24] According to Statistics NZ, consignments valued under $1000 are excluded from trade statistics for import into or export from New Zealand; see http://datainfoplus.stats.govt.nz.

3.3 Case study: Plastics in clothing

The Ellen MacArthur Foundation estimates that 63% of virgin feedstock used for clothing is plastic.[25] Global estimates suggest that 1 billion tonnes of polyester, polyamide and acrylic (PP&A) fibres have been produced since 1950, and that polyester accounts for 70% of all PP&A fibre production.[26] In addition to the concerns around low recycling rates for clothing (reported to be <1%), a big concern for the textile industry is its contribution to plastics entering the ocean through washing.The process of washing plastic-based textiles causes microfibres to shed which then enter the waterways (see Figure 13).

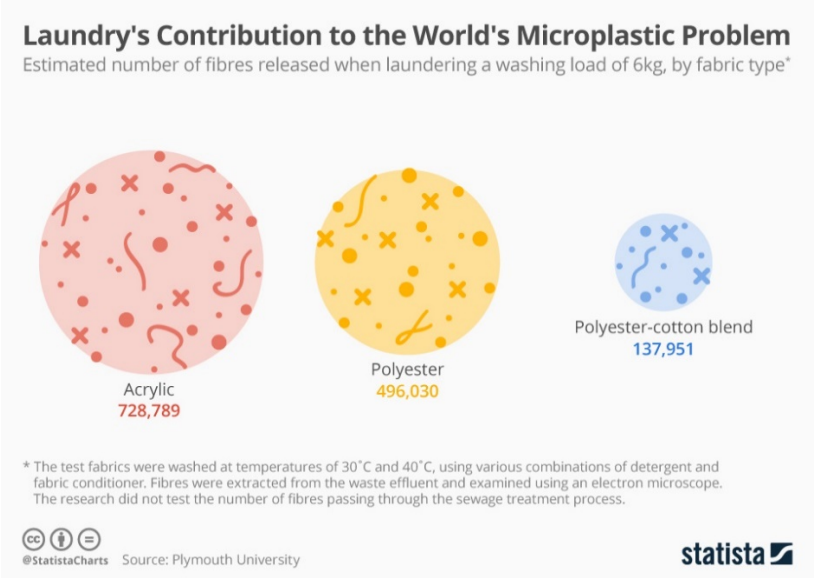

Figure 13 Estimates of the number of fibres released from acrylic, polyester and polyester-cotton blend clothing during a laundry cycle.

How big is the plastic clothing problem for Aotearoa New Zealand?

Some plastic articles of clothing are captured in the 'Plastics and articles thereof' harmonised trade codes in import data from Statistics NZ, but this does not account for all synthetic fibres imported into the country. Drawing on data from the 'Apparels' and 'Textiles' harmonised trade codes captured in import data from Statistics NZ, we estimated the weight of synthetic textiles imported into Aotearoa New Zealand as finished products (Figure 14).[27]

Tonnages of apparels defined as 'of synthetic fibres', 'of artificial fibres' and 'of man-made fibres' and textiles defined as 'of nylon or other polyamides', 'of polyester' or those coated or laminated with plastics were included (see Appendix 3 for a list of all codes

[25]Ellen MacArthur Foundation, "A New Textiles Economy: Redesigning Fashion's Future " (2017).
[26] Geyer, Jambeck, and Law, "Production, Use, and Fate of All Plastics Ever Made."
[27] Data from Harmonised Trade data from Statistics New Zealand Infoshare available at: http://archive.stats.govt.nz/infoshare/

included in this analysis). Note that man-made fibres may include viscose rayon and other non-synthetic fibres, so this is potentially an over-estimate.

Figure 14 Estimated tonnes of synthetic textiles imported into Aotearoa New Zealand not captured as plastic imports.

In 2018, an estimated 13,544 tonnes of synthetic textiles were imported to Aotearoa New Zealand.

3.4 Recommendation

See recommendation 2b– to be finalised with completion of full report.

4 WHAT DO WE MANUFACTURE FROM IMPORTED PLASTIC?

We assume the amount of resin imported into Aotearoa New Zealand is manufactured into plastic products and/or packaging materials onshore (see 3: How much plastic do we import?). Understanding the material type, lifetime use and sector use of manufactured products is essential for informing decisions around managing plastic waste and directing efforts for redesign of products manufactured in Aotearoa New Zealand.

Plastics manufacturers have detailed data on their use of polymers and products produced and disposed. Previously, this information has been collected and aggregated by Plastics NZ via surveys, with the last survey completed in 2012.

Based on the results of the 2012 survey, Plastics NZ estimated that over half of the imported resin was manufactured into packaging, with the remainder mainly used in construction and agriculture (see Figure 15). Of the material manufactured into packaging, 60% was used for rigid packaging and the remaining 40% was used for flexible packaging.

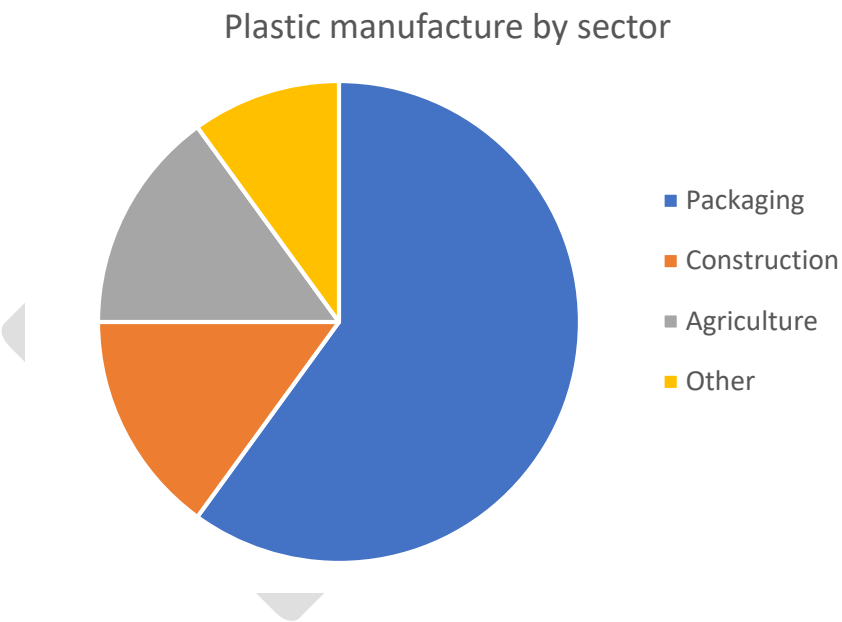

Figure 15 Plastics NZ estimates of the proportion of imported resin used for manufacture by sector

For comparison, estimates for sector use of resin plastics calculated from data for Europe, the United States, China and India covering the period 2002–2014 are 44.8% packaging, 18.8% construction, 11.9% consumer and institutional products, 6.7% transportation, 3.8% electrical, 0.8% industrial machinery, and 13.2% other.[28]

[28] Geyer, Jambeck, and Law, "Production, Use, and Fate of All Plastics Ever Made.".

Around 60% of the resin imported into Aotearoa New Zealand is manufactured into packaging, which is dominated by single-use or short-lived products.

The estimates made by Plastics NZ are derived from survey data which was then extrapolated based on import data from Statistics New Zealand. Plastics NZ stopped collecting mass balance surveys after 2012, due to limitations in data availability (reporting was voluntary and dropped off when the Packaging Accord finished in 2009) and concerns around accuracy of the data and the number of assumptions needing to be made to perform estimates.

As a result, there is no recent, accurate data on the products and packaging manufactured in Aotearoa New Zealand from imported resin.

Specifically, we lack clarity on:

- The amount of each polymer type used for manufacture, by sector
- Key product uses, by sector
- How long products are used for (single-use vs long-term).

Some companies are making the weight of plastic packaging they produce publically available, as part of their participation in the New Plastics Economy Global Commitment.[29] This includes some New Zealand owned and operated companies, such as Earthwise Group Ltd who stated that they produce 284 tonnes of plastic packaging per year.

5 HOW MUCH PLASTIC DO WE EXPORT?

There is little data on how much plastic is exported from Aotearoa New Zealand. Data is collected on items identified as 'Plastics and articles thereof' but not on other products that may include plastic. Furthermore, Aotearoa New Zealand's export industry relies on plastic packaging.

Examples of some of the exported products that may use plastic packaging include:

- Milk
- Meat
- Fruit and vegetables
- Seafood
- Honey.

[29] Ellen MacArthur Foundation, "The New Plastics Economy Global Commitment " (2017).

Detailed data on tonnage and $NZD value of exports is available from Customs New Zealand via Statistics New Zealand.[30] As with imports, plastic resin and some products are captured under the harmonised trade code 39 'Plastics and articles thereof'. Waste plastic exports are captured in this data but not included in this analysis (see 8.4 Plastic sent overseas for recycling).

For articles captured in trade data, export tonnages have fluctuated between 2009 and 2018, with an overall increase from roughly 60,000 to 75,000 tonnes and an associated increase in value of $79 million (see Figure 16).

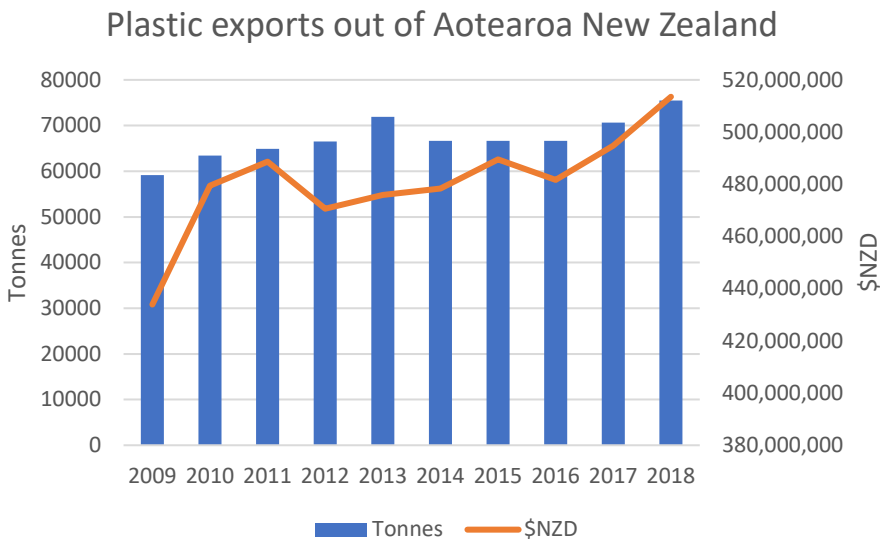

Figure 16 Plastic exports captured by 'plastics and articles thereof' by tonnes and $NZD for the past 10 years, excluding plastic waste.

Tonnage and $NZD value is available for all other exported products, including finished products and packaged goods that contain plastic, but the weight or type of plastic within these is not recorded. The same method used to estimate plastic use in imported finished products (see 3.3: Case study: plastics in clothing), could be used to estimate the amount of plastic exported in all exported products.

5.1 Recommendation

See recommendation 2b– to be finalised with completion of full report.

[30] Data from Harmonised Trade data from Statistics New Zealand Infoshare available at: http://archive.stats.govt.nz/infoshare/

6 HOW MUCH PLASTIC IS IN USE IN AOTEAROA NEW ZEALAND?

Global estimates have considered the volumes of plastic 'in use' and how this differs by sector. It's estimated that 30% of plastics ever produced are currently in use. Entering and leaving the 'in use' phase differs significantly by sector. In 2015, 146 million tonnes of plastic entering use were for packaging, and 141 million tonnes left the use phase, whereas 65 million tonnes entered use for construction and only 12 million tonnes left use. PVC (#3), a dominant material type used for pipes in construction, had over double the weight enter the use phase compared to the weight that left (38 vs 16 million tonnes).[31]

Understanding which types and how much plastic is in use, and when it is likely to leave the use phase, is important for waste management planning. We also need more information about the nature and quantity of plastic use in Aotearoa New Zealand in order to increase resource efficiency and appropriately reuse, refurbish, remanufacture, repair and recycle plastic products in New Zealand's economy.

6.1 Packaging mass balance estimates

The closest estimates to establishing the volume of plastic in use in Aotearoa New Zealand are the packaging mass balance results published as part of the Packaging Accord from 2004 to 2009,[32] and – in response to concerns about the methods used for the previous estimates – a follow-up estimate published in 2015 using a simplified methodology.[33]

In 2008, the mass balance estimates were 136,491 tonnes of plastic packaging produced, 154,381 tonnes consumed, and 36,918 tonnes recovered. It is worth noting that there are significant limitations in this estimate because, due to the lack of consistent and verified data, many assumptions were made that may have introduced error. The estimates did not capture packaging material imported and exported around finished goods (as discussed in 3.2: Knowledge gaps) and relied on the goodwill of third party agencies providing accurate data. Methodological limitations of this approach are described in detail by Packaging New Zealand in their 2015 report.

The more simplified approach was used to estimate recovery rates for 2013 based on export waste and population/GDP data. Assuming all plastic waste was exported, the estimate relied on Statistics New Zealand export data (as discussed in 8.4: Plastic sent overseas for recycling). The limitation of this is that the method excludes the amount of plastic reused or recycled onshore. Using this method, the weight of plastic packaging estimated to be recovered in Aotearoa New Zealand was 41,900 tonnes per

[31] Geyer, Jambeck, and Law, "Production, Use, and Fate of All Plastics Ever Made."
[32] Packaging Council of New Zealand / Accord Secretariat, "New Zealand Packaging Accord 2004 Year Five Progress Report," (2009).
[33] D Grimmond, "Review of Packaging Mass Balance Measurements," (Packaging Council of New Zealand, 2015).

year, equating to 9.4 kg per person. This method does not provide an estimate for production or consumption.

Estimates from 2008 suggest that around 150,000 tonnes of plastic packaging are consumed in Aotearoa New Zealand every year, which equates to 30 kg per person.[34]

These estimates highlight how the shortcomings in data currently limit our ability to understand the scale of plastic in use and the need to establish a uniform approach to measure the types and volumes of plastic being used in Aotearoa New Zealand.

It may be possible to address the lack of consistent, aggregated data on the amount of plastic in use by utilising, repurposing or extending existing data frameworks. An example is provided in the case study below, whereby information on the weight and material type of primary and secondary packaging is recorded through a supply chain database's product catalogue.

[34] Based on a New Zealand population of 4.96 million at 31 March 2019 according to Statistics NZ https://www.stats.govt.nz/topics/population

6.2 Case study: Capturing plastic packaging data through a supply chain database

Many manufacturers, brand owners, suppliers and retailers use the global GS1 database to share information with one another as a product moves through the supply chain from manufacture to purchase, within and between countries.

A network of regional organisations, including GS1 New Zealand, connect their datasets through the global data synchronisation network (GDSN). A standardised language is used for product data across the network, via a data dictionary.

GS1 New Zealand jointly maintains its database with GS1 Australia. Known as the National Product Catalogue, the database contains every product registered with GS1 across the two countries (see Figure 17).

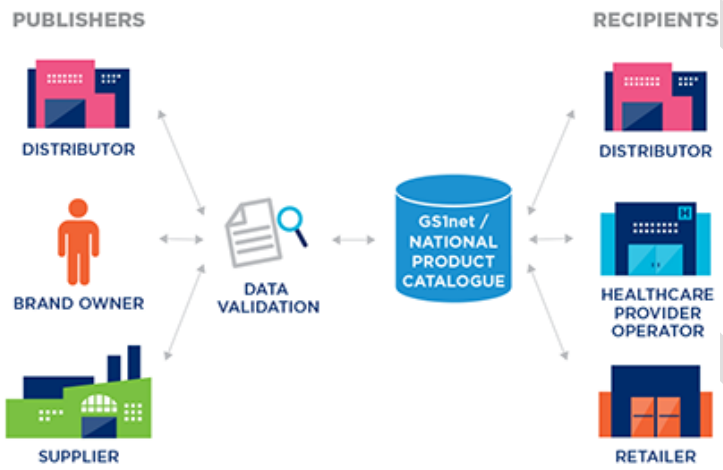

Figure 17 Data flows between publishers and recipients of data within the GS1 network and National Product Catalogue. Source: www.gs1nz.org

The global network requires certain attributes (variables) to be captured. Any other requirements are localised, generally dictated by local regulation and/or data recipients.

In Aotearoa New Zealand, recording the packaging material type code was initiated in 2004 because of the Packaging Accord, as a voluntary means to provide the packaging data required by the Ministry for the Environment. This classifies packaging material by type of plastic, e.g. LDPE, HDPE and bio-plastics certified by the European standard.

Examples of additional packaging codes available within the GDSN but not yet captured in Aotearoa New Zealand include:

- Packaging level type: capturing primary, secondary and tertiary packaging so that packaging used throughout the supply chain is recorded (e.g. packaging for shipping or removed by retailer prior to sale).
- Packaging marked label accreditation: for example, whether the packaging is accredited as compostable according to specified standards.
- Packaging recovery rate type: whether the packaging can be organically recycled, materially recycled or energy recovered according to specified standards.
- Packaging recycled content type: the ratio of post-consumer recycled material (as defined by ISO 14021) to total material.

- Packaging recycling process: whether packaging is compostable, energy recoverable, recyclable, reusable.
- Packaging recycling scheme code: based on the resin identification codes
- Packaging reusability standard: whether the packaging meets certain standards for reuse

An example of how packaging is coded within GS1 is shown below.

Comment	Attribute	Value
The main	packagingTypeCode	BOTTLE
It has a	packagingFeatureCode	LABEL
It has a	packagingFeatureCode	CAP
	packagingWeight	1.2 GRM
The	packagingMaterialTypeCode	POLYMER_HDPE
	packagingMaterialCompositionQuant	1 GRM
	packagingMaterialTypeCode	POLYMER_PE
	packagingMaterialCompositionQuant	0.2 GRM
Next is	packagingTypeCode	BLISTER_PACK
	packagingWeight	0.5 GRM
	packagingMaterialTypeCode	POLYMER_LDPE
	packagingMaterialCompositionQuant	0.5 GRM
Next is	packagingTypeCode	CM
	packagingWeight	0.4 GRM
	packagingMaterialTypeCode	PAPER_PAPERBOAR
	packagingMaterialCompositionQuant	0.4 GRM

In addition to consumer packaged goods, GS1 databases include apparel and footwear, consumer electronics and healthcare products. Notably, the data recipient isn't limited to retailers. For example, the New Zealand government is a data recipient for some healthcare products.

The key data recipients in Aotearoa New Zealand are Countdown and Foodstuffs, who between them have around 95% of market share for supermarkets. The products captured by these retailers cover 60-70% of all sales and include all major products.

Voluntary uptake by suppliers is variable, with only around 50% of Countdown's suppliers using the database at present.

Further exploration of the potential use of GS1 to measure plastic use in Aotearoa New Zealand is warranted.

6.3 Case study: Uncertainty around data on plastic beverage containers

Plastic beverage containers are one of the most common single-use plastic packaged products. These are manufactured onshore or imported as packaged goods.

Two groups have estimated the production and recovery of beverage containers in Aotearoa New Zealand using different approaches. Other groups have used data from these studies to perform cost-benefit analysis of a container deposit scheme, but not provided new estimates themselves. [35]

- Waste Not Consulting: [36] Data from members of the Packaging Forum was shared with the group confidentially to be aggregated for analysis.
  - Consumption data: direct from some major brand owners but not independently verified; relied on market share estimates from brand owners to extrapolate consumption data.
  - Recovery data: tonnages by material type direct from four recyclers and Fonterra but not independently verified. Used proportion of recovered material that were beverage containers from one recycler as well as info on geographical locations and populations to extrapolate data. Lack of data from Auckland's main recycler is a limitation that particularly affects PET (#1) and HDPE (#2) estimates.
- Envision: [37] Data was derived from international data.
  - Consumption data: per capita consumption rates were based on consumption data from South Australia who have an established CDS and converted to tonnage data. To validate estimates, data were also compared that from British Columbia in Canada and Western Australia.
  - Recovery data: estimates based on questionnaire data from 16 New Zealand local authority representatives on the volumes of beverage containers recovered through kerbside and public space recycling programmes.
  - Note: limitations in the methods used by this study have been discussed in detail. [38]

[35] Covec Ltd, "Evaluating the Costs and Benefits of Introducing a Container Deposit System for New Zealand: Summary of Analysis " (Funded by The Packaging Forum's Public Place Recycling Scheme, 2016).
[36] Waste Not Consulting, "National Recovery Rate for Beverage Containers," (Prepared for the Packaging Forum, 2018).
[37] Envision, "The Incentive to Recycle: The Case for a Container Deposit System in New Zealand " (2015).
[38] W Snow, "Costs and Benefits of a Container Deposit Scheme for New Zealand: Review of the Packaging Forum's 2016 Cba of a Cds for New Zealand," (2016).

Table 3 Estimated rates of consumption and recovery of plastic beverage containers in Aotearoa New Zealand

		Beverage container consumption - tonnes	Beverage container recovery - tonnes	Recovery rate
Waste Not Consulting	PET (#1)	13,977	8,066	58%
	HDPE (#2)	13,512	5,455	40%
Envision	PET (#1)	14,274	Not reported	40%*
	HDPE (#2)	10,686	Not reported	40%*

*Estimated in this report to be below 40% and possibly as low as 30%

Information on the number of beverages produced/consumed and recovered/landfilled in Aotearoa New Zealand is not readily or easily available. The estimates of the tonnes of PET (#1) and HDPE (#2) consumed through beverage containers differ between the two methods and both are limited by the reliance on industry-reported data without third party audit. This makes understanding the potential impacts of efforts to improve plastic recovery, such as container deposit schemes, very difficult. There is a need for comprehensive, verified data.

Estimates suggest that over 25,000 tonnes of plastic drink bottles are consumed in Aotearoa New Zealand each year.

That's the equivalent of 1.2 billion 500mL soft drink bottles – averaging 242 bottles per person per year.[39]

[39] Based on a New Zealand population of 4.96 million at 31 March 2019 according to Statistics NZ https://www.stats.govt.nz/topics/population and the average bottle weight of 20.7g for a 500mL PET bottle for carbonated beverages used by Envision https://static1.squarespace.com/static/539a5fdee4b09201c768daef/t/59f79b546926704f354d8cee/1509399400468/The+InCENTive+to+Recycle_full+report.pdf

6.4 Case study: Use of plastic agrichemical containers

Agrichemical containers, often contaminated with chemical residue, are a commonly used product in the agricultural sector. Industry wide data on packaging volume into market is unknown. Agrecovery, a not-for-profit charitable trust set up as a product stewardship scheme, collects and recycles agrichemical containers using funds from the brand owners.

The weight of plastic agrichemical containers in use in Aotearoa New Zealand has been estimated for the purpose of the scheme.

- Agrecovery brand owners declared the number/tonnes of 0 – 60 L HDPE (#2) plastic containers they put on the market from July 2011 to June 2012 to the Agrecovery Foundation via their levy declarations.
- The brand owners represented 85% of market share.
- 560 tonnes was declared and extrapolated to ~650 tonnes of chemically contaminated HDPE (#2) containers between 0 – 60L that could be recycled annually.
- Because a significant proportion of total packaging put into the market is in HDPE (#2) drums sized over 60L and some agrichemicals come in non-HDPE packaging, this is likely to be an underestimate.

Accounting for other volumes and plastics, Agrecovery estimate more than 1.2 million plastic agrichemical containers, equating to 750 tonnes of plastic, are sold every year in Aotearoa New Zealand.

An estimated 750 tonnes of plastic agrichemical containers are sold every year in Aotearoa New Zealand.

6.5 Knowledge gaps

As can be seen from comments throughout this report, we have serious gaps in our knowledge of how plastic moves through Aotearoa New Zealand. We are limited in our understanding of the amount and types of plastic that are:

- In imported finished products and packaging (see 3: How much plastic do we import?)
- Manufactured into products and packaging onshore (excluding those exported) (see 4: What do we manufacture from imported plastic?)
- Reused (see 7: How much plastic do we reuse?)
- Collected as waste and sent to landfill or recycled (see 8: How much plastic do we waste?)

Discussion around the potential for technology such as blockchain to track plastics data will be covered in Chapter 3: Innovation Solutions, not yet complete.

6.6 Recommendations

See recommendations 2c, 2d, 2e– to be finalised with completion of full report.

7 HOW MUCH AND WHICH TYPES OF PLASTIC DO WE REUSE ONSHORE?

In order to reduce how much plastic we waste, it is favourable to reuse plastic products where appropriate. Reuse systems are particularly important to combat the mountain of waste that comes from single-use plastic packaging for food and drinks.

There are a few reuse systems that exist in Aotearoa New Zealand, but it is far from commonplace. Examples of systems that reuse plastic products include:

- Globelet reusable cups at festivals[40]
- Ecostore refill stations[41]
- Again again coffee cups[42]
- Medsalv reprocessing single-use medical devices[43]

We need to track reuse systems in order to understand the amount of plastic waste diverted by their implementation.

7.1 Case study: A reusable system to replace single-use cups

Globelet offers a reusable cup system for festivals and other events. The cups are made from recycled polypropylene (#5) and manufactured onshore.

Globelet provides the following statistics on their reuse system:[44]

- For a festival of 10,000 people, 15,000 reusable cups are required vs 50,000 single-use cups
- On average, 75% of cups get returned for reuse, 0.1% of cups are damaged (and then recycled into crates) and 0.8% are disposed of (but returned if waste management performed onsite). In comparison, all single-use cups are disposed of.
- So far, some cups have been used for 6 years for a particular event.
- Over 7 years, some cups have been used over 300 times – that's 1 cup preventing disposal of 300 single-use cups.

Through a reusable cup system used at a festivals in Aotearoa New Zealand, a single cup made from recycled polypropylene (#5) has displaced 300 single-use cups

[40] More information on Globelet's reuse system is available at: https://www.globelet.com/
[41] More information on Ecostore's reuse system is available at: http://www.ecostore.co.nz/refill-stations
[42] More information on Again Again's reuse system is available at: https://www.againagain.co/
[43] More information on MedSalv's reuse system is available at: https://www.medsalv.com/
[44] Statistics on Globelet's reuse system are available at: https://www.globelet.com/blog

7.2 Best practice

The UK's Waste and Resources Action Programme (WRAP) provides a methodology and accompanying tool for quantifying the environmental and economic impacts of reuse.[45]

The key characteristics of the methodology include guidance on:

- What to include and exclude in the analysis (i.e. system boundaries)
- Product lifetimes and displacement effects of reuse
- Allocation of environmental or economic impacts to different parts of the supply chain
- Use of costs and prices
- Jobs and labour costs.

7.3 Knowledge gaps

At present, we do not have comprehensive information on all reuse systems displacing single-use plastics that are currently in place in Aotearoa New Zealand, and as a result we lack information on the types and weight of plastic currently being diverted from use/waste due to these existing reuse systems.

We also do not know the key products that future reuse efforts should focus on (prioritised by quantity, volume, material type etc.) or the potential environmental and economic impacts of reuse systems for NZ (further detail to follow in Chapter 3: Life cycle analysis, not yet complete).

7.4 Recommendation

See recommendation 6b– to be finalised with completion of full report.

[45] WRAP, "A Methodology for Quantifying the Environmental and Economic Impacts of Reuse," (2011).

8 HOW MUCH PLASTIC DO WE WASTE?

To quantify the amount of plastic that New Zealanders waste, we need to consider the volume sent overseas and that amount that is dealt with onshore. Waste data reported here does not include the amount of plastic that leaks into the environment, or waste that is dumped, buried or burned in non-regulated sites.

Currently in Aotearoa New Zealand, plastic waste is managed through recycling (the majority of which is sent offshore) and sending waste to landfill. Plastic is collected for recycling or landfill through multiple systems, including commercial, household kerbside, public space bins and drop-off points (see Figure 18).

For recycling, plastic is either sent to a material recovery facility (MRF) where it is sorted prior to being shipped offshore, or sent directly offshore (commercial collection only). The specific types and presentation of plastic that are accepted through kerbside collection differ by council – for example some councils request bottle lids left on while others want them removed (further discussion of this issue to follow in Chapter 3: Innovation solutions, not yet complete).

At the MRF, plastic is separated out from other materials that are collected (glass, paper, cardboard) and also separated into different types of plastic. The technology at the MRF determines which types of plastic can be separated out. In general, plastics are separated into bales of type 1, type 2 and mixed bales. Contaminated plastics and plastics that are not accepted at the particular MRF are removed and sent to landfill, where household and commercial rubbish were sent.

An overview of Aotearoa New Zealand's resource recovery sector post China's National Sword and Blue Sky initiatives is provided in the National Resource Recovery Project Situational Analysis.[46]

[46] Eunomia Research & Consulting Ltd (NZ), "National Resource Recovery Project – Situational Analysis Report," (Prepared for the Ministry for the Environment, 2018).

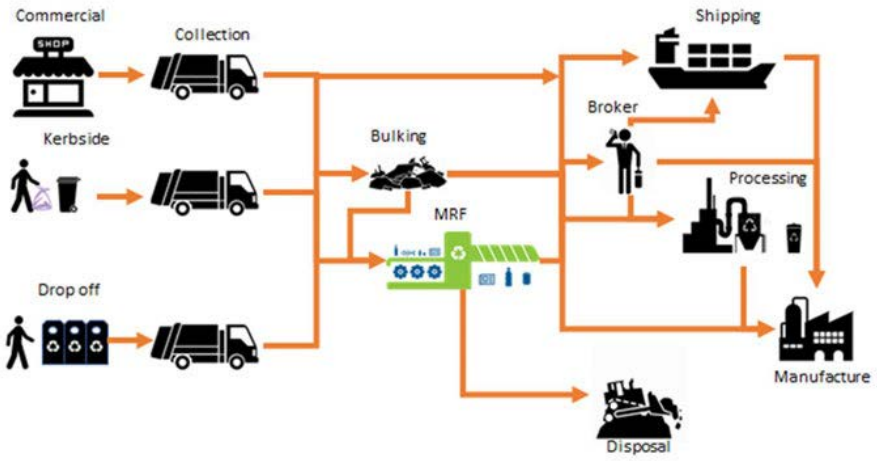

Figure 18 The process for plastic recycling in Aotearoa New Zealand. Placeholder image from Eunomia Consulting to be adapted.

Waste data does not account for the amount of plastic that leaks into the environment.

8.1 No existing requirement for data collection

Currently, there are no statutory requirements under the Waste Minimisation Act 2008 (WMA) for councils to report waste data within a specific data framework or to report data externally.

Under section 51 of the WMA, councils are required to prepare a Waste Management and Minimisation Plan (WMMP). Part of this is a waste assessment, for which data should be collected on waste quantities, projection of quantities, composition, source of waste, and destination of waste and diverted materials.[47] The Ministry for the Environment encourages councils to find as much relevant data as possible for their assessment and aim to have their data capture methodology consistent with those of other councils but, ultimately, the level of data collection is determined by a council's own circumstances, desired community outcomes, interests, and available resources.

Councils may also be limited in the data they can access if they contract out collection and recovery services to private operators. Where private operators manage facilities and collection services under contract, some data may be obtained through key performance indicators in the contract they have with council or through bylaws.

[47] Ministry for the Environment, "Waste Assessments and Waste Management and Minimisation Planning – a Guide for Territorial Authorities," ed. Ministry for the Environment (Wellington, 2015).

8.1.1 Mandating data collection

The WMA allows regulations to be developed under section 86 that could require a council to report on the expenditure of their waste levy money or, if set under section 49, on performance standards for the implementation of a WMMP.

8.2 Plastic collected for recycling

To understand the amount and types of plastic collected for recycling, data is required from the collection system or from the MRFs.

Details on the amount of plastic collected at kerbside for recovery and landfill can be found in the Waste Assessment published by each council. Variations in what is reported reflect the different arrangements councils have with commercial waste operators. Most report the percentage of plastic that makes up the total kerbside collection, but this generally groups all plastics together so we cannot determine proportions of various types. Commercial sensitivity issues and a lack of resourcing limit the granularity of most reported data.

8.2.1 Household kerbside

The National Resource Recovery Project Situational Analysis estimated the annual tonnage of recycled plastic to be 45,000 tonnes, of which 25,000 was from household sources and 90% was exported.[48]

In 2016, the plastic component of Auckland's kerbside recycling was reported as 1039 tonnes HDPE (#2), 4077 tonnes PET (#1) and 2056 tonnes mixed plastic(#s 3-7).[49]

Annually, 25,000 tonnes of recycled plastic are collected from households, which is the equivalent of the weight of plastic drink bottles consumed in Aotearoa New Zealand.

8.2.2 Public place collection

Data on rates of recycling have been published in the Public Place Recycling voluntary product stewardship scheme 2016 annual report.[50] In the four years included in the

[48] Data for this estimate was compiled from a range of sources including information supplied in confidence during interviews for the National Resource Recovery Taskforce, available at: https://www.mfe.govt.nz/sites/default/files/media/Waste/national-resource-recovery-project-redacted.pdf

[49] Auckland Council, "Auckland's Waste Assessment 2017," (2017).

[50] The Packaging Forum Inc, "Public Place Recycling, Voluntary Product Stewardship Scheme " (2016).

report, a total of 462 tonnes of plastic rubbish had been collected for recycling via public place collection systems.

Table 4 Annual tonnes of plastic recycled through the public place collection scheme

	Commercial (tonnes)	Councils (tonnes)
2012	87	52
2013	99	17
2014	102	18
2015	73	14

Between 2012 and 2015, 462 tonnes of plastic was recycled through the public place collection scheme in Aotearoa New Zealand.

8.2.3 Soft plastic recycling scheme

Most local council recycling schemes do not collect soft plastic, but the industry-led Soft Plastic Recycling Scheme collected 365 tonnes (approximately 91 million bags) in 2017, roughly 50 tonnes per month.[51]

The nationwide Soft Plastics Recycling Scheme was put on hold in December 2018 after recyclers in Australia stopped accepting the material, but as of May 2019 had resumed in Auckland at 37 locations with onshore processors using the plastic for products such as fence posts and ducting.[52]

In 2017, 365 tonnes of soft plastics were recycled – but a lack of recycling market for these plastics meant that in the following year, the majority of that plastic was landfilled.

[51] Sustainable Business Network Circular Economy Accelerator, "New Zealand's Plastic Packaging System, an Initial Circular Economy Diagnosis," (2018).

[52] Details about changes to collection for the Soft Plastics Recycling Scheme available at: https://www.recycling.kiwi.nz/solutions/soft-plastics

8.3 Case study: Palmerston North City Council recycling

Palmerston North City Council collects over 4000 tonnes of recycling from the Palmerston North kerbside collection service and owns their own MRF, which receives recycling from Horowhenua City Council, Waste Management – Palmerston North and New Plymouth and Envirowaste – Palmerston North.

Annually, the MRF processes around 4800 tonnes of material. The composition of the products are: 70% fibre; 13% plastics; 4% steel; 2% aluminium and 11% waste. These figures vary depending on the season and region of collection but are reflective of the average values.

Currently, Palmerston North City Council sells 3 different grades of plastics to companies based in Aotearoa New Zealand. Clear PET (#1) is sold to a company in Wellington and HDPE (#2) and PP (#5) are sold to a company based in Palmerston North.

Table 5 Palmerston North City Council kerbside collection by plastic grade

	Tonnes (% of total collection)			
	2015/16	**2016/17**	**2017/18**	**2018/19**
PET clear (#1)	209.56 (3.72)	186.42 (3.90)	189.02	199.68
HDPE natural (#2)	93.72 (1.66)	81.4 (1.70)	70.62 (1.47)	74.36 (1.73)
HDPE coloured (#2)	35.76 (0.63)	78.24 (1.63)	99.6 (2.07)	81.36 (1.90)
PP (#5)*	NA	NA	NA	7.2 (0.16)
Mixed plastics (#s 3,4,6,7)	NA	NA	NA	240.48
Mixed plastics (#s 3-7)	206.88 (3.67)	157.68 (3.30)	213.84	NA
Waste	735.41 (13.06)	784.19 (16.33)	784.19	570.32
Total collected for recycling	5628	4802	4805	4293

*May 2016 onwards, HDPE coloured (#2) separated from mixed plastics; January 2019 onwards, PP (#5) separated from mixed plastics (#s 3,4,6,7).

Of the 603.08 tonnes of plastic collected for recycling by Palmerston North City Council's kerbside collection in 2018/19, 362.6 tonnes were recycled onshore.

8.4 Plastic sent overseas for recycling

Traditionally, our country has sent a significant proportion of our plastic waste (~90%) overseas. The amount of exported plastic waste is captured within the 'Plastics and articles thereof' trade commodity (codes: 3915100000; 3915200000; 3915300000; 3915900000).

In 2017, China instituted a new policy that significantly reduced their intake of recycling. The effects of China's policy changes were felt more strongly in 2018, when restrictions were tightened further. Blocked from entering China, some of this material was diverted to other countries, mainly throughout South East Asia.

Between 2016 and 2018, the tonnage of plastic waste exported from Aotearoa New Zealand has decreased overall (see Figure 19). The most significant changes have been a decrease in waste exported to China and Hong Kong, as a result of policy changes, and a subsequent increase in export to Indonesia and Malaysia. In response to the burden of waste now reaching many South East Asian countries, many are following in China's footsteps and implementing policies to restrict or scrutinise waste imports.[53]

An amendment to the Basel Convention that will restrict shipments of difficult-to-recycle plastic waste to developing countries has been signed by 187 countries and will begin to be enforced in 2020.[54]

These changes highlight the need for onshore processing capabilities for recycling plastic in Aotearoa New Zealand so that recyclable plastic is not landfilled here.

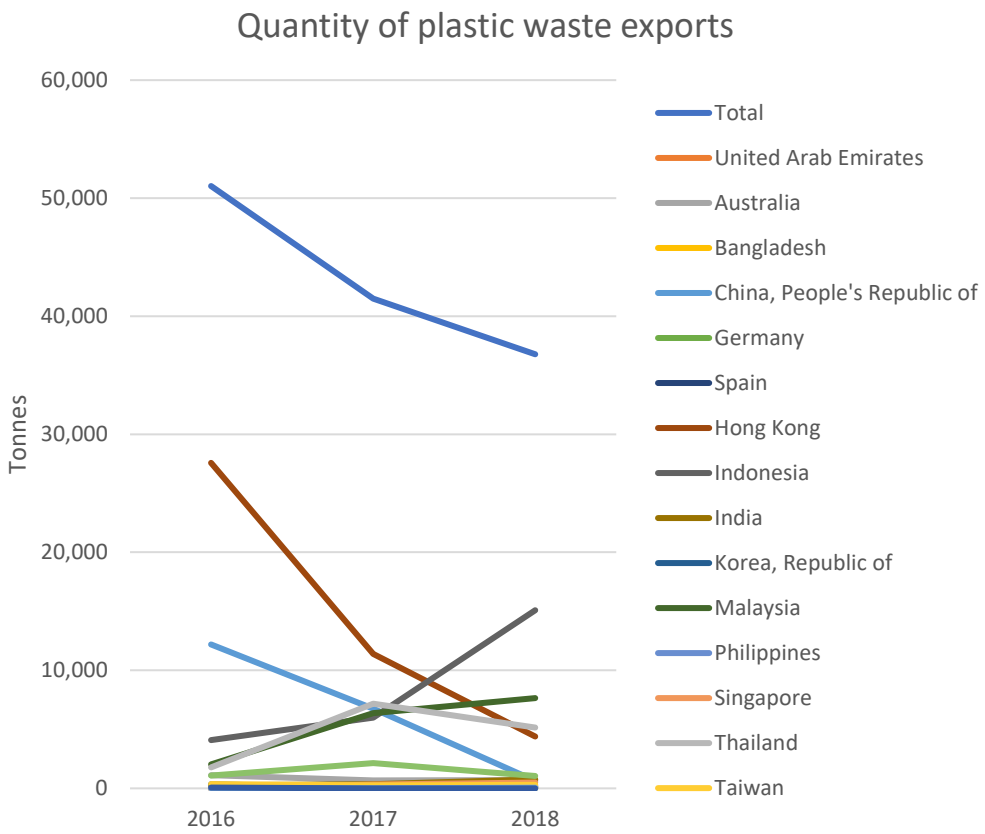

Figure 19: Tonnes of plastic waste exported from Aotearoa New Zealand.

[53] Colin Staub, "Import Restrictions Ripple across Southeast Asia," *Plastics Recycling Update*, June 6 2018.
[54] Holden, "Nearly All Countries Agree to Stem Flow of Plastic Waste into Poor Nations."

Plastic waste export data suggests that around 15,000 tonnes of plastic waste that was previously sent offshore is either being stockpiled or landfilled in Aotearoa New Zealand.

8.5 Plastic sent to landfill

Aotearoa New Zealand's landfills are classified into 5 classes and each accepts different waste. Details of waste accepted by landfill class are described in detail by WasteMINZ.[55] All types of landfill accept plastic waste, but the proportion of plastic waste going to each class of landfill differs.

Under the Waste Minimisation Act 2008, a disposal levy of $10/tonne was introduced for class 1 landfills. Class 1 landfills accept all waste types (except non-putrescible industrial waste), but represent only 11% of consented waste disposal facilities. Class 2-5 landfills are not levied under the Act. This means that industrial, commercial, household and municipal solid waste types are always levied, but other waste types are only levied if they are landfilled in a class 1 landfill.

Disposal sites can be 'consented' or 'permitted'. A permitted activity site does not require resource consent or monitoring and as such the ability to collect data for these sites is limited.

The Ministry for the Environment website states that, "at present we don't have data on the composition of what's going into landfills or the amount of resources that are being diverted from landfill".[56] While there is data on the composition of waste that goes into landfill, it is not aggregated or easy to access, nor is it in the public domain. The main reason for the lack of aggregated, accessible data is that there is no requirement for commercial contractors to provide this data to local or central government under current law. Some councils are introducing bylaws to require waste operators to be licensed and ensure these licensed waste operators report waste data.[57]

The 11% of landfills that are currently levied are required to submit monthly information on the net amount of waste disposed of at their facilities (gross tonnage minus diverted tonnage) in order to pay the levy, so there is good quality data available on the quantity of material that is going to levied disposal sites. Data is managed through the Ministry for the Environment's online waste levy system (OWLS).

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[55] WasteMINZ, "Technical Guidelines for Disposal to Land," (2018).
[56] Ministry for the Environment, Waste and Government; Available at: http://www.mfe.govt.nz/waste/what-government-doing
[57] Ministry for the Environment, "Waste Assessments and Waste Management and Minimisation Planning – a Guide for Territorial Authorities."

Expansion of OWLS to include other landfills and to collect further information could be a potential way to improve data on tonnes of waste sent to and diverted from landfill.

Expansion of OWLS to include other landfills and to collect further information could be a potential way to improve data on tonnes of waste sent to and diverted from landfill.

A study reviewing potential impacts of adjustments to the waste levy estimated the total waste generation for Aotearoa New Zealand in 2015 to be 15,311,725 tonnes, of which 9,660,315 tonnes were landfilled (see table 6).[58]

Table 6 Tonnages and proportion of plastic waste to landfill and recovery in Aotearoa New Zealand in 2015

Waste destination	Tonnes	Data source for tonnage
Class 1 Landfill	3,220,888	2015 data from Ministry for the Environment (2016) Monthly Levy Graph (background data)
Class 2 Landfill	2,575,771	Estimated from 2013 data with waste growth equivalent to change in real GDP applied from Ministry for the Environment (2014) New Zealand Non-Municipal Landfill Database, October 2014
Class 3 Landfill	64,394	
Class 4 Landfill	3,799,262	
Farm dumps	1,362,666	
Recovery	4,288,743	Estimate based on data from various sources (details provided in report)
Total waste generated	15,311,725	

8.5.1 Municipal landfill

The most recent publically available estimates on the tonnages of waste sent to municipal landfill (class 1) in Aotearoa New Zealand comes from the OECD Environmental Statistics.[59] The estimates show an increasing trend for the total

[58] Eunomia Research & Consulting Ltd, "The New Zealand Waste Disposal Levy: Potential Impacts of Adjustments to the Current Levy Rate and Structure," (2017).
[59] OECD, "Municipal Waste Database," (2015).

amount of waste and waste per capita between 2010 and 2015 (see Figure 20). Note that plastics is not the only type of waste reported in these figures.

The waste levy was implemented in 2009, therefore we would ideally compare tonnages of municipal waste to landfill before and after this time to determine the effectiveness of the waste levy. However, we cannot compare these due to changes in data collection methods.[60]

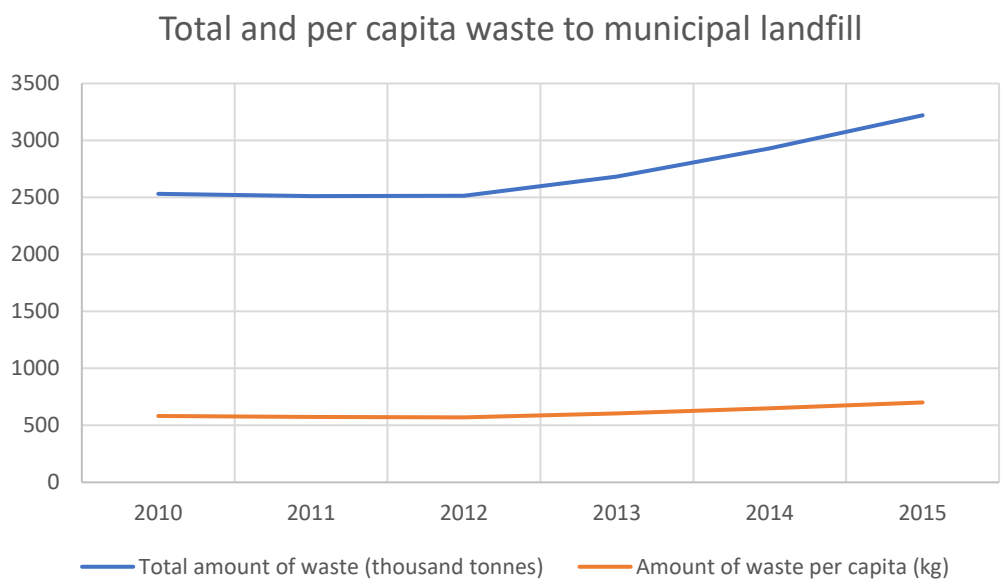

Figure 20 Total and per capita waste to municipal landfill in Aotearoa New Zealand

In 2015, over 3 million tonnes of waste, including plastic, went to municipal landfill in Aotearoa New Zealand.

It is difficult to gauge the effectiveness of the waste levy on reducing waste to landfill for non-municipal waste because not all of these landfills are levied.

According to a review of the effectiveness of the waste disposal levy published in 2017, in the period July 2013 to June 2016, levied waste disposal facilities received a total of 10,681,295 tonnes of gross tonnage of waste. From this, 1,207,786 tonnes of material

[60] The way municipal landfill data was collected changed in 2010 due to the Waste Minimisation Act 2008. Data collected prior to 2010 is considered imprecise, and the Ministry for the Environment has advised not to compare this with data collected from 2010 onwards. Details at: http://www.mfe.govt.nz/more/environmental-reporting/reporting-act/waste/solid-waste-disposal-indicator/quantity-solid-waste

were diverted, leaving total net waste tonnage of 9,473,509 tonnes.[61] Except for 2012, net waste to levied landfills has increased every year since the levy was introduced (see Figure 21).

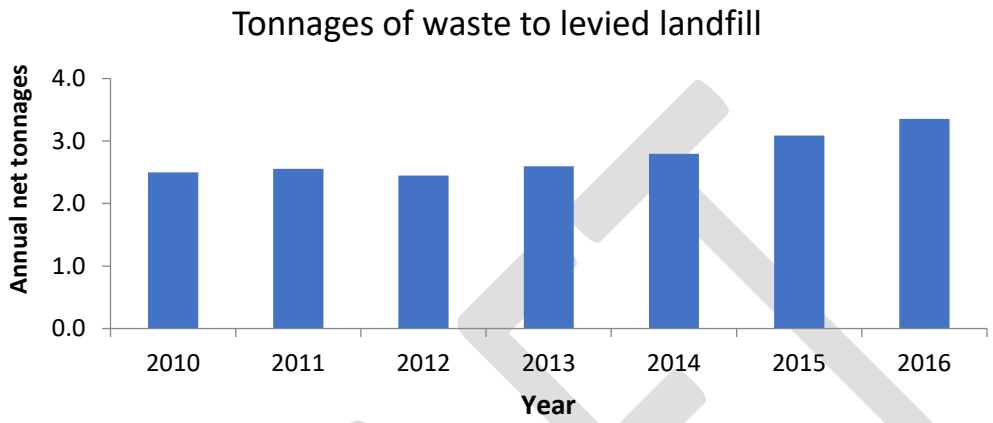

Figure 21 Annual net tonnages of waste to levied landfills since 2010

8.5.2 Non-municipal landfill

In 2012, the Ministry for the Environment engaged Tonkin & Taylor Ltd to develop a database of non-municipal solid waste landfills throughout Aotearoa New Zealand.[62] The primary purpose of this database was for estimating greenhouse gas emissions, and a secondary use was to inform review of the waste disposal levy.

The non-municipal solid waste landfill database was retrospective and only captured data until 2012. It is not framework for ongoing data collection. Where data was missing, information was extrapolated.

From this database, total tonnes of waste going to non-municipal landfill was back-cast and projected through to 2015, predicting an upward trend (see Figure 22). Data is also shown by region (see Figure 23). Note these tonnages include other waste not just plastic.

In August 2018, the Ministry for the Environment announced that part of their waste work programme would include looking at options to expand the waste dispoal levy to apply to currently non-levied landfills.[63]

[61] Ministry for the Environment, "Review of the Effectiveness of the Waste Disposal Levy 2017," ed. Ministry for the Environment (Wellington2017).
[62] Tonkin & Taylor., "New Zealand Non-Municipal Landfill Database," (prepared for the Ministry for the Environment 2014).
[63] Ministry for the Environment, Waste work programme to tackle tough problems (19 August 2018); Available at: http://www.mfe.govt.nz/news-events/waste-work-programme-tackle-tough-problems

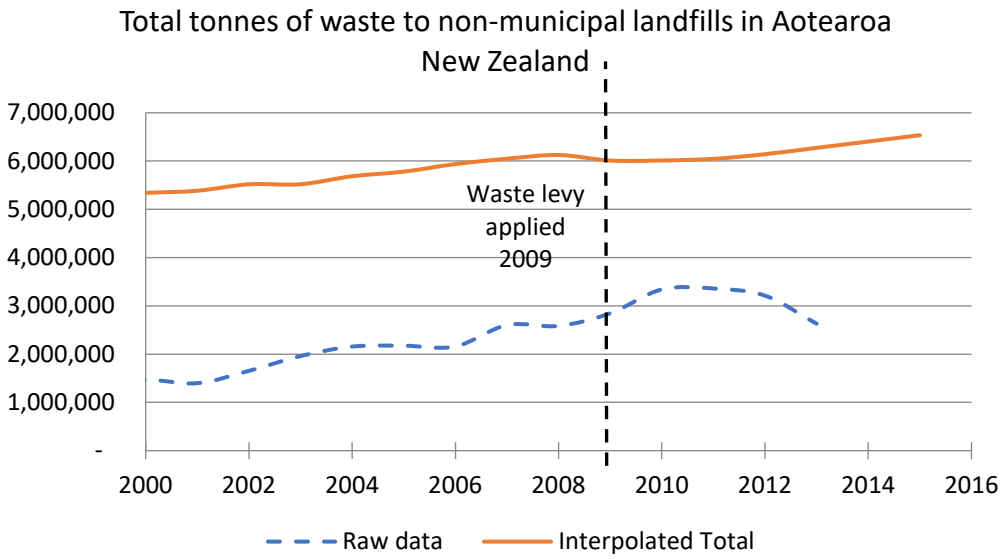

Figure 22 Waste disposed in non-municipal landfills from 2000-2015[64]

It is estimated that over 6 million tonnes of waste, including plastics, went to non-municipal landfills in Aotearoa New Zealand by 2015

[64] Taylor., "New Zealand Non-Municipal Landfill Database."

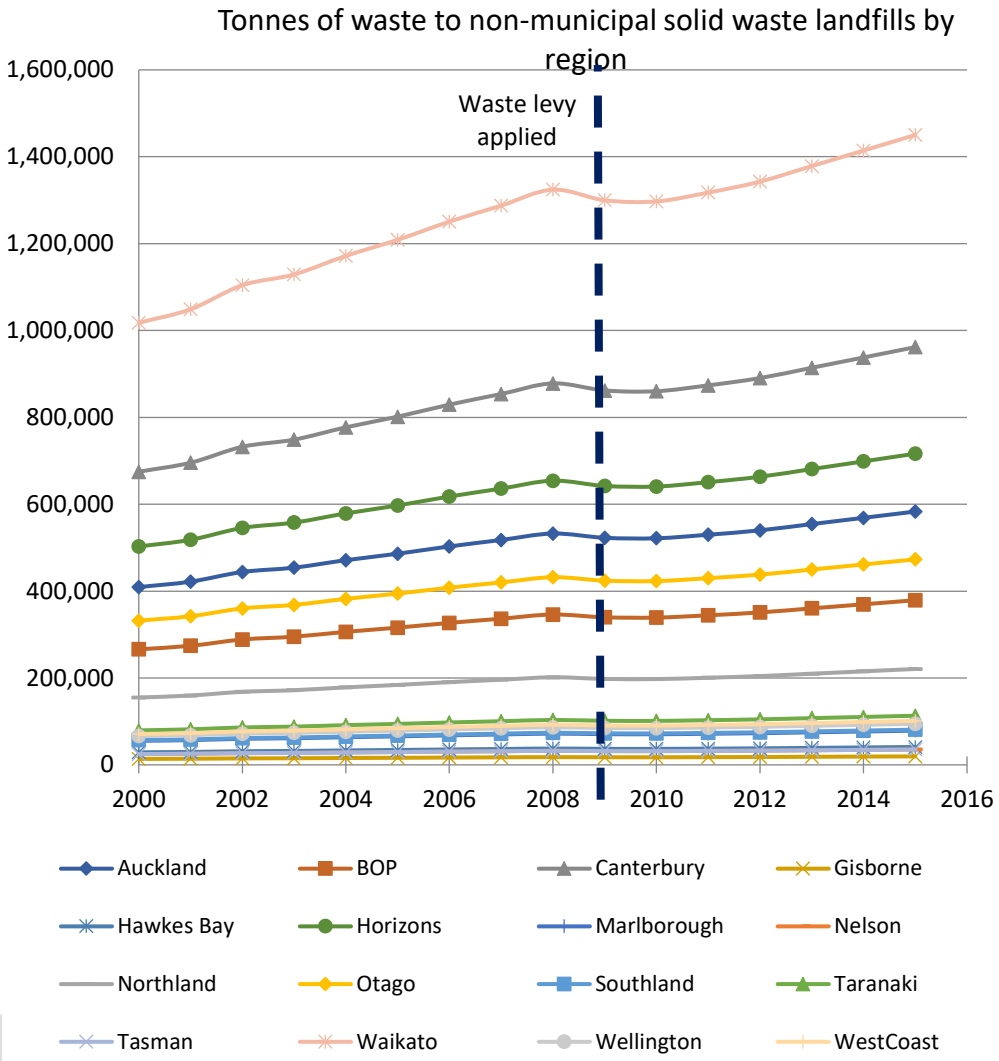

Figure 23 Tonnes of waste disposed at non-municipal landfills by region (including farm dumps)[65]

8.5.3 Proportion of landfilled waste that is plastic

To understand the amount of plastic waste we are landfilling, we need to know the proportion of the waste going in to landfill that is plastic.

The method used by the Ministry for the Environment to estimate waste composition proportions is a Solid Waste Analysis Protocol (SWAP).[66] Waste is surveyed at domestic source or disposal facilities, using a specific sampling regime and classification system, to estimate proportions.

[65] Ibid.

[66] Ibid.

Through SWAP analysis at a sample of municipal waste disposal facilities between 2004 and 2012, it was shown that the proportion of plastic decreased between 2004 and 2008, but increased between 2008 and 2012 (see Figure 24). In 2012, plastic made up a large proportion of waste, second only to food and garden waste. Together, plastic and food and garden waste made up nearly 40% of municipal waste.

Also notable is the increase in textile waste, a proportion of which will be synthetic materials of plastic fibre.

These surveys have not been conducted since 2012.

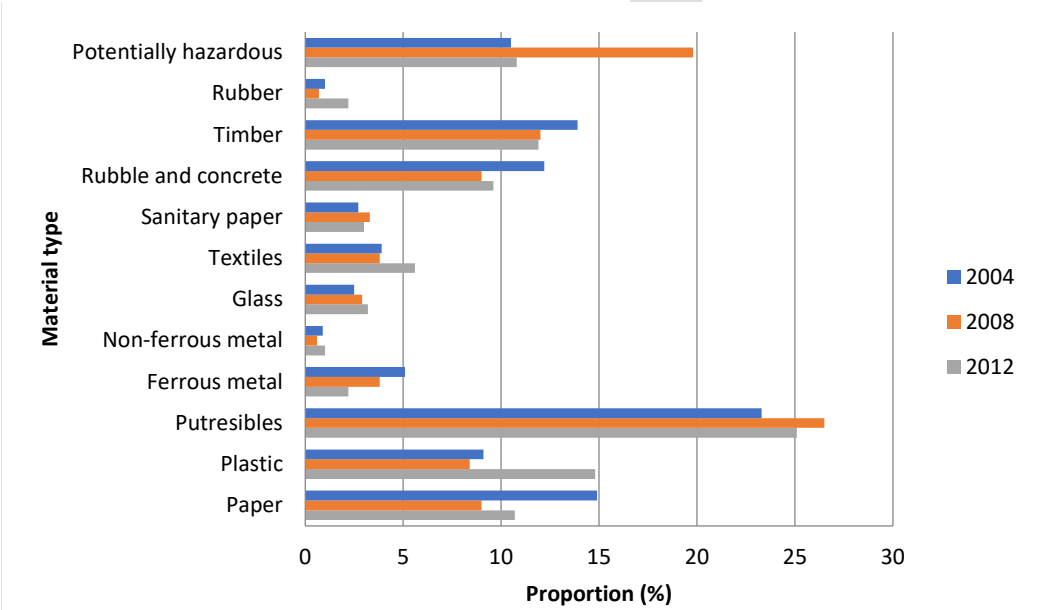

Figure 24 Estimated proportion for common waste streams at municipal waste disposal facilities from 2004 to 2012

More recently, Perrot *et al.* estimated landfill waste composition based off regional council data between 2011 and 2017.[67] Their estimates put plastics at 12.1% of municipal landfill waste (see Figure 25).

[67] Perrot, J.-F. Municipal Waste Management Strategy Review and Waste-to-Energy Generation Potential in New Zealand. Master's Thesis, The University of Auckland, Auckland, New Zealand, 2018

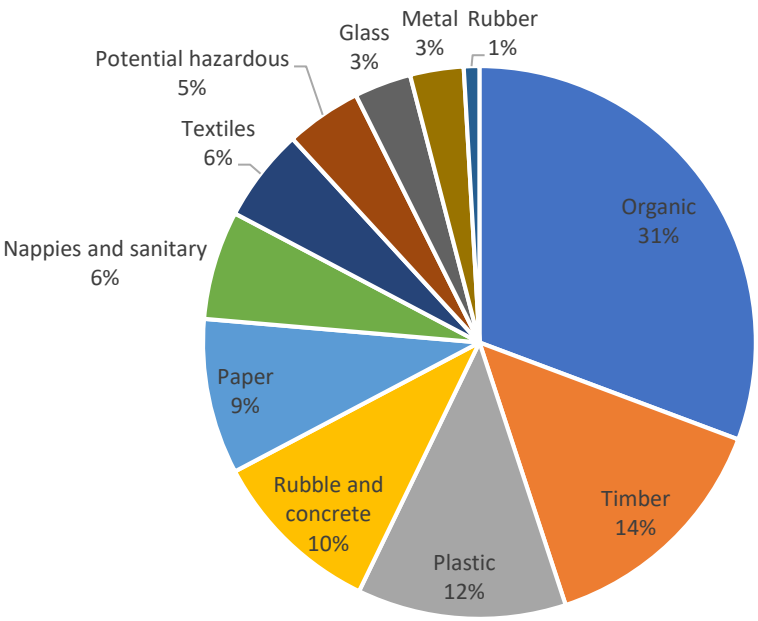

Figure 25 Waste composition according to regional council data. [68]

Fewer studies have estimated the composition of waste to Class 2-4 landfills. The study reviewing potential impacts of adjustments to the waste levy [69] cites 0% of waste to these landfills being plastic, based on a survey of waste materials to Fulton Hogan operated cleanfills in 2003. [70] However, Class 2-4 landfills can accept plastic waste and given the increase in use of plastics in industries such as construction, there is a need for a current survey of composition of these landfills.

Based on available data, we can make a conservative estimate of the proportion of waste to landfill by multiplying the total waste to Class 1 landfills (approximately 3.2 million tonnes) by the estimated proportion of waste that is plastic (12%), giving a total of 384,000 tonnes.

If 12% of waste is plastic in Class 1 landfill, around 380,000 tonnes of plastic would have been landfilled in 2015.

[68] Perrot, J.-F. Municipal Waste Management Strategy Review and Waste-to-Energy Generation Potential in New Zealand. Master's Thesis, The University of Auckland, Auckland, New Zealand, 2018

[69] Ltd, "The New Zealand Waste Disposal Levy: Potential Impacts of Adjustments to the Current Levy Rate and Structure."

[70] Greg Slaughter, "Construction of New Zealand's First 100% Recycled Road."

8.6 Waste from manufacturing process

A proportion of plastic that goes into the manufacturing process is lost as scrap material or rejected products due to design issues or defects.

The most recent published data on the amount of pre-consumer industrial waste in Aotearoa New Zealand comes from a 2005 report by Plastics NZ.[71] The report identified 4487 tonnes of waste from this source for recycling in New Zealand. The report figure excludes plastic waste that was recycled in-house through feedstock recycling.

Recyclability is not an issue for this plastic as it has generally come from a clean manufacturing stream.

Plastics NZ have set up a database to allow manufacturers to exchange manufacturing waste to improve its utilisation.

8.7 Case study: Agricultural plastic waste

Assessments of plastic waste in the agricultural industry have been performed by GHD for the Environment Canterbury Regional Council in 2013[72] and the Waikato and Bay of Plenty Regional Councils in 2014.[73,74] These three regions have the highest number of farms in Aotearoa New Zealand. The same survey methodology was used across both studies, but the breakdown of waste type differed, limiting comparison of specific materials across both. There were 53 farms surveyed for Canterbury and 69 for the Waikato and Bay of Plenty. Non-natural rural waste includes waste streams from dairy, livestock, arable farming and horticulture.

Key findings:

- National projections based on these assessments estimate over 2.1 million tonnes of rural wastes (including plastics) are produced annually in Aotearoa New Zealand (37 tonne average per property multiplied by 58,071 rural properties in New Zealand, not accounting for variations in activity by different farm type).
- Plastic was one of the most prevalent non-natural rural wastes. Types of plastic waste are varied and some are hazardous. Examples include containers, drums, silage and baleage wrap, netting, mulch film and crop cover, agrichemical containers, animal health plastic packaging and plastic sheep dip, fertiliser bags, domestic refuse (see Appendix 5).
- Almost all sites burn, bury and/or bulk store waste indefinitely as a disposal strategy (92% Canterbury; 100% Waikato and Bay of Plenty), which has the potential to impact water quality in streams, rivers and groundwater.

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[71] Withington, N. (2005) *Sustainable End of Life Options for Plastics in New Zealand-Plastics New Zealand Research Report*. Plastics NZ, PO Box 76 378 Manukau, Auckland.
[72] GHD, Non-natural rural waste: Site survey data analysis (2013), prepared for Environment Canterbury Regional Council; Available at: https://api.ecan.govt.nz/TrimPublicAPI/documents/download/1851763
[73] GHD, Rural waste surveys data analysis: Waikato & Bay of Plenty (2014), prepared for Waikato Regional Council ; Available at: http://www.waikatoregion.govt.nz/assets/PageFiles/30542/TR201455.pdf
[74] Council waste assessments also include some farm waste data but are not included in this case study.

- Significant differences in plastic use may result from different farming infrastructure – for example, areas where farms had irrigated paddocks there was a reduced volume of plastics from wraps and sacks.

Table 7 Example waste streams of plastic from rural properties

Waste type	Canterbury			Waikato/Bay of Plenty		
	Total surveyed (tonnes)	Average/farm (tonnes)	Total for 8,826 farms x average	Total surveyed (tonnes)	Average/farm (tonnes)	Total for 14,685 farms x average (tonnes)
Containers	1.7	0.03	264.78	2.2	0.03	440.6
Drums	2.7	0.05	441.3	5.0	0.07	1027.9
Silage wrap	14.8	0.3	2647.8	11.4	0.2	2937.0
Netting	10.9	0.2	1765.2	9.1	0.1	1468.5
Mulch film and crop cover	2.6	0.05	441.3	5.8	0.1	1468.5

An estimated 5874 tonnes of plastic wraps, covers and films and 1468.5 tonnes of plastic containers and drums would be used on agricultural properties in the Waikato and Bay of Plenty regions alone each year.

8.8 Case study: Plastic waste during new-build construction

Plastic use is increasing in construction. For example, plastic pipe has largely replaced iron pipe and plastic conduit has largely replaced metal conduit.

During 2017-2018, Cerqueira evaluated the use of source separation for the recovery of construction waste on an active new-build construction site.[75] The site chosen was a residential development of approximately 350 m^2 floor area in Auckland. Amongst other construction materials, approximately 80 kg of mixed plastics were able to be separated into soft and hard grades and sent to Visy recycling or Mitre 10 to achieve 100% diversion. In this case study, of the 6.8 tonnes of waste audited, a total of 4.1 tonnes were diverted from landfill representing 60% waste recovery and diversion. However, contractors have

[75] Cerqueira, I.B.S. (2018). Waste Recovery and Landfill Diversion by Source Separation on an Active Construction Site. A final year project report MG7101, submitted in partial fulfilment of the requirements for the Degree of Bachelor of Engineering Technology (BEngTech, Civil), Unitec Institute of Technology (unpublished).

indicated to Green Gorilla that separation at source is not sustainable due to the time required (and costs incurred as a consequence).

An exploratory study is underway at Unitec to identify and quantify plastic waste streams, and their potential for recycling, from new-build construction. The study will inform a broader national study of the potential for diversion, of all materials, within the new-build and deconstruction sectors, including the economic implications of a range of models for construction waste processing with a medium-term goal to provide economic and sustainable alternatives to landfilling.

This study measures the waste product of the new build process, but does not measure the waste from construction demolition.

Approximately 80 kg of mixed plastic waste was generated from a residential development of 350m² floor area in Auckland.

8.9 Knowledge gaps

While there are several studies reporting varying levels of data for landfilled or recovered waste, comprehensive data is not available or consistent in order to aggregate a national data set for plastic waste that captures weight by material type.

8.10 Opportunities for capturing waste data

8.10.1 National Waste Data Framework

In response to the lack of standardisation in waste data collection in Aotearoa New Zealand, WasteMINZ developed a National Waste Data Framework (NWDF) that could be implemented by both local government and the waste industry across the country.

> *"Lack of standardisation has meant it is, at the least, time-consuming and difficult to meaningfully collate and share data, at any level, or to accurately monitor the impacts of interventions on waste flows. This has long been recognised as preventing both the public and private sectors from effectively planning, monitoring, and reporting on waste issues and developing and prioritising solutions."*
>
> *National Waste Data Framework Project*[76]

[76] Details of the National Waste Data Framework, including all published reports, are available at: https://www.wasteminz.org.nz/projects/national-waste-data-framework-project/

Stage 1 of the project was completed in 2015 and was supported by a grant from Waste Minimisation Fund and contributions from local government partners. The framework:

- Establishes a set of definitions to act as a common language for collecting and reporting waste data
- Determines *what* data is gathered
- Determines *who* gathers this data
- Specifies *how* the target data is gathered
- Directs *who* data is reported to
- Sets out *how* the data that are collected are collated and presented

The framework sets out protocols for gathering and reporting data on solid waste that is disposed of at disposal facilities (as defined by the WMA 2008), and also for presenting information about waste and diverted material services and facilities. The 7 reporting indicators established by the NWDF collect data required for the WMMP assessment which each council has to perform.

The framework is designed with councils at the centre of data collection. Within the NWDF documentation, this is cited to be a result of the Ministry for the Environment under the previous government stating a clear preference for voluntary methods, in the first instance.

In the 4 years since completion, efforts to align data collection with the NWDF have been varied due to the voluntary nature of the framework.

- **Currently implementing the framework:** Two regional groups of councils are currently implementing the framework. Wellington councils (8 councils in total), and the Bay of Plenty and Waikato Councils (16 councils in total).
- **Active efforts to implement:** Several councils have made active efforts to implement the framework at some level, such as aligning weighbridge codes, using the NWDF data in their Waste Assessments, or initiating licensing of waste operators/adopted new bylaws. This includes Auckland, Central Hawkes Bay, Dunedin, Hamilton, Hutt City, Mackenzie District, Matamata-Piako, Opotiki, Palmerston North, Ruapehu, South Waikato, Tauranga, Timaru, Waipa, Whakatane, Wellington, Western Bay.
- **Some alignment:** around 40 councils have made some level of alignment of their data collection with the NWDF. This is mainly through SWAP audit methodology aligning the 'activity source data' with the NWDF.
- **No alignment:** roughly 20 councils have not aligned data collection with the NWDF.

The Ministry for the Environment highlights the NWDF as a resource for councils to refer to but does not mandate use, though this is possible via the WMA.

Given that the NWDF is ready to go and could be implemented by all councils due to not being overly prescriptive or rigid, mandating use would advance waste data quality in Aotearoa New Zealand. The limitations of the framework, such as the lack of

centralised data collection/maintenance and the fact it doesn't address diverted materials or non-levied landfill sites could be addressed over time.

In the 4 years of voluntary implementation of the National Waste Data Framework, only 24 of 67 local councils are fully implementing the framework.

8.11 Recommendations

See recommendations 2b, 2d, 2e– to be finalised with completion of full report.

9 HOW MUCH PLASTIC IS LEAKING INTO THE ENVIRONMENT?

The majority of studies measuring plastic pollution in the environment have been undertaken overseas, but overall our knowledge of the extent of the problem is limited and often focuses on visible examples of harm to fish, birds and marine mammals.

Global estimates of the scale of plastic pollution have been made. A study by Jambeck *et al.* in 2015 calculated that of the 275 million tonnes of plastic waste generated in 192 coastal countries in 2010, 4.8-12.7 million tonnes entered the ocean.[77] It is estimated that 80% of marine plastic debris comes from land and only 20% from ocean-based sources, with commercial fisheries being a large contributor.[78]

In the context of Aotearoa New Zealand, there are relatively recent approaches to measuring litter in certain parts of the environment. These studies can help us begin to understand the scale of the plastic pollution problem locally, identify the most problematic plastic products, and provide a baseline to track improvements based on behaviour or policy changes.

The most effective means of dealing with leakage is to prevent it, particularly as it is almost impossible to capture plastics already in the ocean, where over time much will disintegrate into smaller pieces and may leach toxins. Effective, systemic and enduring mitigation of this environmental harm requires measurement and monitoring tools not yet developed in Aotearoa New Zealand, and only unevenly applied in other countries.

9.1 Land-based plastic pollution

9.1.1 National Litter Survey

On behalf of the Public Place Recycling Product Stewardship Scheme, which aims to increase recycling and abate loose litter, Waste Not Consulting conducted two National Litter Surveys in Aotearoa New Zealand. The first, published in 2015,[79] provided baseline data prior to the initiation of the recycling scheme. The purpose of the second report, published in 2018,[80] was to monitor outcomes of the scheme.

Between 2015 and 2018, there was a 5% reduction in the number of litter items counted. However, there was a 22% decrease in the number of transects that had no or low amounts of litter.

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[77] J. R. Jambeck et al., "Plastic Waste Inputs from Land into the Ocean," *Science* 347, no. 6223 (2015).
[78] W. C. Li, H. F. Tse, and L. Fok, "Plastic Waste in the Marine Environment: A Review of Sources, Occurrence and Effects," *Science of the Total Environment* 566 (2016)..
[79] Waste Not Consulting, "National Litter Survey 2014-2015: Summary of Results," (Funded by the Packaging Forum's Public Place Recycling Scheme, 2015).
[80] Waste Not Consulting, "National Litter Survey 2017-2019: Summary of Results," (Funded by the Packaging Forum's Public Place Recycling Scheme 2018).

Table 8 National Litter Survey: baseline and outcome monitoring for the Public Place Recycling Product Stewardship Scheme

	2014/15	2017/18
Visible and bulky litter	18,620 items/581,764m^2 of public space 32 items/1,000m^2 surveyed	17,735/581,764m^2 of public space 30.5 items/1,000m^2 surveyed
Transects graded as having virtually no visible litter or mostly free of visible litter	87%	65%

For plastic litter specifically, items were classified by type of plastic for drink packaging (e.g. PET (#1) drink containers and HDPE (#2) drink containers) but for food packaging plastics were grouped with multi-material items.

The 2017/18 litter survey results identified a significant proportion of litter was plastic packaging. Food packaging of plastic or mixed materials made up 13.3% of the litter count, and plastics drinks packaging made up 5.8% (excluding 'other drink packaging', which may contain some plastic items such as bottle tops). Of the plastic drinks, nearly half (2.3%) were PET (#1) bottles, which are recyclable. Soft plastic packaging contributed 9.1% of litter, but was not specifically measured in the baseline data.

These findings illustrate that single-use plastic packaging is a key contributor to plastic in the environment in Aotearoa New Zealand.

9.2 Plastic pollution in waterways

Land-based plastic pollution finds its way into the ocean through waterways. Understanding the pattern and extent of plastic travelling through waterways is crucial to inform efforts to capture leaked plastic and prevent it entering the marine environment.

9.2.1 Palmy Plastic Pollution Challenge

A citizen science programme in Palmerston North reported preliminary findings from a litter audit to benchmark all forms of plastic pollution in the city that took place in April 2019.[81] Plastic litter was measured across 41 sample sites from the city streams then analysed by volunteers though a process of sorting, counting and weighing items of stream litter/waste.

In total over 11,000 litter items were collected from the sample sites, representing approximately 3% of the total length of the main city streams. This finding equates to approximately 2680 items of litter / plastic per site (1000m^2). Food wrappers made up almost 25% of all items collected.

[81] Further details of the methodology used for the Palmy Plastic Pollution Challenge are available at: https://drive.google.com/file/d/1qZzdhpuqrs7_Pui4RzLR6_hyGSq2BEkE/view

The initial estimate is that this equates to over 360,000 items of mostly plastic litter currently in the process of being mobilised from the streams into the Manawatu River.

The significant difference in reported litter rates between the land-based survey (30.5 items/1,000m^2) and surveyed waterways (2680 items/1000 m^2) may be attributable to waterways being the funnel for litter to the ocean, different methods, and different regions surveyed. Further research to measure and understand plastic pollution processes in Aotearoa New Zealand is necessary.

Further research to measure and understand plastic pollution processes in Aotearoa New Zealand is necessary.

9.3 Marine-based plastic pollution

Because marine plastic debris shifts with ocean currents, it is more difficult to understand the scale of plastic litter that comes from mismanaged waste in Aotearoa New Zealand.

9.3.1 Plastic pollution from fisheries

While there is no data quantifying the amount of ocean plastics attributed to mismanagement of waste from Aotearoa New Zealand, there is evidence that suggests that some of the waste comes from our shores or offshore activities.

US mariner, Captain Charles Moore, first described the phenomenon of the ocean gyres in 1997. Ocean gyres are slowly churning eddies of plastic 'smog' covering areas bigger than many countries. Two of the five gyres are in the Pacific – one off the coast of California and the other west of Chile. While it may seem these are far enough from Aotearoa New Zealand's shores to be 'not our problem', the findings of a 2018 expedition by Agalita Marine Research and Education South Pacific[82] to the southern Pacific gyre reminds us otherwise.

In their studies of plastic in ocean gyres, Agalita identified fish bins belonging to New Zealand seafood companies (see Figure 26). At sea, the researchers collected 1 bin from Talleys Group Limited and 1 bin of unknown brand, but identified as being manufactured in New Zealand.

[82] Further details about the Agalita Marine Research and Education South Pacific available at: https://www.algalitasouthpacific.com/

On Rapa Nui (Easter Island), they were shown 24 different bins, from two people, that had washed ashore and now collected and re-used by them. 18 of the bins were from identifiable New Zealand and Australian companies.

Table 9 Australian and New Zealand fisheries companies with bins found by Agalita

Company	Number of bins
Talley's	4
Deep Cove Fisheries	4
Sanford	3
United Fisheries	2
Bluewater Products Dunedin	1
Dallington Fish Supply Christchurch	1
Whitecloud Seafoods Christchurch	1
Skeggs Foods Nelson	1
RF McLaughlin & Consolidated Fishermen Australia	1
Unidentifiable	6

This study does not identify the proportion of ocean waste that comes from our shores, but indicates that emphasis must be placed on reducing plastic mismanagement during offshore activities.

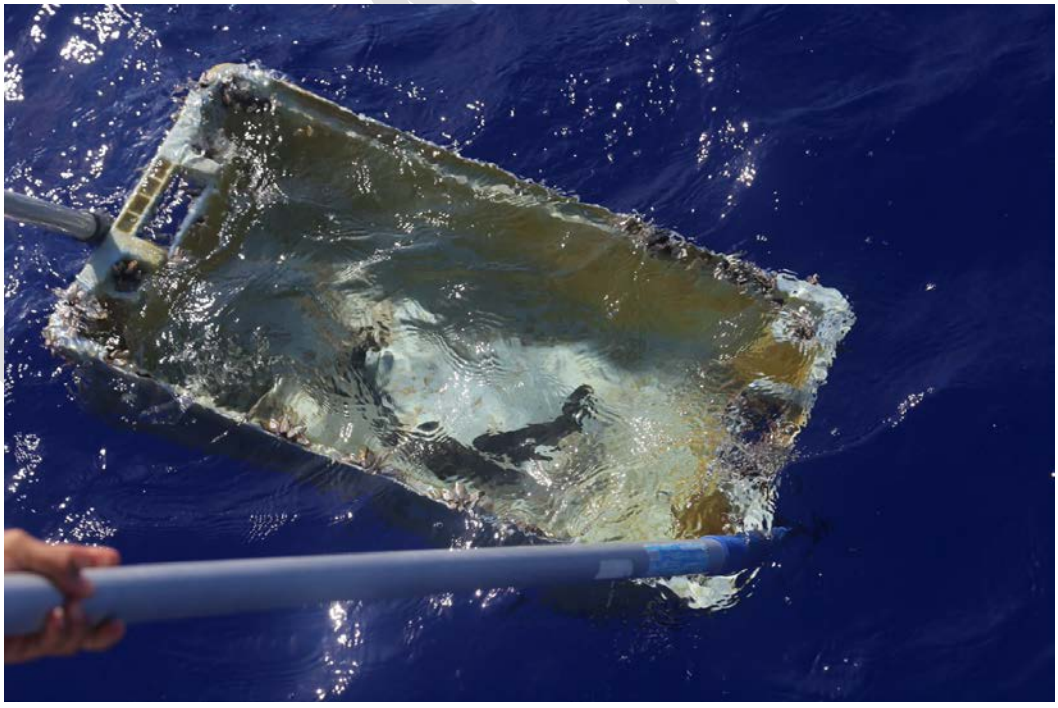

Figure 26 Example of plastic waste from a New Zealand fisheries company found in the ocean. Source: Agalita Marine Research and Education South Pacific.

9.3.2 Plastic ocean debris

Several studies have identified plastic pollution in the marine environment around Aotearoa New Zealand.

Floating consumer and industrial plastics were identified in the Hauraki Golf during trawls undertaken between July to September 2008 and consisted of colours and lengths likely to be mistaken as food items for small to medium seabirds.[83]

Yeo et al. identified persistent organic pollutants around Australia and Aotearoa New Zealand's North Island associated with plastic pellets/nurdles.[84] High concentrations of persistent organic pollutants were recorded in Auckland and Australia's large cities, while very low concentrations were found at the tip of the North Island.

Studies of biota around Aotearoa New Zealand have identified ingested plastic in the endangered green turtle *Chelonia mydas*.[85] The predominant plastic items ingested were soft plastics (e.g. single-use food packaging, plastic bags), and white, clear or translucent items. Research is underway to quantify plastic ingestion in the stomachs of dolphins stranded in Aotearoa New Zealand.

Plastic debris has also been identified among burrow-nesting seabird colonies on one offshore island in northern New Zealand, but not on the other five islands surveyed.[86]

9.3.3 Marine microplastics

The remoteness and relatively low population density of Aotearoa New Zealand may be thought to result in low levels of marine microplastic pollution. However, levels have been shown to be independent of population density in other areas.[87]In fact, the highest reported density of plastic debris anywhere in the world was on Henderson Island, a remote island in the South Pacific, with up to 671.6 items/m^2 on the surface of beaches in 2017.[88]

Eriksen et al. modelled levels of plastic, including microplastic, in surface waters around the globe, estimating a minimum of 5.25 trillion particles weighing 268,940 tonnes, of which 35,500 tonnes were microplastic.[89] The level of microplastic pollution

[83] Megan Young and Nigel J. Adams, "Plastic Debris and Seabird Presence in the Hauraki Gulf, New Zealand," *New Zealand Journal of Marine and Freshwater Research* 44, no. 3 (2010).
[84] Bee Geok Yeo et al., "Pops Monitoring in Australia and New Zealand Using Plastic Resin Pellets, and International Pellet Watch as a Tool for Education and Raising Public Awareness on Plastic Debris and Pops," *Marine Pollution Bulletin* 101, no. 1 (2015).
[85] D. A. Godoy and K. A. Stockin, "Anthropogenic Impacts on Green Turtles Chelonia Mydas in New Zealand," *Endangered Species Research* 37 (2018).
[86] Rachel T. Buxton et al., "Incidence of Plastic Fragments among Burrow-Nesting Seabird Colonies on Offshore Islands in Northern New Zealand," *Marine Pollution Bulletin* 74, no. 1 (2013).
[87] H. Hirai et al., "Organic Micropollutants in Marine Plastics Debris from the Open Ocean and Remote and Urban Beaches," ibid.62, no. 8 (2011).
[88] J. L. Lavers and A. L. Bond, "Exceptional and Rapid Accumulation of Anthropogenic Debris on One of the World's Most Remote and Pristine Islands," *Proceedings of the National Academy of Sciences of the United States of America* 114, no. 23 (2017).
[89] Marcus Eriksen et al., "Plastic Pollution in the World's Oceans: More Than 5 Trillion Plastic Pieces Weighing over 250,000 Tons Afloat at Sea," *PLOS ONE* 9, no. 12 (2014).

in the marine environment around Aotearoa New Zealand is currently poorly understood and levels within surface waters have not been examined.

In 1977 and 1978, Gregory identified the wide distribution of preproduction plastic pellets (nurdles) around Aotearoa New Zealand.[90,91] These pellets were found in highest densities around main population centres (Auckland, Wellington and Christchurch), but were also found in remote areas. More recently, work as been carried out looking at the density of nurdle pellets in Wellington Harbour by Agalita South Pacific, but the findings have not yet been published.

Assessment of coastal sediment microplastics was carried out for beaches around Christchurch. A range of different morphologies and polymer types were identified.[92] Pellets and fragments were identified, and fibres were disregarded in this study. The predominant polymer types were PS (#6) (55%), PE (polyethylene) (21%) and PP (#5) (11%).

There is even less known about the levels of microplastics within biota. A recent study looked at plastics within the guts of food species finfish from the South Pacfic region, including some samples from Aotearoa New Zealand water.[93] Plastic ingestion rates were found to be comparative with global ingestion rates. Microplastic characteristics included fibres, film and fragments, and represented a range of polmer types, including PVC (#3), PP (#5), Rayon, PE and PES (polyethersulfone). The majority of polyester and rayon microplastics were fibres, consistent with the high level of both these in clothing and resulting wastewater discharged to the marine environment. Vertical habitat differences (pelagic vs benthopelagic) was found to correlate with the levels of microplastics within the stomachs of the fish.

Even less is known about the levels of microplastics in Aotearoa New Zealand's freshwater systems. A very recent paper by Dikareva and Simon examined the levels and types of microplastics streams in Auckland, across a gradient of urbanisation.[94] All streams were found to contain microplastics similar to levels found in large systems. Levels weren't related to population density, and local-scale factors are thought to have a greater influence on microplastic abundance than catchment-scale factors.

[90] Murray R. Gregory, "Plastic Pellets on New Zealand Beaches," *Marine Pollution Bulletin* 8, no. 4 (1977).
[91] M. R. Gregory, "Accumulation and Distribution of Virgin Plastic Granules on New-Zealand Beaches," *New Zealand Journal of Marine and Freshwater Research* 12, no. 4 (1978).
[92] P. J. Clunies-Ross et al., "Synthetic Shorelines in New Zealand? Quantification and Characterisation of Microplastic Pollution on Canterbury's Coastlines," ibid.50, no. 2 (2016).
[93] Ana Markic et al., "Double Trouble in the South Pacific Subtropical Gyre: Increased Plastic Ingestion by Fish in the Oceanic Accumulation Zone," *Marine Pollution Bulletin* 136 (2018).
[94] Nadezhda Dikareva and Kevin S. Simon, "Microplastic Pollution in Streams Spanning an Urbanisation Gradient," *Environmental Pollution* 250 (2019).

9.4 Case study: Sustainable Coastlines

Sustainable Coastlines has developed a citizen science-based initiative to measure litter on Aotearoa New Zealand's coastlines and collate data in a national coastal litter database.[95]

Following a standardised method based on international best practice (UNEP/IOC guidelines on surveying and monitoring of marine litter[96]), citizen scientists survey a coastal site and record the type and weight of each piece of litter found. The data meets Statistics New Zealand Tier 1 data standards, meaning it can feed into environmental reporting measures for the government. Of note, items less than 5mm in diameter are not recorded, so the findings do not quantify the scale of microplastic pollution.

The project is ongoing, with surveys repeated quarterly at the same site. Over the coming years, the national database will be able to inform and measure the impacts of policy changes and public education campaigns.

The first release of data using this methodology was shared with the Rethinking Plastics panel and provides a snapshot of the scale of plastic that makes up marine pollution. During the 95 beach cleanups undertaken between July 2018 and April 2019, 14,854 plastic items were collected (69% of the total), amounting to 37.3 kg of plastic waste (9.8% of total weight). Single-use plastics dominated the plastic litter items collected from coastal cleanups in Aotearoa New Zealand (see Table 10).

Table 10 Top 10 plastic litter items from Sustainable Coastlines surveys between July 2018 and April 2019

Litter item	Number collected	% of count	Weight (kg)
Unidentifiable hard plastic fragments	5449	36.7	5.1
Food wrappers	2412	16.2	2.7
Cigarettes, butts & filters	1783	12.0	0.4
Unidentifiable foamed plastic fragments	1052	7.1	1.0
Bottle caps & lids	768	5.2	1.6
Lollipop sticks & cotton buds	466	3.1	0.2
Rope	399	2.7	1.3
Straws	358	2.4	0.3
Food containers	278	1.9	1.2
Toys, balls & party poppers	198	1.3	1.2

[95] Further details about Sustainable Coastlines, including data collection methodology are available at: http://sustainablecoastlines.org/

[96] The United Nations Environment Programme (UNEP) and Intergovernmental Oceanographic Commission (IOC) developed guidelines to assist and standardise efforts to monitor and assess marine litter, available at: https://wedocs.unep.org/bitstream/handle/20.500.11822/13604/rsrs186.pdf?sequence=1&isAllowed=y

Single-use plastics dominated the plastic litter items collected from coastal cleanups in Aotearoa New Zealand.

9.5 Knowledge gaps

There are significant gaps in our understanding of the scale of plastic leakage into our land and marine environments, for both micro- and macroplastics.

Several Aotearoa New Zealand-specific studies are underway to expand our understanding of plastics in the environment, but data is not yet available. These include:

- Analysing plastic pollution at a river in Wellington.[97]
- Studying the levels and types of microplastics in green-lipped mussels.

9.6 Recommendations

See recommendations 5a, 5b, 5c, and 5d– to be finalised with completion of full report.

[97] Further details of the research project underway at NIWA analyzing plastic pollution processes in rivers is available at: https://www.niwa.co.nz/freshwater-and-estuaries/research-projects/plastic-pollution-processes-in-rivers

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- Kirsten Edgar, Callaghan Innovation

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- Terri-Anne Berry, Unitec
- Trish Kirkland-Smith and Emily Thomas, Fonterra

11 APPENDICES

Appendix 1 – Rethinking Plastics resources

Appendix 2 – Import data

Appendix 3 – Imported synthetic textiles

Appendix 4 – Export data

Appendix 5 – Rural waste

Appendix 6 - Best practice data collection for plastics

To develop a framework and data collection system that will work in Aotearoa New Zealand we should build on international best practice, such as the following examples.

Waste
During the process of developing the National Waste Data Framework, WasteMINZ reviewed international waste data practice http://www.wasteminz.org.nz/wp-content/uploads/Waste-Data-Framework-International-Practices-FINAL-2-Mar-2015.pdf
2016-17 Australian Plastics Recycling Survey data: This information is collected through a detailed survey of Australian reprocessors, Australian resin manufacturers and importers, and extensive interrogation of Australian Customs data, sourced from the Department of Foreign Affairs and Trade (DFAT). https://www.environment.gov.au/system/files/resources/c8dd95af-c028-4b6e-9b23-153aecbf8c3c/files/australian-plastics-recycling-survey-report-2016-17.pdf
Queensland Waste Data System: https://www.qld.gov.au/environment/pollution/management/waste/recovery/data-reports/qwds
Sustainability Victoria waste data portal: https://www.sustainability.vic.gov.au/Government/Victorian-Waste-data-portal/Interactive-waste-data-mapping/Kerbside-waste-data# and http://calculators.sustainability.vic.gov.au/CalculatorI.html
ACOR 10-point plan #4 re new metrics for waste: "Development of new metrics for waste, recycling and resource recovery activity – beyond tonnes diverted – to include greenhouse gas abatement, energy efficiency, toxicity avoidance, regional development contribution, economic/social capital generation" https://www.acor.org.au/uploads/2/1/5/4/21549240/acor_10_point_plan_for_results-based_recycling_.pdf
Wales municipal waste management: https://gov.wales/statistics-and-research/local-authority-municipal-waste-management/?lang=en
US EPA https://www.epa.gov/sites/production/files/2015-09/documents/06numbers.pdf and https://www.epa.gov/sites/production/files/2018-07/documents/smm_2015_tables_and_figures_07252018_fnl_508_0.pdf and https://www.epa.gov/sites/production/files/2015-12/documents/methodolgy_document_for_selected_municipal_solid_waste_products.pdf
Packaging
WRAP UK: Plastic Packaging Flow Data Report http://www.wrap.org.uk/sites/files/wrap/PlasticFlow%202025%20Plastic%20Packaging%20Flow%20Data%20Report_0.pdf
UK: National Packaging Waste Database https://npwd.environment-agency.gov.uk/Public/PackagingHome.aspx
The EU has a standard data framework for reporting fate of packaging material but has only single category for plastic https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX%3A32005D0270
Construction
Netherlands has BAMB framework https://www.bamb2020.eu/wp-content/uploads/2018/01/Framework-for-Materials-Passports-for-the-webb.pdf

Marine plastics
Work around standardisation has been underway for at least 10 years, and is a very important part of gaining international agreement on the nature and scale of the challenges. See: http://www.gesamp.org/news/how-to-monitor-plastics-in-the-oceans
EU: Assessment of measures to reduce marine litter from single use plastics http://ec.europa.eu/environment/waste/pdf/Study_sups.pdf

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