# Plastics in Complex Finished Products and Packaging

## Final Report for the Parliamentary Commissioner for the Environment

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## Report For

Parliamentary Commissioner for the Environment

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# Executive Summary

Plastics pollution is a rapidly emerging environmental issue resulting from a dramatic increase in plastics use over recent decades and the inability of waste management systems to cope with the waste products that inevitably result.

The transparency of global trade flows of plastics is impacted by classification systems used for official statistics and monitoring. This situation challenges both the understanding of volumes and types of plastics in trade, and the development of trade policy tools to reduce plastic pollution. Reducing the flow of plastic waste into the environment in New Zealand requires an understanding of the key sources of plastics waste and the vectors through which they make their way into the environment.

As components of the overall flow of plastics, complex finished products and packaging are particularly challenging to investigate due to the wide variety of ways in which plastics are utilised within them.

This study has estimated the total quantity of plastic entering New Zealand in complex finished products and in packaging. It has used a 'bottom-up' methodology and import trade data for 2022. The results should be interpreted with caution as numerous assumptions and limitations within the data underlie our calculations.

The method for complex finished products was based on import data aggregated using the Harmonised System (HS) codes into broad groups ("Product Categories") of complex finished products, then further aggregated into "Representative Products" within those groups. The mass and plastic content of Representative Products were estimated using lifecycle assessments, environmental product declarations, industry data, and available literature. Value was reported as $NZ vfd (value for duty). Expert opinion was used as a last resort. The total mass of products, total mass of plastic, plastic intensity for value (tonnes of plastic per million dollars and plastic intensity for mass (tonnes of plastic per tonne of product) were calculated.

The method for plastic packaging was based on HS codes, industry information, and the recent report by Valpak commissioned by the Plastic Packaging Product Stewardship Scheme (led by the Packaging Forum and the Food and Grocery Council). That report quantifies the total mass of packaging placed on the New Zealand market in 2022.

In our approach, we estimated the mass of plastic packaging for the following five sources;

- on imported products (e.g. finished products ready to sell in New Zealand)
- in primary forms (resins and polymers) that are converted into packaging in New Zealand (e.g. plastic bottles that are 'blown' at milk and beverage manufacturers), as well as various other products (e.g. pipes and mouldings of various kinds)
- imported as semi-manufactured products such as film and sheet, which is often made into 'thermoformed' trays for food in New Zealand, and other non-packaging products
- imported as whole packaging, e.g. crates and boxes "for the conveyance and packing of goods". These could be quite specialist products not available from New Zealand manufacturers
- from plastic recycled within New Zealand (a relatively small quantity which is assumed to be made into packaging)

The mass of packaging was also estimated on goods exported from New Zealand.

The mass of packaging on product imported into New Zealand was estimated as the difference between the total mass for the other four other sources and total packaging placed on the market (POM). POM excludes packaging on exported goods.

The total mass of plastic entering New Zealand was also estimated as:

Imported plastic in complex finished products + packaging on imported products + whole plastic packaging and related products + semi-manufactures including imported resins and sheet.

A total of 3,636 complex finished products were included in our analysis, grouped into 12 Product Categories and 86 Representative Products within those groups. Product Categories included, for example, vehicles, textiles, clothing, and machinery. Representative Products within clothing were, for example, coats and jackets, trousers, shirts and blouses, and general clothing.

The total mass of those products was 3.86 million tonnes. The total plastic content was 1.00 million tonnes and the plastic intensity for mass was 0.26 tonnes of plastic per tonne of product.

The main sources of plastic in complex finished products were vehicles (241kt [thousand tonnes] of plastic), textiles (220kt), electrical equipment (218kt) and rubber products (110kt).

The total value ($NZ vfd) of the products was 1.02 billion and the plastic intensity for value was 35.16 tonnes of plastic per million dollars.

Product categories with the highest plastic intensity for value were textiles (216 tonnes of plastic per million dollars) and rubber (130 tonnes of plastic per million dollars). Product Categories with the lowest plastic intensity for value were vehicles, machinery, and instrumentation (23, 20, and 1 tonnes of plastic per million dollars respectively).

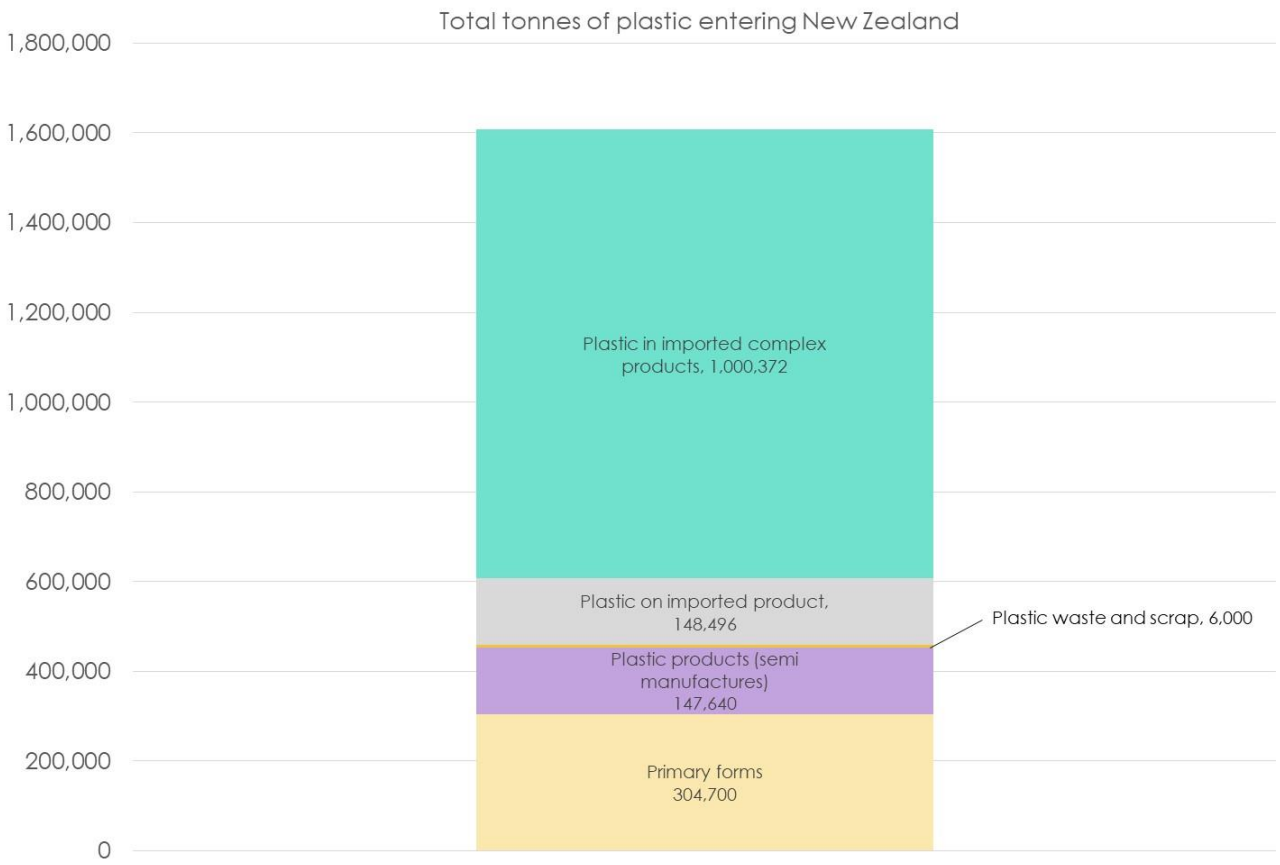
The mass of plastic packaging was estimated as;

- on imported products: 148kt
- in primary forms, film and sheet that is converted into, or used as, packaging: 137kt
- imported as whole packaging: 102kt
- from plastic recycled within New Zealand 6kt

The mass of packaging was estimated on goods exported from New Zealand as 131kt.

The total mass of packaging placed on the market: 263kt. The total mass of plastic packaging entering New Zealand = 262kt + packaging on exported product (131kt) = 394kt.

The total mass of all plastic entering New Zealand was estimated as 1,607 kt and split in the figure below into the main sources.




On a per capita basis plastics imported into New Zealand in 2022 are:

In complex finished products: 195kg per person

In packaging placed on the market: 51kg per person

In total packaging entering New Zealand: 77kg per person

In total: 314kg per person

Caution is required in interpreting these results. Numerous underlying uncertainties and assumptions have been documented in our approach and the main ones discussed in detail. A sensitivity analysis of our analysis of complex finished products is included, as are recommended error bounds for estimates of plastic packaging.

Our study suggests that the mass of plastics entering the country in total (314kg per person) is in the region of six-fold to ten-fold higher than that placed on the market. Key contributors to this difference are the vehicles, textiles, and electrical equipment that New Zealanders consume.

Current policies in New Zealand have focused on plastics with the highest level of public visibility (for example the plastic shopping bag ban, the restrictions on certain single use plastic items, the declaration of plastic packaging as a priority product, and the ratification of the Basel Convention on the export of plastic waste). If the risks from the larger, but less visible sources of plastics are to be managed it will be necessary to shift the balance of this focus and include all types of plastic in the system.

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# 1.0 Introduction

Plastics pollution is a rapidly emerging environmental issue resulting from a dramatic increase in plastics use over recent decades and the inability of waste management systems to cope with the waste products that inevitably result.

The transparency of global trade flows of plastics is impacted by classification systems used for the purposes of official statistics and monitoring. This situation presents a challenge to focussing on the volumes and types of plastics themselves in trade and a challenge to trade policy tools that could be used to support efforts to address plastic pollution. Notably, trade data provide limited information on trade flows in a vast diversity of products that contain embedded plastics or that have associated packaging, such as pre-packaged products, or cross-border flows in plastic packaging used in distribution and transportation of products. Official trade classifications and data are also only available at a granular level for a limited number of the range of single-use plastics that many governments are seeking to better regulate at the national and international level (Deere Birkbeck, 2023).

Reducing the flow of plastic waste into the environment in New Zealand in a cost-effective way requires an understanding of the key sources of plastics waste and the vectors through which they make their way into the environment.

Plastics are imported into New Zealand in various forms, for example as polymers and resins (usually in pellet form), semi-manufactured plastics (e.g. sheet materials), and in complex finished products, and related packaging. Trade statistics provide good information on the quantities of polymers and resins and semi-manufactured plastics imported each year, however information on the quantities of plastics imported in complex finished products is essentially non-existent. Similarly, there is limited information available about the amount of plastic packaging imported or created within New Zealand. A recent report by the PM CSA (Office of the Prime Minister's Chief Science Advisor, 2019) identifies this as a significant knowledge gap, stating that "the total weight and types of plastic that are imported into New Zealand in complex finished products and/or associated packaging is unknown."

The objective of this study was to produce an estimate of the total quantity of plastic entering New Zealand in complex finished products and in packaging. Complex finished products are defined as those that are constructed of multiple materials, for example plastic, copper, steel, and others. The study has been undertaken as a bottom-up exercise, product group by product group. However it also assessed multi-region input-output databases (Lenzen, 2022) as a means of undertaking a complementary top-down approach to help validate the bottom-up approach. The study does not attempt a full plastics flow analysis.

The scope of this study is the mass of plastics contained both in imported complex finished products and in packaging entering and produced in New Zealand. Plastics imported as primary resins and polymers (including semi-manufactured sheet) were out of scope, except for the percentage of them that are converted into packaging within New Zealand. This approach has allowed a direct comparison with the recent study on plastic packaging placed on the market in New Zealand conducted for the Plastic Packaging Product Stewardship group (Skidmore, 2023) which is discussed further in report.

This study is part of a programme of work from the Parliamentary Commissioner for the Environment on natural resource use and efficiency in the New Zealand economy. The main objective of that programme is to assess the environmental pressures associated with the extraction, processing, use and disposal of natural resources both today and in the future.

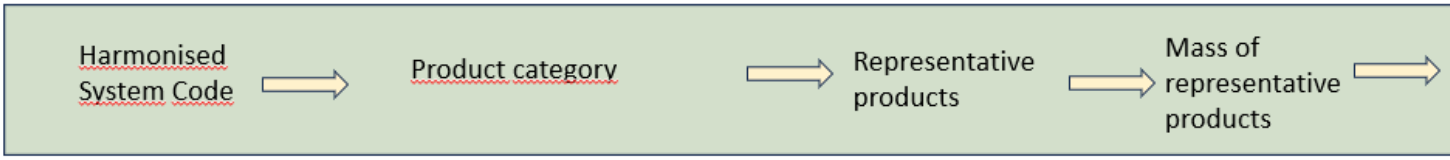
# 2.0 Methodology

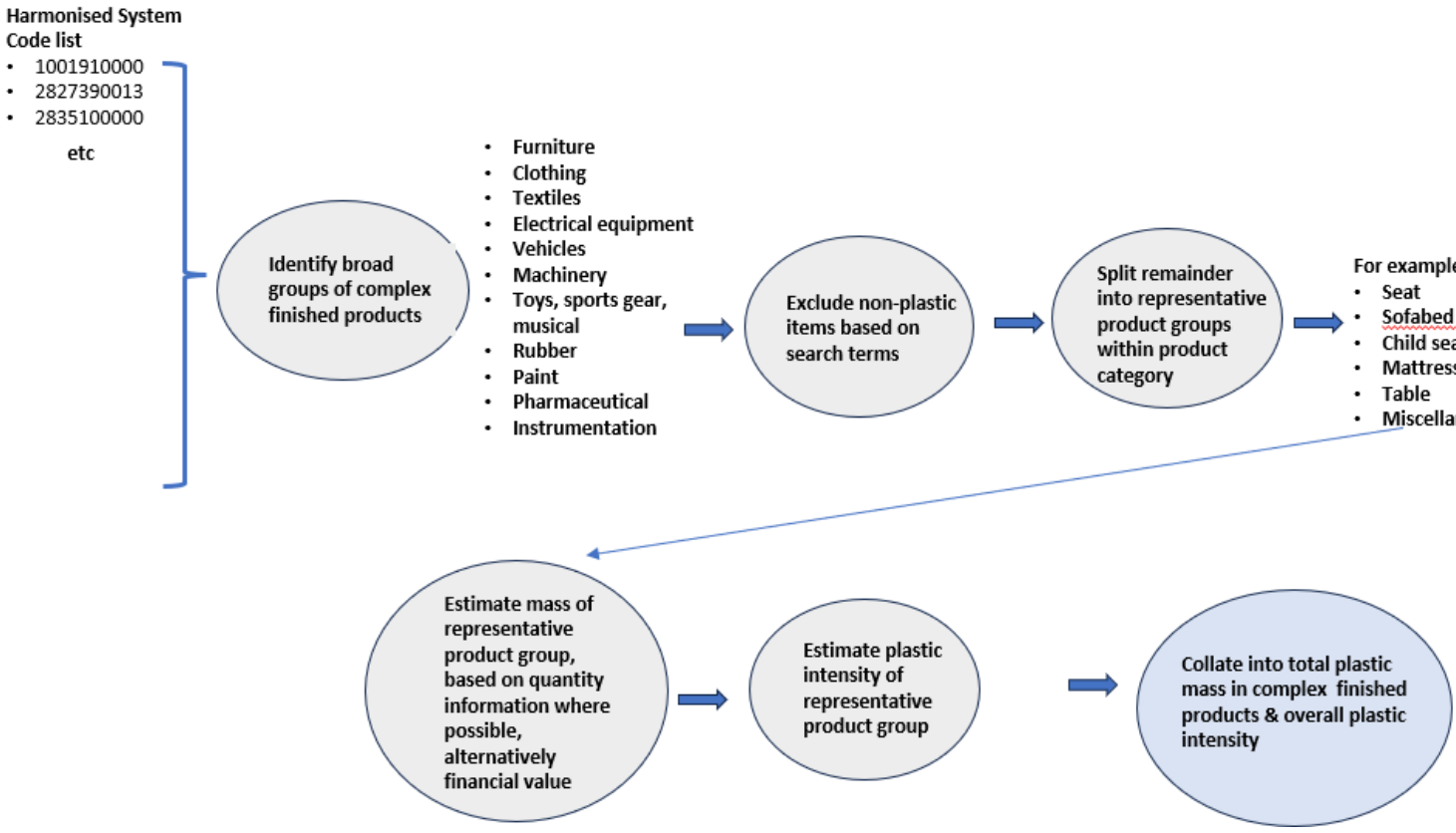
## 2.1 Overview

This study employed a bottom-up approach to assess the plastic content in imported complex finished products and packaging in New Zealand. Three separate data sources were utilised; import data, mass data, and plastics intensity data. The study also utilised consultation with key industry bodies (notably Plastics New Zealand, and Valpak in the UK via the Plastic Packaging Product Stewardship group).

The methodology for packaging differed from that for the methodology for complex finished products.

**For complex finished products the method (Figure 2-1: Overview of methodology for plastic content of complex finished products**



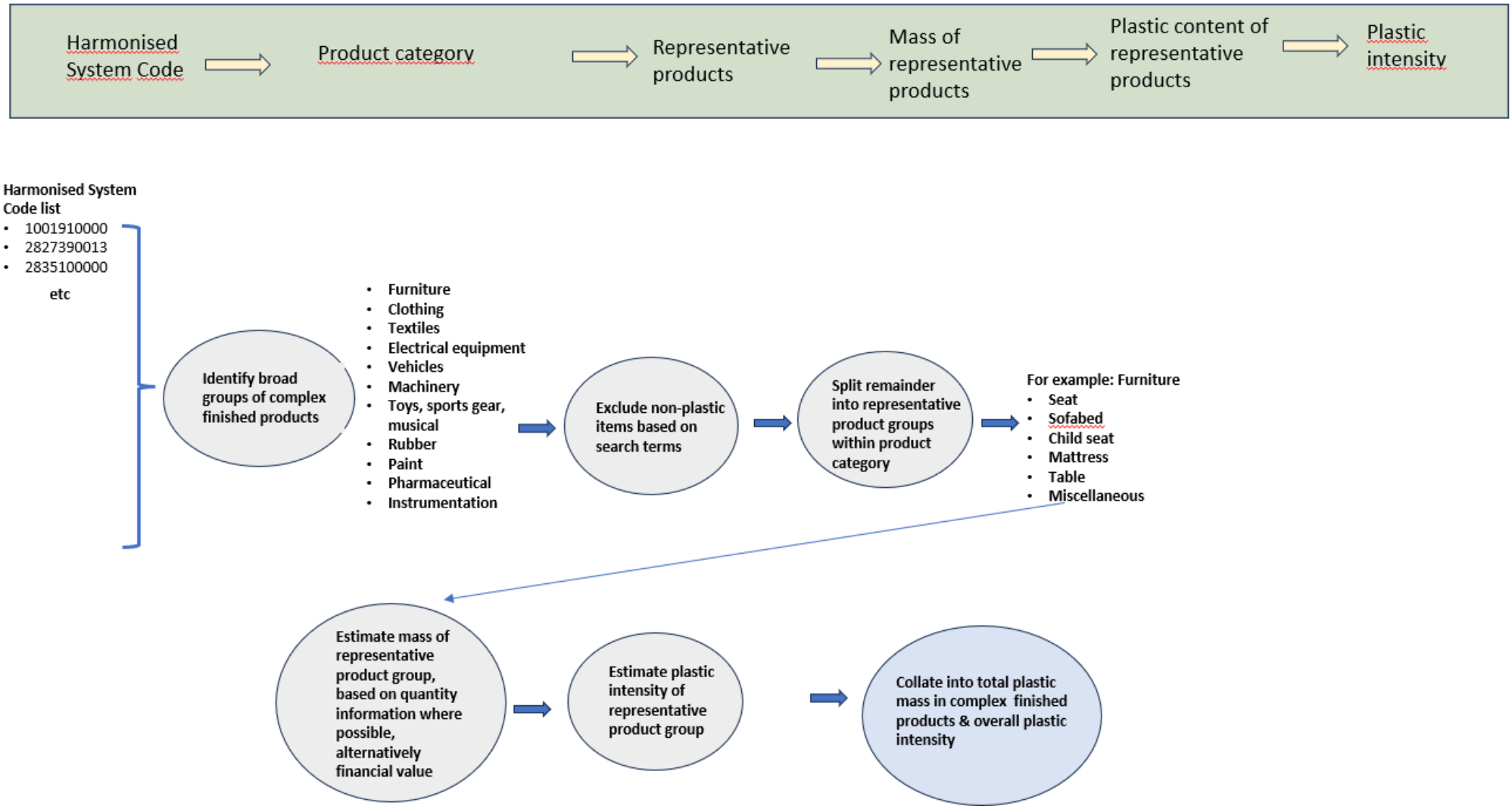




) followed a number of steps:

1. identify import items likely to include significant plastic,
2. aggregate those items into groups,
3. establish a mass for those groups,

4. establish a plastic intensity for those groups, and
5. collate the results from these groups into total plastic content.

## Figure 2-1: Overview of methodology for plastic content of complex finished products



For packaging the method was to quantified packaging from four sources:

- the conversion of primary forms of plastic (resins and polymers) into packaging in New Zealand
- packaging items identifiable from import data for semi-manufactured plastics e.g. films, crates, bottles, and caps
- packaging made of recycled plastic
- packaging on imported products

The data was initially processed in Microsoft Access before being exported to Microsoft Excel for the majority of the analysis, the modelling process itself being described in sections 2.3 and 2.4. Limitations within the data and assumptions required were numerous and are described in section 2.2. To address the uncertainty that these introduce to our results, a sensitivity analysis was conducted on key Product Categories of complex finished products, while a representative error bound is reported for the sources of packaging.

## 2.1.1 Bottom-up analysis

The main analytical approach employed in this study was a bottom-up analysis, assessing the data product category by product category. This method, using very granular and raw data, provided context-specific insights into the volume and pathways of plastic entering New Zealand. Three separate sources of data were utilised:

- import data (from Stats NZ)
- mass data (mostly estimated for representative products in a category)
- plastic intensity data (estimated for representative products in a category)

Import data from Stats NZ was utilized to estimate the total amount of plastic entering New Zealand. This dataset contained over 100,000 individual import records categorized into 11,409 unique items. We aggregated these items into broader product categories based on their likelihood of containing plastic. Much of this import data is only in terms of the value of imports, sometimes in units (number of items), and rarely in mass terms, and hence mass estimates (total mass of a product group) had to be made by working back from representative retail unit prices and unit product weights. Finally, it was necessary to then establish the 'plastic intensity' (proportion of plastic by mass in a product group), also described further below. To determine the plastic content in representative products, the study incorporated literature such as lifecycle analysis (LCA) reports, environmental product declarations (EPDs), industry sector reports, and other published studies, as well as some expert opinion.

Given the central role of the bottom-up approach in our research, we have included a complete list of all data sources to ensure transparency and reproducibility of our findings. This full list is detailed in Appendix A.1.0.

## 2.1.2 Top-down analysis

Two databases that describe the global flow of resources between countries were assessed for their potential to inform or validate our bottom-up approach. These were the Global Material Flow Database (GMFD) (Lenzen, 2022) and EXIOBASE (Stadler, 2018).

The GMFD (Lenzen, 2017) (Lenzen, 2022) is a multi-regional input-output database developed for the United Nations Environment Programme (UNEP) International Resource Panel (UNEP IRP) (Industrial Ecology Virtual Laboratory, 2023) as a resource for understanding and tracking the linkages between

economic growth and raw material usage. The model has satellite extensions that cover materials, GHG emissions, energy, and a range of other factors. Its purpose is to harness and focus disparate resources to provide comprehensive representations of interregional trade, economic structure, industrial interdependence as well as environmental and social impact.

EXIOBASE is a global, detailed Multi-Regional Environmentally Extended Supply-Use Table (MR-SUT) and Input-Output Table (MR-IOT) (Stadler, 2018). It was developed by harmonizing and detailing supply-use tables for a large number of countries and estimating emissions and resource extractions by industry. Subsequently the country supply-use tables were linked via trade. The MR-IOT can be used for the analysis of the environmental impacts associated with the final consumption of product groups.

Our assessment found that both resources had limited utility for describing the trade of complex manufactured products, such as those containing plastics. The highly granular level we were able to engage at with the import data could not be improved or related in a meaningful way to the data describing the global flows of resources.

### 2.1.3 Packaging

Packaging was analysed in a different way to complex manufactured products. This was because while there is some import data that applies to packaging that is imported complete, such as plastic crates, and semi-manufactured sheet materials and resins (usually as pellets), there is no data regarding the plastic packaging used on imported products themselves. This could include:

- primary sales packaging
- secondary collation packaging (e.g. shrink wrap)
- tertiary transit packaging, such as pallet film wrap

While the Valpak study conducted for the PPPS group (Skidmore, 2023) provides an estimate of the total plastic packaging placed on the market in New Zealand (263kt), some of this packaging is made in New Zealand from imported sheet materials (e.g. thermoformed food trays), and some from imported and New Zealand recycled pellets (e.g. bottles blown for beverages). As a consequence, the Valpak figure should in theory be an overestimate of the quantity actually on products imported into New Zealand; our primary objective. This meant that estimates had to be made of the resin and sheet materials made into packing in New Zealand, as well as those exported with product once made. The detail of this is explained further below.

## 2.2 Data limitations

The main limitations of the data source and methodology used in this analysis are outlined below along with actions or assumptions taken to address them. These limitations can be grouped into those related to estimating the quantity and mass of complex finished products, those related to estimating their plastic intensity, and those to estimating the mass of sources of packaging.

### 2.2.1 Limitations related to conversion of quantity to mass

#### 2.2.1.1 Relationship between value and quantity

Stats NZ states that:

> *"Quantities are not applicable for all HS codes. Codes with no applicable quantity have the quantity fields blank." (Stats NZ, n.d.)*

It is, however, slightly unclear whether, for the HS codes that do have a quantity reported, that quantity represents all items for which a financial value was reported.

For example, for the first HS code in the data: "0101210010: Horses; live, pure-bred breeding animals, thoroughbred, race breeding stock, stallions". The financial value of these imports is reported as $60,387 and the quantity as 4. Can it be inferred that the average cost per horse is therefore $15,097? Or, could there have been some imports for which a financial value was reported but not a quantity, which would therefore mean in fact more than 4 horses were imported, bringing the average cost per horse significantly down.

To investigate this possibility a check was made of the raw data. There were no instances where, for a single HS code, there were multiple types of quantity. Similarly, there were no instances for a single HS code where there was some data with a quantity and some without. This supports the assumption that quantity represents all items for which a financial value was reported.

We have assumed that the quantities reported do cover all of the financial value reported.

## 2.2.1.2 Quantity of an import item may not be reported

Not all import items have a reported mass. Of the 3,636 HS codes included in our analysis, 407 (11%) were denominated in mass (kg), 1,544 (42%) were denominated in number (e.g. number of tractors), and 406 (11%) were denominated in square metres. There were 931 HS codes (26%) with no quantity of any type but with a financial value. This rate of items without quantity information was similar to that measured across the entire import data set for 2022; 30.9%. Our approach to quantifying mass for HS codes where it was not present is described in section 2.3.5.

## 2.2.1.3 Meaning of financial value

Financial values were present for each imported item and denominated as "Value For Duty" (vfd) and "Cost Including Insurance and Freight" (cif). It is unclear what the relationship is between these denominations and retail price. Value for duty has been used throughout in our analysis. It was possible to conduct our modelling without the need to use secondary data on the retail price of items as a proxy.

## 2.2.1.4 Correct assignment of items to HS code by importers

The assumption was made in our analysis that importers assign the correct HS code to their imported goods. There may be instances where the goods are not recorded under the correct code. One possibility is HS code 3923902800 which relates to non-nestable plastic articles for the conveyance or packing of goods, of a size exceeding five litres. The data indicates 79.8 million units of these were imported in 2022, which seems a high number.

## 2.2.1.5 Assumption of complete plastics use

We assume that all plastics imported in 2022 were used in 2022, or that there is at least a constant flux over time and there is no significant increase or decrease in the 'stock on hand' of plastics, and no fundamental change in the characteristics of that stock. A time series analysis that applied our methodology to other earlier years of import data would show whether this assumption was valid.

## 2.2.1.6 Packaging

Significant gaps in data availability on packaging were reported in the study (Skidmore, 2023) used as the basis for our calculation of packaging contained on imported products. Critically, data collected by the producers of packaging was limited, and packaging use by other companies was commercially sensitive. In some instances, proxy data from the United Kingdom was used to help overcome these

gaps. Contact was made with Valpak in the UK to confirm their scope, and the following reply was received from author James Skidmore:

> *"The core scope of the work was to investigate consumer (supplied to household consumers) and hospitality packaging, and the associated direct supply chain packaging (specifically, that is cases of completed products into retail/retail warehousing and hospitality/hospitality wholesale - plus any consignment/pallet wrap). For these sectors we undertook a detailed analysis in collaboration with NZ retailers and wider stakeholders to understand the composition by polymer and format. However, in order to compare recycling performance with other countries we needed to consider all packaging, and therefore undertook a simpler calculation for the other sectors, such as manufacturing, construction and agriculture. For these sectors we calculated a total plastic POM number but did not investigate the composition in the same level of depth as this was not in scope."*

In addition, the relative amounts of conversion to packaging of primary forms of plastic versus semi-manufactured sheet and film was unknown. Plastics New Zealand report that packaging derived from both of these sources totalled 137,405t. We have used this figure and not attempted to split it by primary forms and semi-manufactured. Recording of these flows in a detailed, regular and standardised manner at industry level would be a significant aid to the understanding of plastics flows in New Zealand and could probably be achieved without encroaching on the commercial sensitivity of the individual companies involved.

Furthermore, items within HS codes describing articles 'for the conveyance and packing of goods' will not all be packaging, and the amounts of these non-packaging articles was not known. Our assumption was that 50% of all items for the conveyance and packing of goods were packaging. We include a wide error bound of +/- 50% around this estimate.

# 2.3 Import data analysis

## 2.3.1 Description of import data

Stats NZ publishes annual trade data on the total amount of merchandise imported into New Zealand. This study uses the 2022 import data to provide a basis for the total amount of goods imported into the country (Stats NZ, 2023).

This dataset contains 100,183 individual import records ordered into 11,409 unique categories ("HS10 codes") using the New Zealand Harmonised System Classification (NZHSC) (Stats NZ, 2024).

The Harmonized System is a standardised numerical method using 10-digit codes (HS10) for classifying traded products. It is used by customs authorities around the world to identify products when assessing duties and taxes and for gathering statistics. The HS is administrated by the World Customs Organization (WCO) and is updated every five years.

For each ten-digit HS code, the import data lists the value of goods imported into New Zealand in terms of both $NZ vfd (value for duty) and $NZ cif (cost, insurance and freight). Our analysis throughout has used $NZ vfd.

Of the 11,409 HS10 codes, 8,490 (74%) had a quantity reported. The units for quantity are shown in Table 2-1.

**Table 2-1: Abbreviations used for quantities in the dataset (Stats NZ, n.d.)**

| Unit abbrev. | Description | Unit abbrev. | Description |
|---|---|---|---|
| BDU | Bone dry units | LMS | Litres (of motor spirit) |
| CEN | Hundred | LPA | Litres (of pure alcohol) |
| DZN | Dozen | LTR | Litres |
| GRM | Grams | MIL | Thousands |
| HBX | Hundred of boxes | MTK | Square metres |
| HNK | Hank | MTQ | Cubic metres |
| KGM | Kilograms | MTR | Metres |
| KTC | Kilograms (of tobacco content) | NCL | Number of cells |
| NMB | Number | NPR | Pairs |
| NMP | Packs (number of) | NRL | Rolls (number of) |
| TNE | Tonnes | | |

## 2.3.2 Model stage 1: Identification of Product Categories

In modelling stage 1 imported products were aggregated at a high level with respect to their likely plastic content.

The 11,409 items (each HS10 code being an "item") were aggregated based on the first two digits of the HS code (HS2) to 98 groups. These groups were reviewed and allocated into the following 3 categories:

1. **Include HS2 code in further analysis**
    - Contains complex finished products that contain plastic, in the product and possibly packaging.
2. **Include HS2 code for packaging analysis only**
    - Products that contain no plastic but will probably have plastic packaging
3. **Exclude HS2 code from further analysis**
    - Products that contain no plastic and have no plastic packaging.

The result of this was 33 HS2 codes for further analysis, 17 HS2 codes for packaging analysis only, and 48 HS2 codes excluded. The excluded HS2 codes are listed in Appendix A.3.0.

The 33 HS2 codes for further analysis were grouped into 'Product Categories'. A Product Category contained generally similar types of items (Table 2-2).

## Table 2-2: Aggregation of HS2 codes into Product Categories

| Product category | HS2 codes |
|---|---|
| Medical | 30: Pharmaceutical products |
| Paints | 32: Tanning or dyeing extracts |
| Small machinery & instrumentation | 37: Photographic or cinematographic goods<br>90: Optical, photographic, cinematographic, measuring, checking, medical or surgical instruments and apparatus; parts and accessories<br>91: Clocks and watches and parts thereof<br>93: Arms and ammunition; parts and accessories thereof |
| Rubber | 40: Rubber and articles thereof |
| Textiles | 50: Silk<br>51: Wool, fine or coarse animal hair; horsehair yarn and woven fabric<br>52: Cotton<br>53: Vegetable textile fibres; paper yarn and woven fabrics of paper yarn<br>54: Man-made filaments; strip and the like of man-made textile materials<br>55: Man-made staple fibres<br>56: Wadding, felt and nonwovens, special yarns; twine, cordage, ropes and cables and articles thereof<br>57: Carpets and other textile floor coverings<br>58: Fabrics; special woven fabrics, tufted textile fabrics, lace, tapestries, trimmings, embroidery<br>59: Textile fabrics; impregnated, coated, covered or laminated; textile articles of a kind suitable for industrial use<br>60: Fabrics; knitted or crocheted<br>63: Textiles, made up articles; sets; worn clothing and worn textile articles; rags<br>67: Feathers and down, prepared; and articles made of feather or of down; artificial flowers; articles of human hair |
| Clothing | 61: Apparel and clothing accessories; knitted or crocheted<br>62: Apparel and clothing accessories; not knitted or crocheted<br>65: Headgear and parts thereof |
| Footwear | 64: Footwear; gaiters and the like; parts of such articles |
| Machinery | 84: Nuclear reactors, boilers, machinery and mechanical appliances; parts thereof<br>86: Railway, tramway locomotives, rolling-stock and parts thereof; railway or tramway track fixtures and fittings and parts thereof; mechanical (including electro-mechanical) traffic signalling equipment of all kinds |

| Product category | HS2 codes |
|---|---|
| Electrical equipment | 85: Electrical machinery and equipment and parts thereof; sound recorders and reproducers; television image and sound recorders and reproducers, parts and accessories of such articles |
| Vehicles | 87: Vehicles; other than railway or tramway rolling stock, and parts and accessories thereof<br>88: Aircraft, spacecraft, and parts thereof<br>89: Ships, boats and floating structures |
| Toys, sports, recreation & music | 92: Musical instruments; parts and accessories of such articles<br>95: Toys, games and sports requisites; parts and accessories thereof |
| Furniture | 94: Furniture; bedding, mattresses, mattress supports, cushions and similar stuffed furnishings; lamps and lighting fittings, n.e.c.; illuminated signs, illuminated name-plates and the like; prefabricated buildings |

### 2.3.3 Model stage 2: Search terms for plastic

Model stage 2 was a more detailed assessment of items within each Product Category to include only those likely to contain plastic.

Expert assessment of each Product Category was used to develop a list of search terms (Appendix A.5.0) specific to that Product Category to include items for further analysis. For example, within HS2 89; "Ships, boats and floating structures", search terms were developed to include kayaks and to exclude barges.

Having completed this process, a total of 3,636 items (HS10 codes) had been identified as complex finished products containing plastic.

### 2.3.4 Model stage 3: Identification of Representative Products within Product Categories

In model stage 3, items within a Product Category were aggregated into a number of groups that represented the variety of items within the Product Category.

For example, in the "Furniture" Product Category, items were aggregated into Representative Products such as; "Table", "Chair", "Mattress", "Child seat", and "Sofa bed". Where a small number of items did not align with any group they were allocated to 'Miscellaneous'.

## Table 2-3: Representative Products within each Product Category

| Product Category | Representative Products | Count of items (HS10 codes) within Product Category |
|---|---|---|
| Clothing | Accessories and underwear, Bathrobes and dressing gowns, Children's clothing, Coats and jackets, Dresses, General clothing, Jumpers and sweatshirts, Shirts and blouses, Shorts and skirts, Suits, Ensembles and Overalls, Swimwear, Trousers, T-shirts. | 463 |
| Electrical equipment | Large electrical equipment, Medium size electrical equipment, Small size electrical equipment, All (general) electrical equipment. | 836 |
| Footwear | Footwear | 235 |
| Furniture | Bedding, Car seat, Lighting, Lighting of plastic, Mattresses, Parts of furniture, Refrigerator, Seat (general), Seat (swivel), Sofa bed, Table, Upholstered seat, Unknown, Unknown (plastic) | 14 |
| Instrumentation | Bi/Monoculars, Projectors, Clocks, Lenses, Photographic, Small instruments, Spectacles, Watches | 261 |
| Machinery | Agricultural machinery, Air conditioning, Drilling, Dryer, Elevator / conveyor, Fan / Hood, Heat pump, Heater, Mower, Parts of machinery, Refrigerator / freezer, Miscellaneous machinery | 427 |
| Medical | Pharmaceutical, Pharmaceutical (of plastic), Textiles (within Medical Product Category) | 37 |
| Paints | Dyes / pigments, Ink, Paint, Varnish | 101 |
| Rubber | Tyres, Other rubber products | 197 |
| Textiles | Textiles described as 10% plastic, Textiles described as 50% plastic, Textiles described as 100% plastic, Textiles described as 85% or more plastic, Textiles assumed 10% plastic, Textiles assumed 35% plastic, Textiles assumed 50% plastic, Textiles assumed 70% plastic, Textiles assumed 90% plastic, Carpet, Clothing, Global Fibre Mix. | 677 |
| Toys, sports, recreation and music | Balls, Dolls, Toys, Small electrical equipment | 58 |
| Vehicles | Agricultural vehicles, Aircraft, Bicycles / carriages (non-motorised), Boats, Road vehicles, Road vehicles: Motorcycles, Trailers, Trains and buses, Parts of vehicles | 264 |

A sense check was conducted to ensure that the list of Representative Products accurately reflected the Product Category. That is, the representative items reflected the import value, mass, and tallies (for an item) within that Product Category.

## 2.3.5 Model stage 4: Quantify mass

In model stage 4 a mass for each item (HS code) included in our analysis was estimated as closely as possible.

### 2.3.5.1 Quantifying mass where quantity of items was available

Trade data on imported products includes a financial value for each HS code, but not always a quantity. In addition, the quantity may be in a denomination that has not direct relationship to mass (Table 2-1).

Of the 3,636 HS codes included in our analysis, 407 (11%) were denominated in mass (kg), 1,544 (42%) were denominated in number (e.g. number of tractors), and 406 (11%) were denominated in square metres.

There were 931HS codes (26%) with no quantity of any type but with a financial value. This was a similar rate of items without quantity information to that measured across the entire import data set for 2022; 30.9%.

A representative mass per unit for HS codes that included a quantity was obtained from relevant industry data; LCAs, EPDs and industry reports (e.g. per item, per $m^2$). If that data was not available, a proxy (similar) product for which data was available was selected instead.

### 2.3.5.2 Quantifying mass where no quantity of items was available

Where no quantity information was available for a HS code, its financial value was used to estimate the mass of units within it. In these cases, mass was estimated based on the average $NZ vfd/kg of the other items within that Product Category that did have a quantity. For example, if no quantity was available for $1,000 NZ vfd worth of agricultural ploughs and we had calculated from agricultural machinery (where quantity was available) an average mass per value of 0.5kg/$NZ vfd, then we estimated the mass of ploughs at 0.5 x 1,000 = 500kg.

## 2.3.6 Model stage 5: Quantify plastic intensity

In model stage 5 the plastic intensity of Representative Products was quantified.

Information was collated on the material composition, and more specifically the plastic content (including by type of polymer where possible), of Representative Products. The internal and external validity of the sources used were assessed to ensure the underlying methodology was robust and that the results are applicable in the context of our analysis.

Where possible, the mass content by key polymer was also calculated, although the information sources often did not provide this level of detail. Many sources of material composition aggregated all polymers into an overall figure for plastic content.

The main sources of information used are described below.

### 2.3.6.1 Life Cycle Assessment (LCAs)

LCAs are comprehensive studies that evaluate the environmental impacts of a product throughout its entire life cycle, from raw material extraction to disposal. These assessments provide detailed data on the mass and composition of materials used in products, making them valuable for understanding environmental impacts and material use. While LCAs provide comprehensive data on the environmental impacts of specific products throughout their life cycles, a significant limitation is that an LCA is usually specific to one particular product rather than being representative of a group of products. This means that the data obtained from LCAs does not fully capture the diversity and variations within a broader category of products, limiting the breadth of the findings.

We utilised LCAs in instances where broader research and data were unavailable and to supplement that data.

### 2.3.6.2 Environmental Product Declarations (EPDs)

An Environmental Product Declaration (EPD) is an independently verified and registered document that communicates transparent and comparable data and other relevant environmental information about the life-cycle environmental impact of a product. EPDs follow specific standards and are verified by third parties, ensuring the credibility and consistency of the information. However, like LCAs, EPDs provide detailed insights into the material composition and environmental performance of specific products, which may not fully represent a broader category. Similar to LCAs we utilised EPDs in instances where broader research and data were unavailable and to supplement that data.

### 2.3.6.3 Industry reports

These reports are produced by organisations within the industry and often contain aggregated data, market analyses, and trends. These reports are valuable for providing a broad overview of industry practices, including general information on material use and plastic content. One such example is the Tyrewise report on a Regulated Product Stewardship for End of Life Tyres (Tyrewise Advisory Group, 2020), which offered specific insights into weights and material composition for tyres. The main advantages of industry reports include offering a comprehensive view of industry practices and trends, providing market insights with data on production volumes and economic factors, and delivering relatively current data due to frequent updates.

The data in industry reports are often aggregated, which can obscure specific details and variations within product categories, leading to a lack of granularity in understanding the material composition of individual products. Since these reports are produced by industry organizations, there may also be a potential bias towards presenting data in a favourable light, necessitating cross-referencing with other sources to ensure objectivity. Despite these limitations, by leveraging industry reports such as the Tyrewise report for tyres, we aimed to enhance our understanding of industry practices.

### 2.3.6.4 Published literature

Published literature includes peer-reviewed journal articles, conference papers, and other scholarly works. These sources offer in-depth research findings and theoretical insights into material composition and environmental impacts. The major advantage of published literature is the rigorous review process it undergoes, which ensures the quality and reliability of the information. This thorough vetting process means that the data and conclusions presented are generally well-substantiated and credible. A limitation of published literature is that it can be highly specialized, focusing on specific aspects or niche topics, which can limit its applicability to broader or more general contexts. Conversely, some literature may cover broad topics without delving into specific product types, which can also affect its relevance. Additionally, relevant literature may not be available for every product category needed for this

research. In such cases, it was necessary to seek additional sources to obtain a more comprehensive understanding, such as using LCAs or EPDs.

### 2.3.6.5 Expert opinion

In some cases, estimates were made by product experts within the Eunomia team who had extensive knowledge of the product groups in question. This was only done as a last resort.

## 2.4 Packaging data analysis

### 2.4.1 Overview

The objective of the packaging part of our study was to estimate the mass of packaging on products imported into New Zealand. To focus specifically on this source of plastic packaging amongst the other sources of plastic packaging, it was necessary to estimate quantities for other sources too.

In brief, there are five main sources of plastic packaging entering New Zealand:

- on imported products (e.g. finished products ready to sell in New Zealand)
- in primary forms (resins and polymers) that are converted into packaging in New Zealand (e.g. plastic bottles that are 'blown' at milk and beverage manufacturers), as well as various other products (e.g. pipes and mouldings of various kinds)
- imported as semi-manufactured products such as film and sheet, which is often made into 'thermoformed' trays for food in New Zealand, and other non-packaging products
- imported as whole packaging, e.g. crates and boxes "for the conveyance and packing of goods". These could be quite specialist products not available from New Zealand manufacturers
- from plastic recycled within New Zealand (a relatively small quantity which is assumed to be made into packaging)

Packaging is also on goods exported from New Zealand, and this will have been made from resins and sheet materials, as part of the total imported.

A recent report commissioned by the Plastic Packaging Product Stewardship scheme (led by the Packaging Forum and the Food and Grocery Council) was researched and written by Valpak in the UK (Skidmore, 2023). Valpak worked with the retailers and brands in NZ, as well as using some UK proxy data for non-grocery, to get a total placed on market (POM) figure that implicitly included packaging formed (converted) in NZ, as well as that on imported products, and imported whole packaging (like crates).

"Placed on the market" refers to when a product is first made available for distribution, consumption, or use on the market as part of a commercial activity.[1]

Unfortunately for our study, the Valpak work did not break that total POM figure down by these sources.

This was, however, a detailed study and can be considered reasonably reliable, hence we use the Valpak total sum as a basis to identify plastic packaging on imported products (see 2.4.2).

We do this by estimating a quantity from each source (except on imports) and assuming that packaging on imports is the total quantity minus these other sources. We present this below as an equation where;

[1] Placing manufactured products on the market in Great Britain - GOV.UK (www.gov.uk)

VPOM = Valpak total for plastic packaging 'placed on market' in New Zealand.

TPMINZ = Total packaging made from imported sheet and resin in New Zealand

EPMINZ = Packaging on exports that are made in New Zealand from imported resin and sheet

RRINZ = Recycled resin made and used for packaging in New Zealand

TWIP = Total whole imported packaging (e.g. crates)

**POIP = Packaging on imported products**

Thus:

VPOM = TPMINZ - EPMINZ + RRINZ + TWIP + POIP

And rearranging for POIP gives:

POIP = VPOM – TPMINZ + EPMINZ – RRINZ – TWIP

The following sections outline the Valpak study, then describe our methods and assumptions used to calculate a point estimate and error bounds for the quantity of plastic packaging in the sources described above.

## 2.4.2 VPOM - The Valpak plastic packaging study

In the Valpak study, noted above, the total plastic packaging placed on the market in New Zealand in 2022 was estimated at 263kt. Over 70% came from just two sectors - grocery (107,228t (41%)) and the aggregated category of commercial and industrial manufacturing and other (81,006t (31%)).

### Table 2-4. Summary of Valpak results (Table 33 in Valpak study)

| Sector | Placed on market (t) |
|---|---|
| Grocery | 107,228 |
| Non-grocery | 33,318 |
| Construction and demolition | 7,333 |
| Agriculture | 3,544 |
| Commercial and industrial retail (back of store) | 7,582 |
| Commercial and industrial (hospitality) | 23,220 |
| Commercial and industrial (manufacturing and other) | 81,006 |
| **Total** | **263,231** |

Plastics NZ commented that they thought the study may have underestimated some areas of packaging. To see if this claim could be valid, we examined the UK data and scaled by population to the New Zealand pro-rate figure. The UK placed around 2,219kt of plastic packaging on the UK market in 2021 (WRAP, Prepared by Griff Palmer & Thomas Baker, 2023), with a population of 67million, which scales to 167kt for New Zealand with a population of 5.1million. Comparison with Australia could be more

relevant. In Australia in 2021–22, 6.98 million tonnes of packaging was placed on market (POM), of which 18.3% was plastic, i.e. 1.28m tonnes (Australian Packaging Covenant Organisation Ltd (APCO), 2024). Given a population of ~27m vs 5.1m, pro-rata on that basis for New Zealand is 242kt of plastic packaging, in line with, but still below, the Valpak estimate of 263kt.

The Valpak figure of 263kt therefore seems high if anything, not low.

### 2.4.3 TPMINZ - Packaging from primary forms of plastic converted into packaging in New Zealand

The mass of primary forms of plastic entering New Zealand was estimated as 304,700t of resin (e.g. pellets of plastic) plus at least 79kt of sheet and film materials (Parliamentary Comissioner for the Environment, 2024). Of this, Plastics New Zealand note (on its web site) that 229,000t was converted into products of various kinds, and of these products, 137,405t (60%) was packaging made from these resins, film, and sheet (Plastics NZ, 2022). Some of this would remain in New Zealand, as part of the POM figure, and some would have been exported with products.

While there is a degree of uncertainty associated with the calculation of TPMINZ, the Plastics NZ figure seems to make sense in relation to the other data, and should be more reliable than other estimates used, and so a range of 10% below and above the point estimate of 137,405t, i.e. 123,665t to 151,146t, has been used.

### 2.4.4 TWIP – Total whole imported packaging

Imported whole packaging materials such as plastic bags, nestable boxes, bottles, and caps and fasteners were contained in 18 HS codes. Assumptions regarding the mass for these codes were made (Appendix A.4.0) based on weighing data collected as part of this study.

A description of these materials is given in Table 2-5. Their total estimated mass was 204,500t. It is important to note that other items besides packaging will be contained in these HS codes. This requires some consideration of what is and isn't considered packaging. Generally, in the UK and EU for example, containers used for long-term storage of a product are not considered packaging, and items such as Tupperware boxes or tool boxes (sold as a product), will be contained in the HS codes describing plastic boxes. To account for this, the assumption was made that 50% of the mass of these HS codes related specifically to packaging. Given the wide variety of items covered, this estimate reflects the lack of certainty of the balance between packaging and non-packaging.

On that basis, the mass of whole imported plastic packaging was 102,250t. Given the high degree of uncertainty in calculating TWIP, however, a range of 50% below and above this point estimate (51,125t to 153,375t) is included.

**Table 2-5: HS codes related to imported packaging**

| Description | HS code(s) | Count of HS codes | Estimated mass (tonnes) |
|---|---|---|---|
| Plastic bags and sacks | 3923210100 - 3923292800 | 5 | 25,297 |
| Plastic boxes, cases and crates | 3923100101 - 3923102500 | 9 | 21,816 |
| Plastic bottles, carboys, and flasks | 3923300001 - 3923300019 | 3 | 12,577 |

| Description | HS code(s) | Count of HS codes | Estimated mass (tonnes) |
|---|---|---|---|
| Plastics spools, cops, bobbins and similar supports for the conveyance or packing of goods | 3923400029 | 1 | 66 |
| Plastic stoppers, lids, caps and other closures | 3923500000 | 1 | 9,345 |
| Plastic collapsible tubes for the conveyance or packing of goods | 3923900100 | 1 | 234 |
| Plastic chilly bins for the conveyance or packing of goods | 3923900500 | 1 | 9,594 |
| Plastic articles for the conveyance or packing of goods | 3923901201 - 3923902800 | 6 | 125,570 |
| **Total** | | **27** | **204,500** |

## 2.4.5 RRINZ - Packaging from plastic recycled within New Zealand

Packaging made from recycled plastic within New Zealand and used in New Zealand was estimated from confidential Eunomia data derived in New Zealand for a private client at 5,900t. This was recycled PET. Given uncertainty likely to be inherent in calculating RRINZ a range of 20% below and above (4,720t – 7,080t) the point estimate is included.

## 2.4.6 EPMINZ - Packaging on exported products

Plastic packaging on product exported from New Zealand was estimated based on the mass of New Zealand's exports in 2022 as dairy products (milk powder, butter, and cheese), sheep and beef meat, and fish. These products are known to be the largest group of exports that are almost exclusively packaged in plastic primary packaging (e.g. pots, bottles, trays and tubs). This packaging is extremely likely to be made in New Zealand using both imported resins and sheet materials, plus some film materials.

Packaging on fruit was also considered, however confidential data from one of New Zealand's largest fruit exporters indicated that plastic use on exported fruit was small, as most exported fruit (e.g. kiwi and apples) is packaged using cardboard and other fibre packaging, with only small amounts of plastic film. On this basis fruit was disregarded.

The mass of dairy products was estimated at 4.12 million tonnes based on an export value of $20.6 billion (Stats NZ, 2023) and the assumption that dairy products had an average value of $5/kg. The mass of sheep meat (Meat Industry Association, 2023)and beef (Meat Industry Association, 2023) exported in the 2022-23 agricultural production season was 378,515 tonnes and 497,511 tonnes respectively. The mass of fish exported in 2022 was 236,793 tonnes (Seafood New Zealand, 2023).

The assumption was made that the mass of packaging per kilogram of exported product was 0.025kg/kg of product, based on Eunomia data and the weighing of several plastic packaging items. On this basis, 130,820 tonnes of plastic packaging was estimated to be on product exported from New Zealand, c.f.

with 137kt for TPMINZ, i.e. a very narrow margin. Given the uncertainty in our data and assumptions, a range for EPMINZ from 104,656t to 156,984t is suggested (20% below and above our point estimate). These figures also seem on the high side given our upper and lower figures of 123,665t and 151,146t for TPMINZ.

TPMINZ exceeds EPMINZ which fits with our assumption that the latter is made primarily from the former, though the difference between the two is small (~6.5kt) given that a proportion of the export products we have used in our estimate is also placed on the New Zealand market, not just exported. The error bounds for EPMINZ and TPMINZ sum to ~80kt. Furthermore, some TWIP (~102kt) may be used on exported product. In addition, 95% of New Zealand's milk production is exported and exported dairy products make up most (~80%) of the mass of exported product. The small difference between TPMINZ and EPMINZ is reasonable given these points and the moderate precision in our analysis.

## 2.4.7 POIP - Plastic packaging on imported products

Plastic packaging on imported products can be calculated as the difference between the total amount reported as placed on the market in the Valpak study and the sum of all the sources of that packaging except on imported products after subtracting packaging on exported product (the equation in Section 2.4.1):

POIP = VPOM – TPMINZ + EPMINZ – RRINZ – TWIP

POIP = 263,231 - 137,405 + 130,820 - 5,900 - 102,250

POIP = 148,496 tonnes

To account for the substantial uncertainty in the data and assumptions, an upper error bound can be calculated as:

$POIP_{(upper\ bound)} = VPOM - TPMINZ_{(lower\ bound)} + EPMINZ_{(upper\ bound)} - RRINZ_{(lower\ bound)} - TWIP_{(lower\ bound)}$

$POIP_{(upper\ bound)} = 263,231 – 123,665 + 156,985 – 4,720 - 51,125$

$POIP_{(upper\ bound)} = 240,706$

A lower error bound can be calculated as:

$POIP_{(lower\ bound)} = VPOM - TPMINZ_{(upper\ bound)} + EPMINZ_{(lower\ bound)} - RRINZ_{(upper\ bound)} - TWIP_{(upper\ bound)}$

$POIP_{(lower\ bound)} = 263,231 – 151,146 + 104,656 – 7,080 – 153,375$

$POIP_{(lower\ bound)} = 56,286$

Thus, the final estimate for plastic packaging contained in product imported into New Zealand, rounded to the nearest thousand tonnes is 148,000 tonnes with an error bound of 56,000 tonnes to 241,000 tonnes.

# 3.0 Results

## 3.1.1 Complex finished products

The total mass of imported complex finished products included in our analysis was 3.86 million tonnes. Of that, 1.00 million tonnes was estimated to be plastic giving an overall plastic intensity by mass (tonnes of plastic per tonne of product) of 0.26.

The total value of imported complex products was 1.02 billion ($NZ vfd), giving an overall plastic intensity by value (tonnes of plastic per million dollars) of 35.16.

The table below shows the estimated plastic content by Product Category, rounded to the nearest thousand for financial value, total mass, and total plastic content.

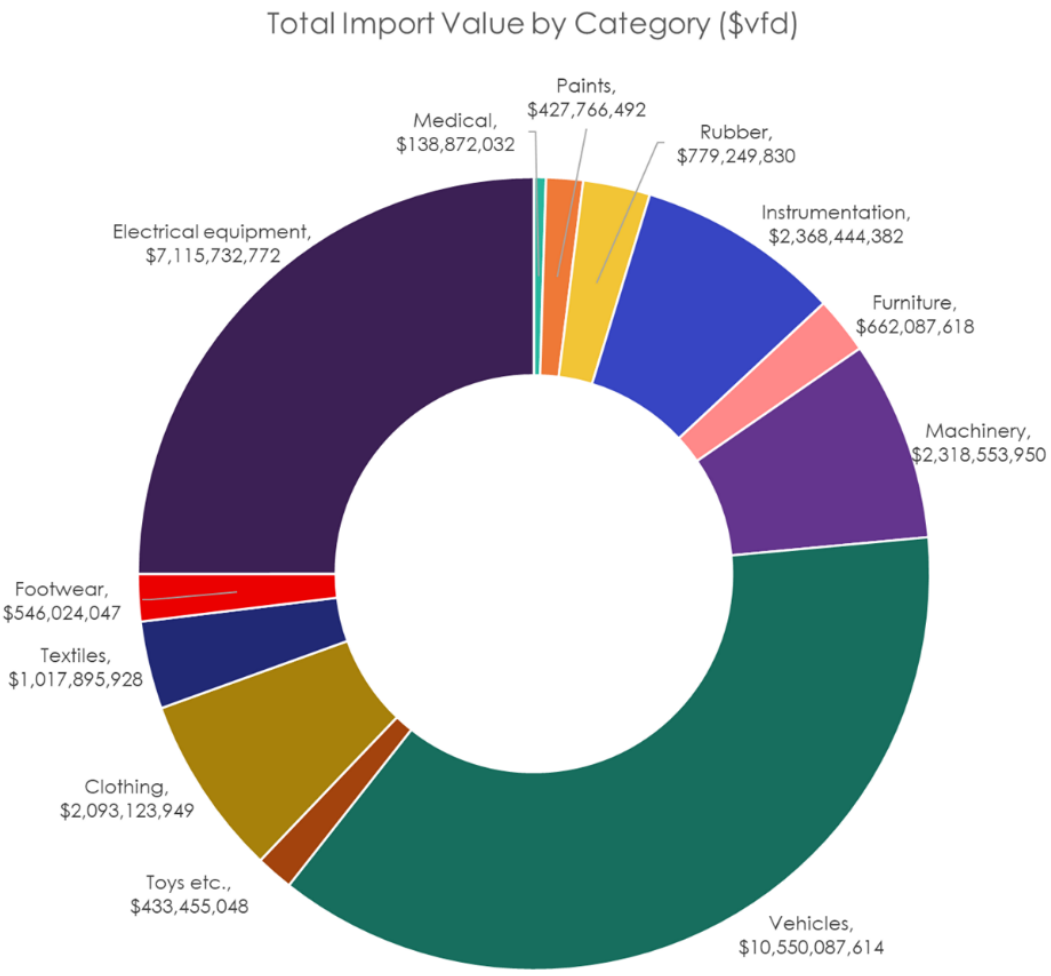
### Table 3-1 Financial Value, Total Mass and Plastic Content by Product Category

| Product category | Financial value ($vfd) | Total mass (tonnes) | Total plastic content (tonnes) | Plastic intensity (tonnes per $mil) | Plastic intensity (tonnes per tonne of product |
|---|---|---|---|---|---|
| Medical | 138,872,000 | 2,000 | 1,000 | 9.68 | 0.55 |
| Paints | 427,766, 000 | 52,000 | 19,000 | 45.34 | 0.37 |
| Rubber | 779,250,000 | 170,000 | 101,000 | 129.69 | 0.59 |
| Instrumentation | 2,368,444,000 | 35,000 | 1,000 | 0.56 | 0.04 |
| Furniture | 662,088,000 | 117,000 | 39,000 | 58.43 | 0.33 |
| Machinery | 2,318,554,000 | 591,000 | 47,000 | 20.38 | 0.08 |
| Vehicles | 10,550,088, | 1,190,000 | 241,000 | 22.83 | 0.20 |
| Toys, sports, music and recreation | 433,455,000 | 55,000 | 30,000 | 70.03 | 0.55 |
| Clothing | 2,093,124,000 | 96,000 | 60,000 | 28.85 | 0.63 |
| Textiles | 1,017,896,000 | 412,000 | 220,000 | 216.56 | 0.53 |
| Footwear | 546,024,000 | 45,000 | 21,000 | 39.05 | 0.47 |
| Electrical equipment | 7,115,733,000 | 1,091,000 | 218,000 | 30.62 | 0.20 |
| **Total: complex finished products** | **28,451,2944,** | **3,858,000** | **1,000,000** | **35.16** | **0.26** |

A breakdown of the financial value of complex finished products is shown in Figure 3-1.

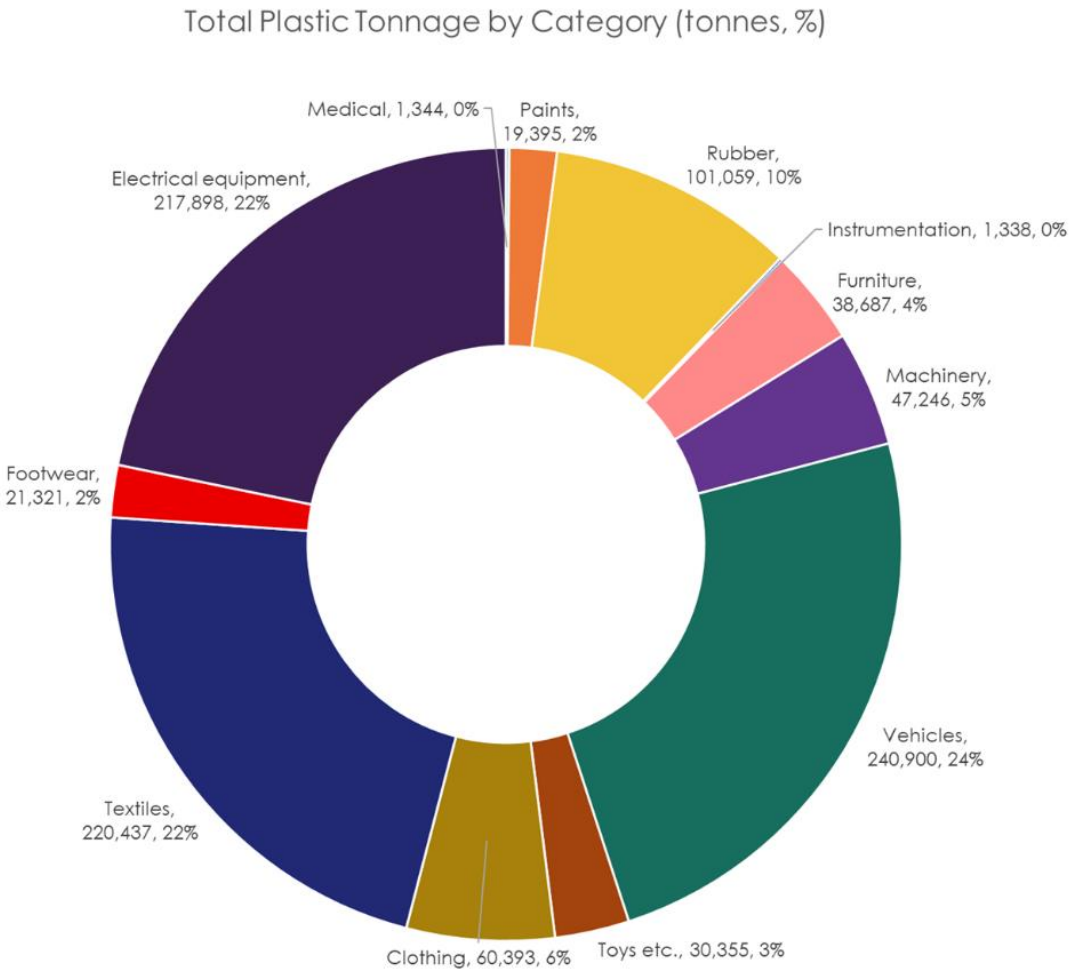
New Zealand spends markedly more on importing vehicles ($10.6 billion NZ$ vfd) and electrical equipment (7.1 billion NZ$ vfd) than on the other categories of complex products. For comparison, the spend on imported textiles (1.0 billion NZ$ vfd) and clothing (2.1 billion NZ$ vfd) is ten-fold and five-fold lower than for vehicles respectively.

## Figure 3-1: Value ($vfd) of categories of imported complex products in 2022



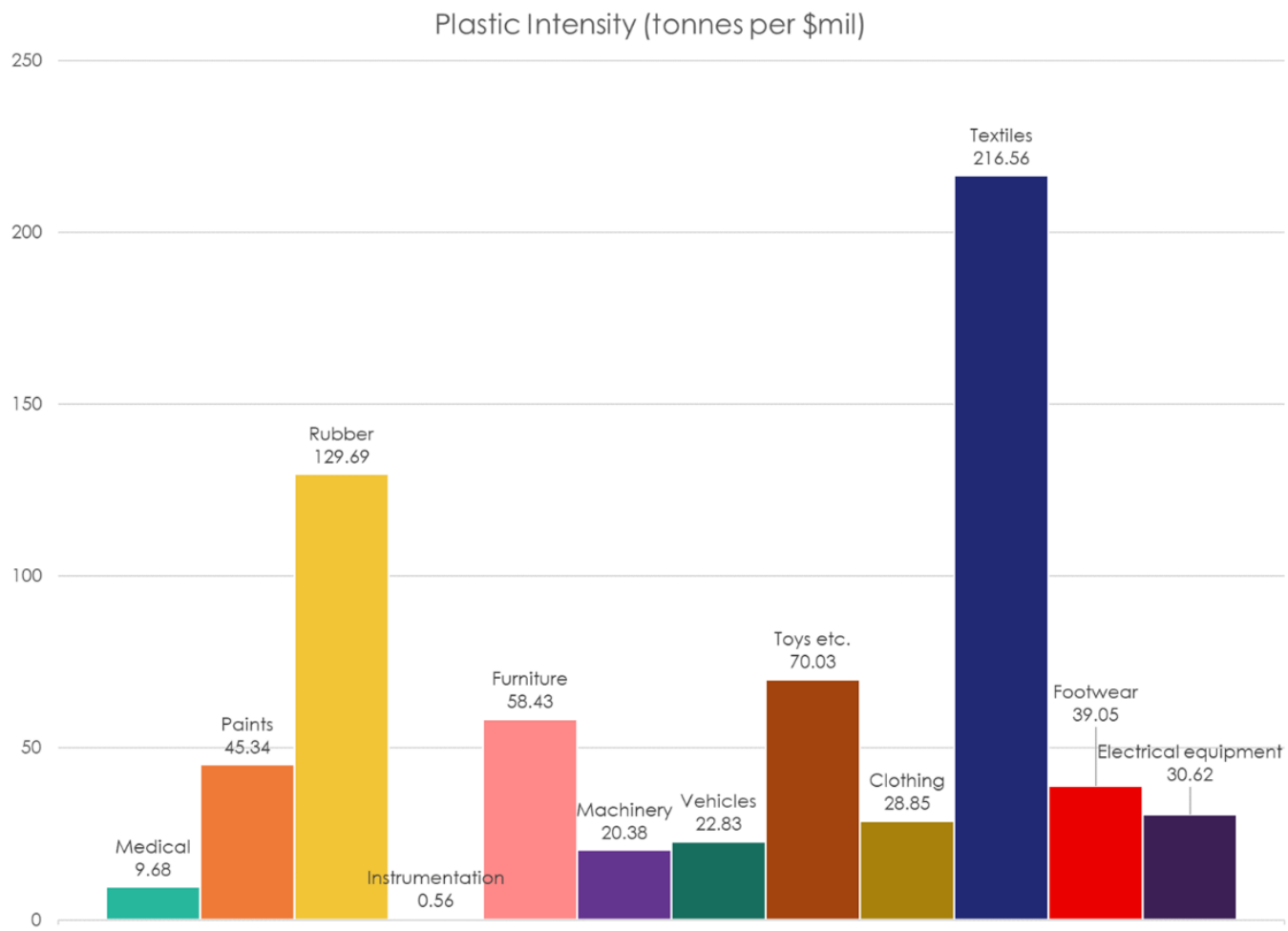

A breakdown of the total plastic content of 1.00 million tonnes into the Product Categories is shown in Figure 3-2. Plastic is primarily imported into New Zealand in complex products as vehicles (~241kt of plastic), electrical equipment (218kt of plastic), textiles (176kt of plastic) and rubber items (101kt), accounting for almost 80% of the plastic by weight in just four categories.

## Figure 3-2: Total tonnes of plastic imported into New Zealand in categories of complex products in 2022



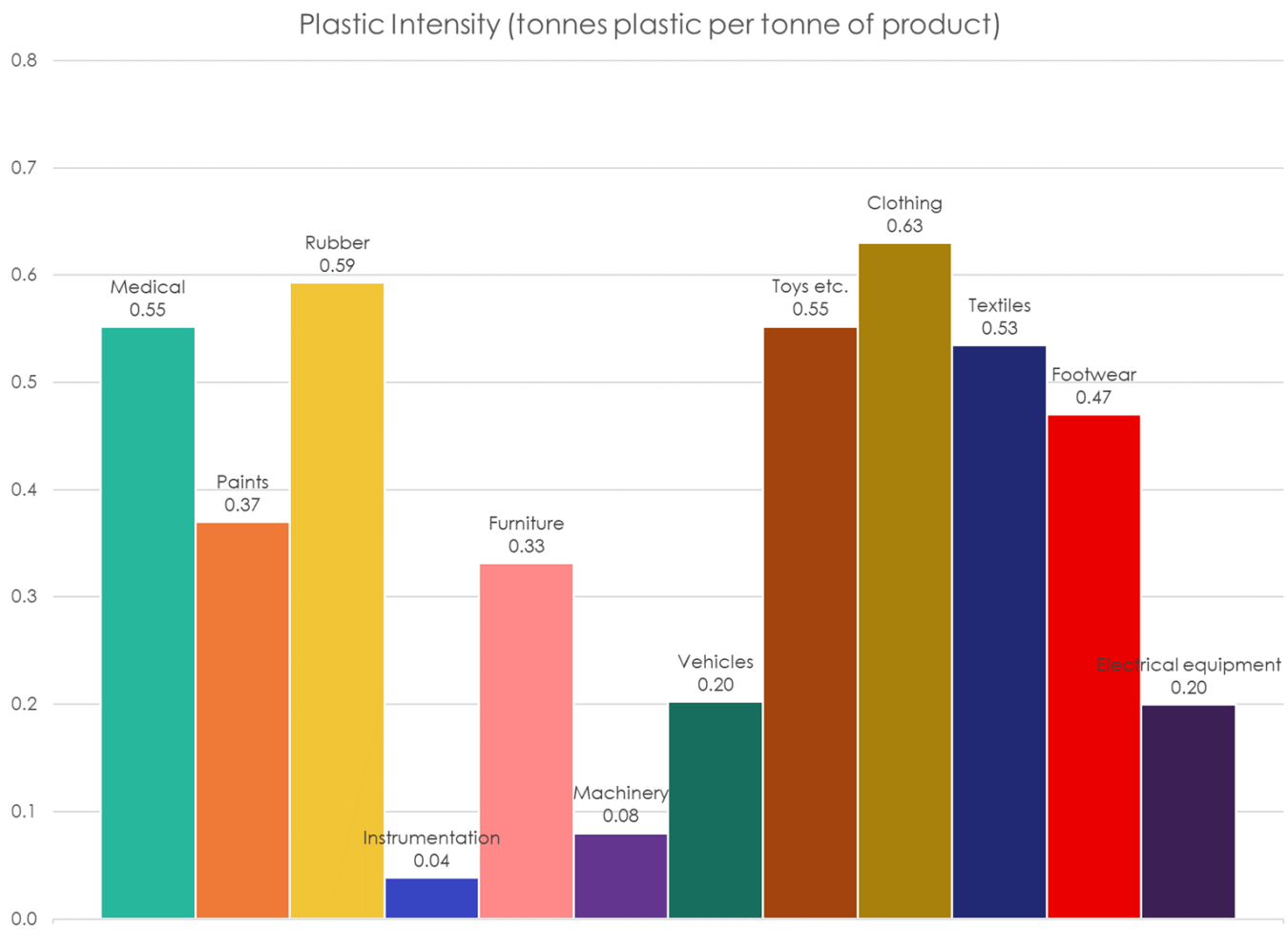

The plastic intensity relative to the value of imported product categories was highest for textiles (172t/million dollars of import value) and rubber (119t/million dollars of import value). It was comparatively low for electrical equipment (8t/million dollars of import value), vehicles (23t/million dollars of import value), and clothing (29t/million dollars of import value) (Figure 3-3).

## Figure 3-3: Plastic intensity of product categories in 2022 by value




The plastic intensity per tonne of complex finished product was highest for clothing (0.63t of plastic per tonne of product) and 22% lower for textiles (0.53t of plastic per tonne of product). This may be partly due to the difference in methodology used for these two categories, despite their similarity. The import data for textiles gives an indication of the material composition of the items, so this was used in our analysis of the plastic content. Conversely, this detailed information was not available in the import data for the clothing category, so secondary research was utilised (Figure 3-4).

**Figure 3-4: Plastic intensity of product categories in 2022 by weight**




## 3.1.2 Packaging

The estimated mass and error bounds for each of the five sources of plastic packaging is shown in Table 3-2Table. POIP was estimated based on the other four sources, so its error bounds are wider because they are the result of the cumulative errors for those four sources. Note that these figures have been rounded to the nearest thousand tonnes so as not to indicate a level of precision that is unwarranted.

**Table 3-2. Mass of plastic in sources of packaging**

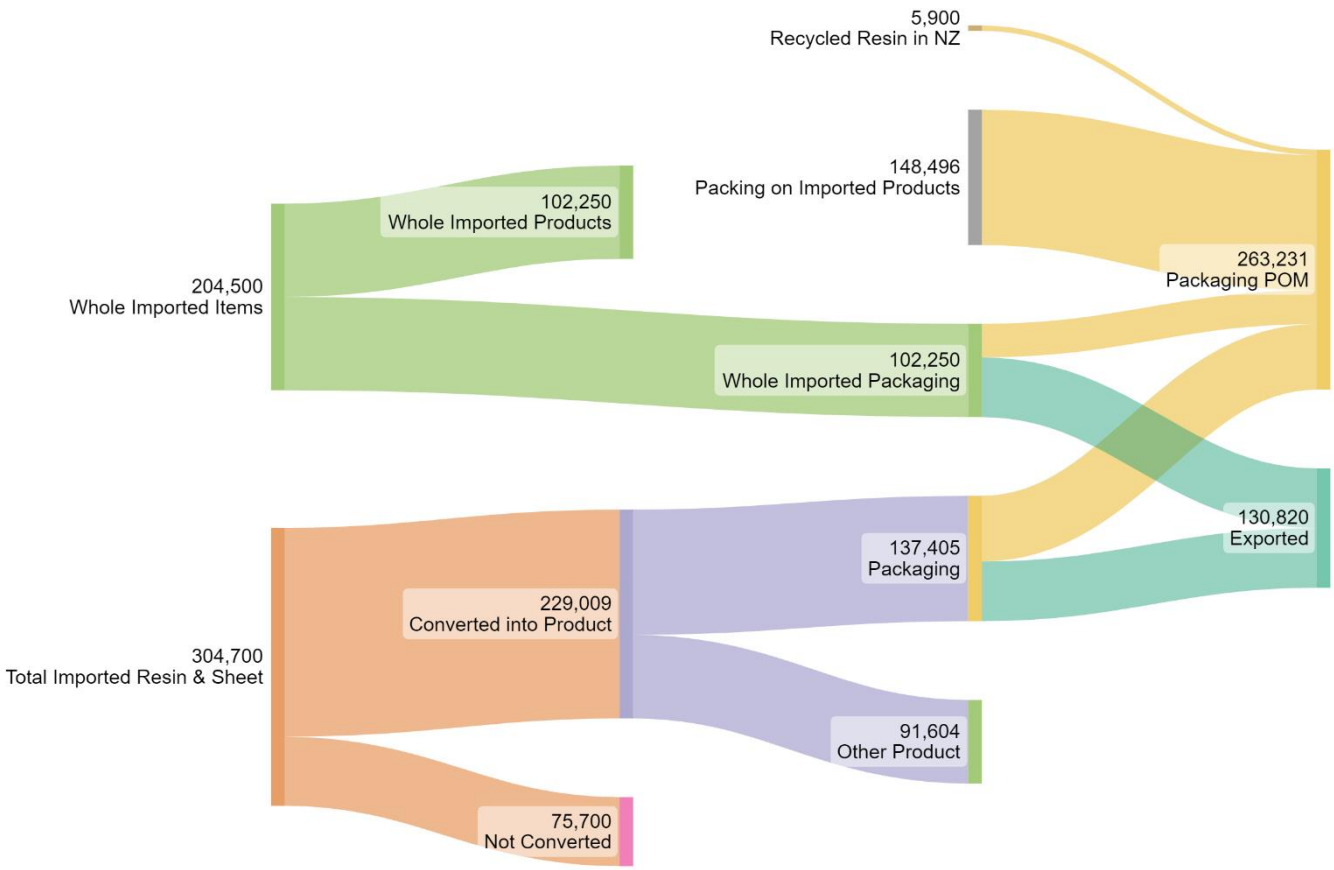
| Source of plastic packaging | Estimated Quantity (tonnes) | Estimated Range of Error (tonnes) |
|---|---|---|
| TPMINZ – Packaging made from the conversion of resins, film and sheet in New Zealand | 137,000 | 124,000 to 151,000 |

| | | |
|---|---|---|
| TWIP – Total whole imported packaging into New Zealand | 102,000 | 51,000 to 153,000 |
| RRINZ – Plastic recycled into packaging in New Zealand | 6,000 | 5,000 to 7,000 |
| EPMINZ – Packaging on products exported from New Zealand | 130,000 | 105,000 to 157,000 |
| POIP – Plastic packaging on products imported into New Zealand | 148,000 | 56,000 to 241,000 |

The total mass of these sources, excluding exports from the total, gives the value placed on the New Zealand market, 263,000t, the original estimate from the recent Valpak study (Skidmore, 2023). The total mass of packaging entering New Zealand in all its forms, including packaging subsequently exported, equals 394,000t.

A flow diagram of plastic packaging is shown in Figure .

## Figure 3-5. Flow diagram of plastic packaging



## 3.1.3 Summary of plastics entering New Zealand

The total amount of plastic entering New Zealand in 2022 can be estimated, based on the results of this analysis (Section 2.4, plus 3.1.1 and 3.1.2) and recent related research (Parliamentary Comissioner for the Environment, 2024). It is made up of (rounded to the nearest thousand tonnes):

- imported plastic in complex finished products (Table 3-1)
- packaging on imported products (POIP)
- imported as primary forms (resins and polymers), including that converted into packaging (TPMINZ) (Parliamentary Comissioner for the Environment, 2024)
- imported as manufactured products (for example whole packaging (TWIP), pipes, tubes, film and sheet) (Parliamentary Comissioner for the Environment, 2024)
- imported plastic waste and scrap (Parliamentary Comissioner for the Environment, 2024)

1,000,000 + 148,000 + 305,000 + 148,000 + 6 = 1,602,000 tonnes. This is illustrated in the figure below:

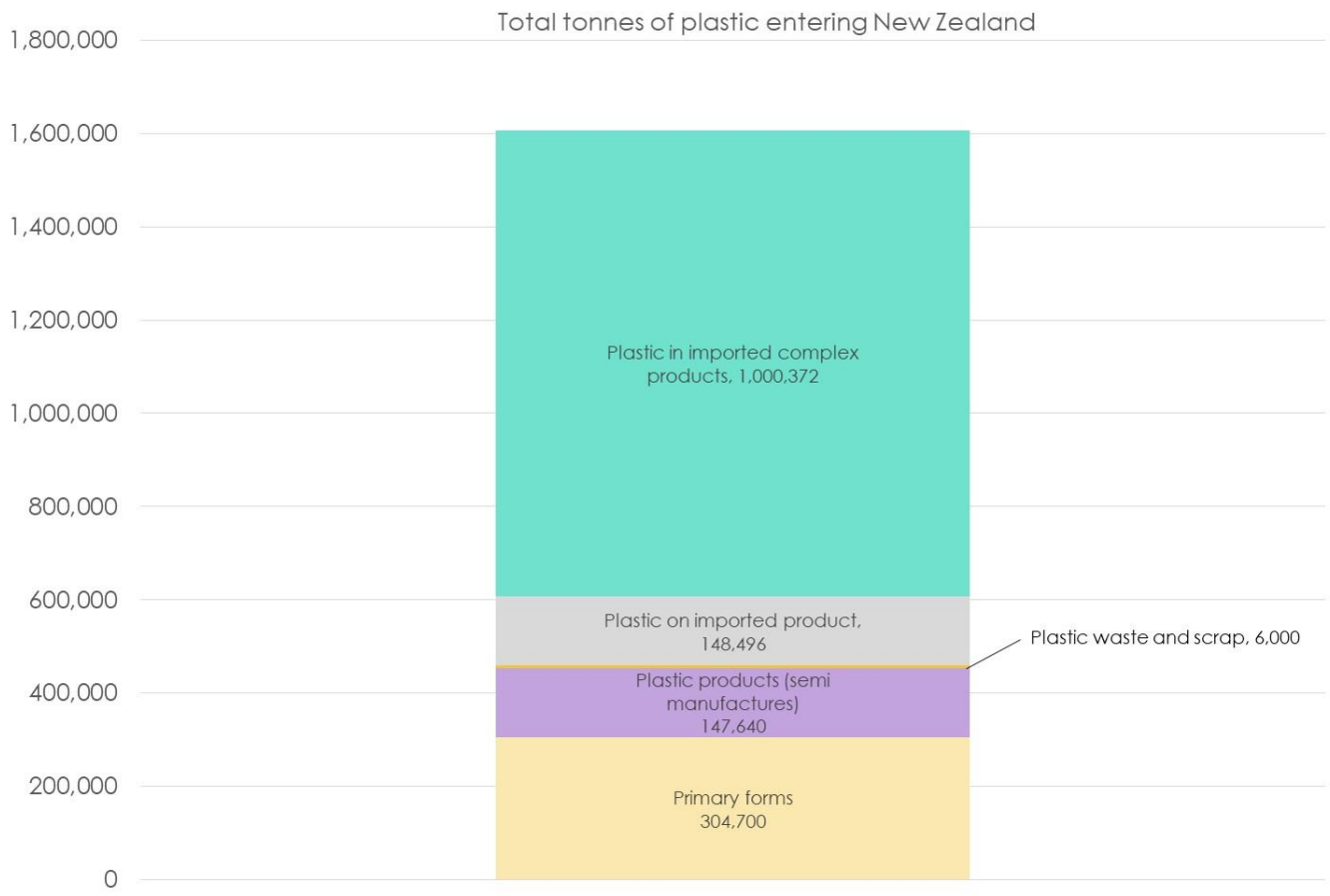
Caution is required in interpreting all estimates due to the numerous underlying uncertainties and assumptions.

The relative contribution of complex finished products and packaging relative to the other main sources of plastic entering New Zealand is shown in Figure 3-5.

Plastics contained in complex products represent 65% of the total mass of plastics entering the country.

Plastics not readily identifiable within trade statistics, i.e. not recorded in HS codes, which is plastics in complex products and on imported products, represent 71% of the total mass of plastic entering the country.

**Figure 3-5. Summary of all sources of plastic in New Zealand in 2022**




On a per capita basis key figures would be:

- for plastic imported as complex finished products: 195kg per person
- for plastic in packaging entering New Zealand or made in New Zealand from primary forms, sheet and film (including that subsequently exported): 77kg per person
- for total plastic entering New Zealand: 314kg per person

Again, caution is required in interpreting our estimates due to the numerous underlying uncertainties and assumptions.

# 3.1.4 Sensitivity analysis

Aggregating HS codes into a group that is then represented by a single representative product requires two key assumptions. The first is that the plastic content of that representative product closely reflects the plastic content of the items in the group. The second is that the mass of that representative product represents the mass of the items in the group. Both assumptions introduce uncertainty into our calculations. In this sensitivity analysis we illustrate that the variation to the total plastic content results never reaches 1% when any single metric is varied by ± 10%. Varying the assumption of the weight of a road vehicle has the greatest effect, causing a ± 0.62% variation to the overall results.

A sensitivity analysis has been performed to assess the impact of certain metrics, which were chosen due to the overall contribution of these product categories to the total results, and the potential uncertainty

in the data used. Each metric was varied individually, by ± 10% of the original value, and the impact on the overall plastic content of both the product category and total results was recorded.

### Table 3-2: Results of sensitivity analysis with metric variation of ± 10%

| Product Category and metric | Original value | Variation of product category plastic content | Variation of total plastic content |
|---|---|---|---|
| **Vehicles:** Mass of road vehicles | 1,300 kg | ± 2.58% | ± 0.62% |
| **Textiles:** Plastic content of "85% or more plastic" items | 90% | ± 0.29% | ± 0.06 |
| **Textiles:** Plastic content of global fibre mix | 63% | ± 0.02% | ± 0.005% |
| **Electrical equipment:** Plastic content of "All EEE" items | 15.21% | ± 1.58% | ± 0.345% |
| **Electrical equipment:** Mass of "Small EEE" items | 1.66 kg | ± 4.57% | ± 0.995% |
| **Electrical equipment:** Mass of "Medium EEE" items | 15.38 kg | ± 3.75% | ± 0.817% |
| **Electrical equipment:** Mass of "Large EEE" items | 48.64 kg | ± 0.09% | ± 0.021% |

# 4.0 Discussion

This study has quantified the plastics imported into New Zealand as complex finished products and packaging. It draws on multiple, disparate data sources and a wide range of supporting information. While every effort has been made to utilise robust data and information, a range of assumptions and generalisations have also been necessary. These have been described throughout the methodology and appendices to assist in the interpretation of our results.

## 4.1.1.1 Comparing our results with other studies

Plastic packaging placed on the market (POM) in the consumer/retail sector (including grocery and non-grocery packaging) and the non-consumer sector (specifically retail back-of-store and hospitality) in New Zealand in 2022 was estimated in the Valpak study (Skidmore, 2023) at 32kg per person. In that same study, plastic placed on the market in all sectors, including agriculture, construction, commercial, and industrial was estimated at 51kg per person. They reported comparative figures for five other countries ranging mostly from 30kg to 40kg per person but 60kg per person in Canada. In Australia plastic packaging placed on the market was reported as 49kg per person (18.3% of the 6.98 million tonnes +/- 11%) (Australian Packaging Covenant Organisation Ltd (APCO), 2024). In Sweden in 2019 plastic packaging placed on the market was estimated at 21kg per person (Swedish Environmental Protection Agency, 2022). Uncertainty inherent in the underlying data and calculations for these estimates would suggest that these results are all broadly similar.

Our study suggests that the mass of plastics entering the country in total (314kg per person) is in the region of six-fold to ten-fold higher than that placed on the market (32kg per person). Key contributors to this difference are the vehicles, textiles, and electrical equipment that New Zealanders consume.

## 4.1.1.2 Comparing trade data with industry data

The mass of imported primary forms of plastic identifiable by using HS codes in trade data (304kt) (Parliamentary Comissioner for the Environment, 2024) exceeds the amount converted into products (229kt) (Plastics NZ, 2022) by a third (33%). This may mean that more primary materials are converted into products than Plastics New Zealand are aware of and/or that some of the primary materials are also exported back out of New Zealand. As noted in Section 2.2.1.6, recording the flows of plastic in a detailed, regular and standardised manner at industry level would be a significant aid to the understanding of plastics flows in New Zealand. It could potentially be achieved without encroaching on the commercial sensitivity of the individual companies involved and would be a significant step toward the rethinking of plastics that we need (Office of the Prime Minister's Chief Science Advisor, 2019).

## 4.1.1.3 Plastics data - quality and access

In researching assumptions about the characteristics of packaging for this study, there was limited success in obtaining information from individual companies and more success in working with industry bodies. Yet our study revealed differences between industry reporting and trade data, which were beyond the scope of this report to investigate. Our experience aligns with the Valpak report which noted significant gaps in data availability in several key areas (Skidmore, 2023). We support Valpak's suggestion that this could be overcome by the introduction of a system which obligates producers to collect and report tonnages of packaging.

## 4.1.1.4 Product stewardship opportunities

Current policies in New Zealand have focused on plastics that have the highest level of public visibility (for example the plastic shopping bag ban, the restrictions on certain single use plastic items, the declaration of plastic packaging as a priority product, and the ratification of the Basel Convention on

the export of plastic waste). If the risks from the larger, but less visible sources of plastics are to be managed it will be necessary to shift the balance of this focus.

New Zealand's Plastic Packaging Product Stewardship Scheme (Plastic Packaging Product Stewardship Scheme, n.d.) aims to create a local and circular economy where plastic packaging is more sustainably collected and recycled by investing in better infrastructure and advanced recycling technologies. While this scheme would be addressing an important source of plastics waste, the results of this study suggest its scope would be, at most, 263kt of plastic (that placed on the market) which is just 16% of the amount (1,607kt) entering New Zealand. In addition, this study suggests a scheme focussed on vehicles and textiles (combined plastic mass of 461kt) could address about twice the mass of plastic. Importantly, the vastly greater mass of plastic per unit in a car or carpet, for example, compared to packaging on consumer goods would suggest that a scheme focussed on cars and textiles could be simpler and require less action by fewer people than one focussed on packaging. For vehicles, at least, recycling is a challenge. While the automotive manufacturing industry is among the largest consumers of primary raw materials such as steel, aluminium, copper, and plastics, little use is made of recycled materials. Although the recycling rates of materials from ELVs are generally high, the scrap metals produced are of low quality and only small amounts of plastic are recycled (European Commission, Energy, Climate change, Environment, n.d.).

This interpretation ignores the education and action of consumers in better use and recycling of packaging which is also an important objective. It also ignores the possibility that impacts on the environment of plastics from consumer packaging may be markedly higher than from the plastics in cars and textiles, making a focus on packaging the better approach.

A similar observation was made in the recent study of the plastic intensity of industries in the United States (White, 2023). That is, policies focused on consumer facing plastics such as plastic bags do not address key plastic pollution pathways, and help policymakers and consumers make decisions that improve environmental outcomes.

Because New Zealand is a small market we have limited ability to influence the upstream manufacturing of products such as vehicles and textiles directly. However, there are a number of potential policy tools and approaches that could be utilised to better manage plastics in our economy. These include:

- Aligning policy settings and actions with international best practice in other jurisdictions (for example the EU). This would mean that importers would have to comply with established international standards, rather than a bespoke New Zealand standard. This would ensure that New Zealand could still access product.

- Establishing a product stewardship scheme for End-of-Life Vehicles

- Establishing a product stewardship scheme for Clothing and Textiles

- Continuing to participate in and advocate for high ambition positions in international treaties (for example the UN Environment Assembly resolution to develop an international legally binding instrument on plastic pollution, including in the marine environment, where NZ is part of the High Ambition Coalition to End Plastic Pollution).

- Utilising the work undertaken in the study to continue to refine and track the flow of plastics in the economy and identify potential areas for intervention

- Developing a comprehensive approach to Eco-labelling that is aligned with international best practices and works to progressively improve the quality and management of goods imported into NZ.

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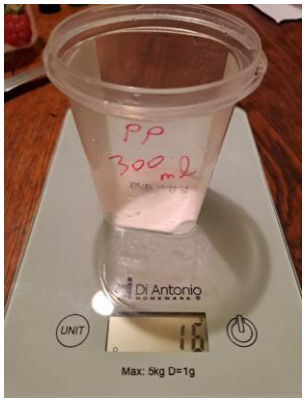
# A.3.0 HS Codes excluded from analysis

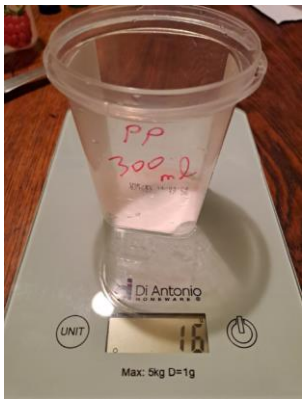
The following HS2 codes were excluded from our analysis having been identified as being unlikely to contain plastic either within the manufactured product, or in any packaging during import.

- 01: Animals; live
- 05: Animal originated products; not elsewhere specified or included
- 06: Trees and other plants, live; bulbs, roots and the like; cut flowers and ornamental foliage
- 13: Lac; gums, resins and other vegetable saps and extracts
- 14: Vegetable plaiting materials; vegetable products not elsewhere specified or included
- 15: Animal or vegetable fats and oils and their cleavage products; prepared animal fats; animal or vegetable waxes
- 23: Food industries, residues and wastes thereof; prepared animal fodder
- 25: Salt; sulphur; earths, stone; plastering materials, lime and cement
- 26: Ores, slag and ash
- 27: Mineral fuels, mineral oils and products of their distillation; bituminous substances; mineral waxes
- 28: Inorganic chemicals; organic and inorganic compounds of precious metals; of rare earth metals, of radio-active elements and of isotopes
- 29: Organic chemicals
- 31: Fertilizers
- 33: Essential oils and resinoids; perfumery, cosmetic or toilet preparations
- 34: Soap, organic surface-active agents; washing, lubricating, polishing or scouring preparations; artificial or prepared waxes, candles and similar articles, modelling pastes, dental waxes and dental preparations with a basis of plaster
- 35: Albuminoidal substances; modified starches; glues; enzymes
- 36: Explosives; pyrotechnic products; matches; pyrophoric alloys; certain combustible preparations
- 38: Chemical products n.e.c.
- 39: Plastics and articles thereof
- 41: Raw hides and skins (other than furskins) and leather
- 42: Articles of leather; saddlery and harness; travel goods, handbags and similar containers; articles of animal gut (other than silk-worm gut)
- 43: Furskins and artificial fur; manufactures thereof

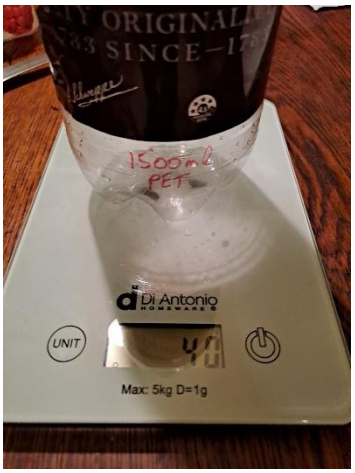
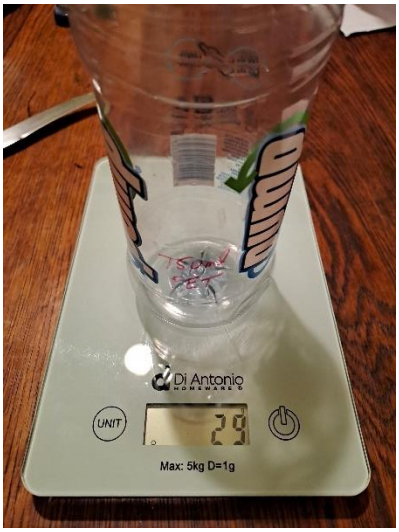
- 44: Wood and articles of wood; wood charcoal
- 45: Cork and articles of cork
- 46: Manufactures of straw, esparto or other plaiting materials; basketware and wickerwork
- 47: Pulp of wood or other fibrous cellulosic material; recovered (waste and scrap) paper or paperboard
- 48: Paper and paperboard; articles of paper pulp, of paper or paperboard
- 49: Printed books, newspapers, pictures and other products of the printing industry; manuscripts, typescripts and plans
- 66: Umbrellas, sun umbrellas, walking-sticks, seat sticks, whips, riding crops; and parts thereof
- 68: Stone, plaster, cement, asbestos, mica or similar materials; articles thereof
- 69: Ceramic products
- 70: Glass and glassware
- 71: Natural, cultured pearls; precious, semi-precious stones; precious metals, metals clad with precious metal, and articles thereof; imitation jewellery; coin
- 72: Iron and steel
- 73: Iron or steel articles
- 74: Copper and articles thereof
- 75: Nickel and articles thereof
- 76: Aluminium and articles thereof
- 78: Lead and articles thereof
- 79: Zinc and articles thereof
- 80: Tin; articles thereof
- 81: Metals; n.e.c., cermets and articles thereof
- 82: Tools, implements, cutlery, spoons and forks, of base metal; parts thereof, of base metal
- 83: Metal; miscellaneous products of base metal
- 96: Miscellaneous manufactured articles
- 97: Works of art; collectors' pieces and antiques
- 98: New Zealand miscellaneous provisions

# A.4.0 Plastic packaging estimates

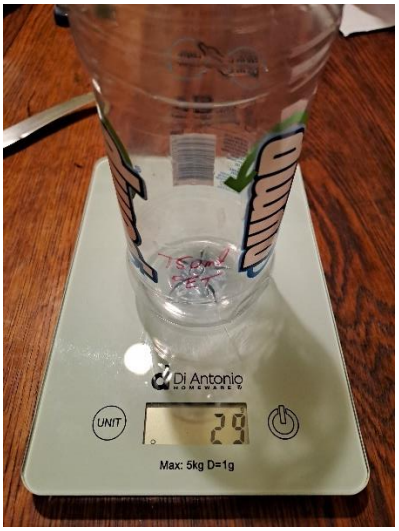
| Packaging definition | Estimate of weight per unit (kg) | Reference examples |
|---|---|---|
| Plastics; boxes, cases, crates and similar articles for the conveyance or packing of goods, of a capacity not exceeding 250ml, nestable | 0.015 | 300mL PP 16g<br>  <br><br>200mL HDPE 23g<br>  <br> |
| Plastics; boxes, cases, crates and similar articles for the conveyance or packing of goods, of a capacity exceeding 250ml but not exceeding 5 litres | 0.025 | 300mL PP 16g |

| Packaging definition | Estimate of weight per unit (kg) | Reference examples |
|---|---|---|
| | |  <br>250mL 17g<br>  <br>200mL HDPE 23g |
| Plastics; boxes, cases, crates and similar articles for the conveyance or packing of goods, of a capacity exceeding 5 litres, nestable | 1 | 12 litre, 311g<br>  <br>9 litre, 220g |

| Packaging definition | Estimate of weight per unit (kg) | Reference examples |
|---|---|---|
| | |  <br>40 litre, 1.43kg<br>  |
| Plastics; carboys, bottles, flasks and similar articles, for the conveyance or packing of goods, of a capacity not exceeding 250ml | 0.020 | 300mL, PET, 20g<br>  |
| Plastics; carboys, bottles, flasks and similar articles, for the conveyance or packing of goods, of a | 0.035 | 1500mL, PET, 40g |

| Packaging definition | Estimate of weight per unit (kg) | Reference examples |
|---|---|---|
| capacity exceeding 250ml but not exceeding 5 litres | |  <br>750mL, PET, 29g<br>  |
| Plastics; stoppers, lids, caps and other closures, for the conveyance or packing of goods | 0.004 | Soft drink lid, 2g<br>  |

| Packaging definition | Estimate of weight per unit (kg) | Reference examples |
|---|---|---|
| | | Personal water bottle lid, 6g<br>  |
| Plastics; collapsible tubes, for the conveyance or packing of goods | 0.020 | 20mL collapsible tubes, 20g each<br>  |
| Plastics; chilly bins, for the conveyance or packing of goods | 0.5 |  <br>20 litre, polystyrene chilly bin |

| | | |
|---|---|---|
| Plastics; carboys, bottles, flasks and similar articles, for the conveyance or packing of goods, of a capacity not exceeding 250ml | 0.020 |  |
| Plastics; carboys, bottles, flasks and similar articles, for the conveyance or packing of goods, of a capacity exceeding 250ml but not exceeding 5 litres | 0.035 |  <br>  |
| Plastics; carboys, bottles, flasks and similar articles, for the conveyance or packing of goods, of a capacity exceeding 5 litres | 0.5 | 10 litre bottle: |

| | | |
|---|---|---|
| | |  |

# A.5.0 Search terms

The following list is search terms used to identify which HS codes to include in scope.

## Machinery, excluded from scope:

*Of base metal, of iron, of steel, leather, Engines, Boilers, Turbines, Turbo-jets, Turbo-propellers, Generators, Pumps, Liquid elevators, Compressors, Safety cabinets, Furnaces, Ovens, Refrigerating (note different to refrigerators), Filtering, Fire extinguishers, Winches, Cranes, Weighing, Mechanical appliances, Jacks, Loaders, Graders, Rollers, Platforms, Bulldozers, Levellers, Shovels, Tunnelling, Boring, Presses, Crushers, Printing, Weaving, Earth, Minerals, Ores, Soil, Industrial, Robots, Mechanical appliances, Moulding, Extrusion, Binding, Cutting, Dairy, Milking, Injection, Machine tools, Lathes, Casting, Moulds, Valves, Bearings, Gears, Pulleys, Clutches, Additive manufacturing, Buildings, Rail, Railway, Transmission, Ships, Machines and mechanical appliances, machines and apparatus of, metal-rolling, parts.*

## Machinery, included in scope:

*Hoods, Fans, Stoppers, Air conditioning, Refrigerators / Freezers, Heat pumps, Elevators and conveyors, Mowers.*

## Furniture, excluded from scope:

*Wooden, Of wood, "; Metal", Of Metal, Of bamboo, Of rattan, Of wicker, Of cane.*

Also after filtering for "lighting"

*Of base metal, Of glass, Other than, Of ceramics*

## Furniture, included in scope:

*Upholstered, Bedding, Lighting – of plastic, mattress, unknown (plastic), refrigerator, sofa bed, car seat, "; plastic".*

## Instrumentation, excluded from scope:

*Other than plastic, Lenses, Spectacles, of glass (replacement lenses), Fibre optics, Movements, Mathematical, Microscopes, Surveying, Drafting / drawing, X-ray, Thermometer.*

## Instrumentation, included in scope:

*Of plastics, Binoculars / monoculars / projectors, Cameras, Watch, Clock, Instruments / apparatus / oscilloscopes, Spectacles, Sunglasses, Goggles, Frames, Lenses, Meters.*

## Toys, games, musical instruments, excluded from scope:

*Of wood, Of metal, Not of plastic, Book, Cards, Board, Jigsaw, Pool, Snooker, Billiards, Bowls, Bowling, Darts, Dartboard, Aerosol, Golf, Ski, Skate, Racket, Tennis, Badminton, Squash, Cricket, Rugby, Football, Soccer, Fish, Fishing, Water, Theatre*

# Toys, games, musical instruments, included in scope:

For musical instruments:

*Electronic, Keyboard, Organ, Electrically.*

For toys and games:

*Electronic, Electric, Video*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