REUSABLE PACKAGING IN THE AOTEAROA NEW ZEALAND GROCERY SECTOR: UNDERSTANDING IMPACTS AND OUTCOMES

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reuse aotearoa
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EXECUTIVE SUMMARY

Grocery items, including food, beverages, cleaning, and personal care products, are key users of single-use packaging. Single-use packaging uses large amounts of raw material resources and over-contributes to waste and plastic pollution, even with high recycling rates. When used for essentials like groceries, single-use packaging brings disposability practices, and exposure to plastics and chemicals of concern, into people's daily lives. In the Aotearoa New Zealand context, the issues of plastic pollution, overpackaging, and the primacy of profit motives that underlie how food and other essential items are made and consumed are also directly connected to colonial and capitalist systems and values.

Reusable packaging systems are a potential alternative that could displace the need for single-use grocery packaging, and help to transform relationships between people and the organisations that produce and distribute essential items, like food. Reusable packaging has thus become a small, but growing area of academic study, non-governmental advocacy, business model experimentation, and policy development.

Long-standing and novel examples of reusable packaging systems both exist across the groceries sector. They include examples of returnable packaging systems and refill by bulk dispenser (RBBD) systems. However, comprehensive studies into their impact across supply chains are still lacking, as are appropriate quantitative and qualitative methods for assessing these impacts. There is a recognised need to interrogate real-world environmental and economic benefits of reusable packaging systems, and their interaction with social and cultural considerations, including accessibility, affordability, collective wellbeing, and public health. Filling these knowledge gaps is critical for assessing the suitability of reusable packaging systems generally, but especially for the packaging of essential items like food and other grocery products.

This research focuses on these knowledge gaps, trialing a methodology to measure the impacts and outcomes of reusable packaging systems in Aotearoa New Zealand's grocery sector. The research draws on case studies with different types of grocery retailers in two regions of the country – Waikato and Wellington – and the producers/suppliers in their supply chain for six focus products (fresh milk, toothpaste, pumpkin seeds, oats, olive oil, and dishwashing liquid). The research used seven indicators – relating to environmental/health, socioeconomic, and cultural impacts – against which to compare performance of single-use and reusable packaging systems (**Table 1**).

Indicators were selected based on a literature review and on findings from a parallel kaupapa Māori research project into the relationship between reuse and te ao Māori. This parallel study was critical because most reusable packaging literature comes from overseas, and therefore is not grounded in the knowledge, perspectives and context of Aotearoa, where this study was undertaken. Tāngata Whenua hold tino rangatiratanga in Aotearoa and therefore ensuring research projects carried out here are informed (and ideally, grounded) in Māori perspectives is essential to ensure they are culturally contextualised and uphold our obligations to Te Tiriti o Waitangi, all of which enhances the quality and relevance of the research.

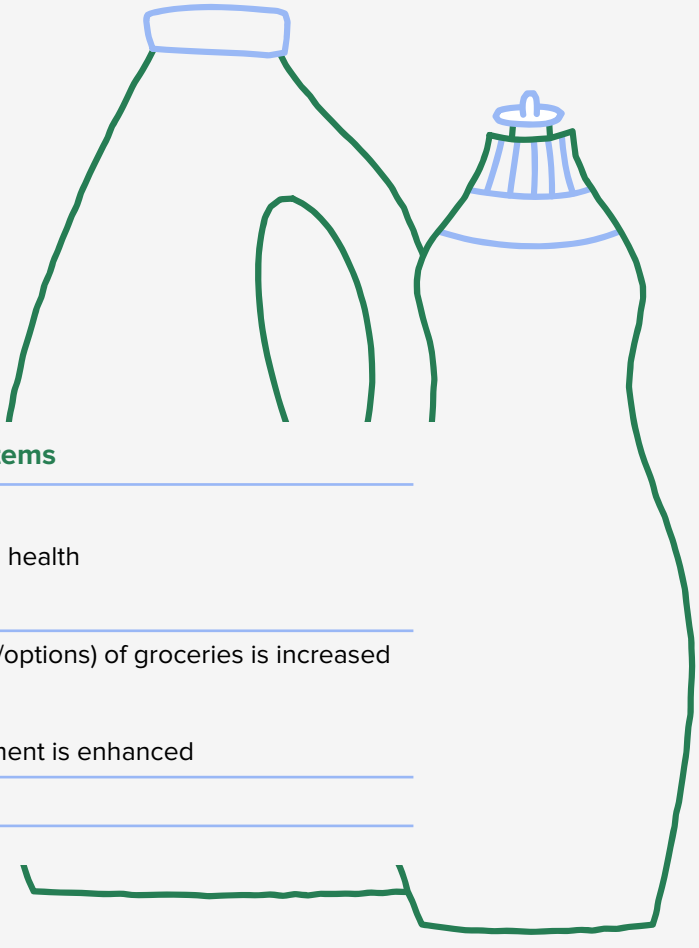


Table 1: Impact indicators for groceries packaging systems

Environmental/health	Packaging is avoided
	Packaging systems protect physical health
	Food waste is avoided
Socioeconomic	Accessibility (cost, ease, availability/options) of groceries is increased
	New, quality jobs are created
	Community wellbeing and engagement is enhanced
Cultural	Collective wellbeing is improved

FINDINGS

ENVIRONMENTAL/HEALTH

In terms of environmental/health impacts, the study found that:

- **Reusable packaging systems almost always reduce packaging use and waste compared to single-use systems.** The extent of this packaging avoidance impact depends on how often consumer-facing packaging units are reused (determined by measuring return rates in returnable packaging systems, or rates of customers bringing their own containers to refill at bulk dispensers). Packaging avoidance is also affected by the supply chain packaging systems used to bring differently packaged products to retail shelves; greater use of reusable packaging in supply chains translates to a greater packaging avoidance impact. Regardless of the packaging avoidance impact, reusable packaging systems almost always reduced plastic usage compared to single-use packaging systems.

- **Producers and retailers do not currently measure and/or report on their packaging consumption.** Consequently, gathering real-world data for the packaging avoidance indicator was laborious or, in the case of supply chain packaging, not always possible, requiring the use of assumptions. We also had to assume reuse rates for most reusable packaging systems because few participants kept accurate data that would enable calculation of actual reuse rates.

- **Any packaging system (whether single-use or reusable) can present human health risks** if relevant hygiene or food safety protocols are not followed; the packaging is easily compromised and enables contamination; or the packaging materials themselves contain chemicals of concern. All producers and retailers were aware of hygiene risks from their packaging systems and the need to comply with food safety protocols, which are regulated and audited by external inspectors. As such, while public concerns about the hygiene of reusable packaging systems are sometimes expressed, these are more perceived than real. In contrast to hygiene considerations, the potential toxicity of different packaging materials was not front-of-mind for most participants, so risk mitigation to reduce presence or migration of chemicals of concern was often not applied when producers and retailers made packaging choices. Despite this, our observations of the packaging used for focus products suggest reusable packaging systems may offer some benefits when it comes to health risks. For example, consumer-facing returnable packaging systems offer an opportunity to shift from packaging materials that may have higher levels of chemicals of concern and potential chemical migration (e.g., plastics or fibre) towards packaging materials that are usually more inert (e.g., glass or metal). While RBBD systems often rely on plastic bulk dispensers and plastic or paper primary bulk packaging, the larger quantity of product contained means less contact between the product and the package or dispenser. However, the act of reusing bulk packaging made of these materials might lead to increased risk of chemical migration from packaging to product over time.

- **Reusable packaging systems do not appear to increase food waste compared to single-use packaged counterparts.** Participants operating reusable packaging systems noted that with careful management and (often) additional labour, reusable packaging systems did not lead to increased food waste. Well-managed stock inventory systems in retail contexts are likely to avoid generation of product waste, regardless of the packaging system.

FINDINGS *CONTINUED*

SOCIOECONOMIC

In terms of socioeconomic impacts, the study found that:

- **Products in reusable packaging systems (especially returnable packaging) are generally more expensive than their single-use packaged counterparts.** Comparing consumer-facing reuse systems, RBBD systems generally offer cheaper prices for equivalent products than returnable systems. Oats in RBBD packaging was the one product that did compete on price with single-use packaged oats. Oats were also the only product where the product in dispensers was generally supplied by the same large suppliers as the majority of single-use packaged brands, meaning the price comparison across packaging systems was more likely to compare like-with-like (other focus products vended via RBBD tended to be supplied by a bespoke supplier on the premium end of the market). This suggests that, where all things are equal, the RBBD model can be a cost-effective means of vending product, potentially making sustainable shopping more affordable (or at least price neutral).

- **Products in reusable packaging systems are less available than single-use packaged products.** Perhaps exacerbated by the supermarket duopoly in Aotearoa New Zealand, retailers that champion reusable packaging systems and stock products in reusable packaging are much less prevalent than mainstream retailers, are in less convenient locations, have fewer parking options, and have more restricted opening hours. The resulting inconvenience makes reusable packaged products less accessible for time-poor individuals and/or marginalised communities who may be burdened by a range of competing priorities.

- **Reusable packaging systems are more labour-intensive than single-use packaged products for both producers and retailers.** Consequently, reusable packaging systems offer potential job creation impacts in the circular economy/green sector. However, this could also increase the costs of reusable packaged products that are passed on to the consumer, particularly when the costs of single-use packaging are not internalised through regulated product stewardship schemes or similar.

- **Reusable packaging systems can help foster community wellbeing and engagement through supporting local businesses, food production, and resilience.** Our participants operating reusable packaging systems described the key community wellbeing outcome as reduced waste and therefore less environmental harm and cost to wider society. They noted that by operating reusable packaging systems they provided customers with greater choice to take pro-environmental action, which can alleviate negative feelings of hopelessness. Approximately half of our participants operating reusable packaging systems supported wider community initiatives (such as waste minimisation campaigns and/or social programmes). Given most reusable packaging systems stock locally made products, their operations also support local businesses and could increase wider community resilience through local food production and shorter supply chains.

CULTURAL

In terms of cultural impacts, the study found that:

- **Cultural considerations are not front of mind for most businesses when they design their packaging systems.** Most of our participants struggled to answer questions about the relevance of cultural considerations to their work, particularly in relation to more political or constitutional concepts, such as sovereignty. For example, no participants directly reflected on the relevance of Te Tiriti o Waitangi, although two participants did point to a responsibility to respect mātauranga and tikanga and/or to support mana whenua, with both providing practical examples of how they were doing this. Overall, where participants were acting on particular cultural considerations (such as choosing whether to stock certain products or implement certain practices) this was usually not due to internal strategic policies or particular investment in this area, but rather reflected the identities or experiences of staff or business owners.

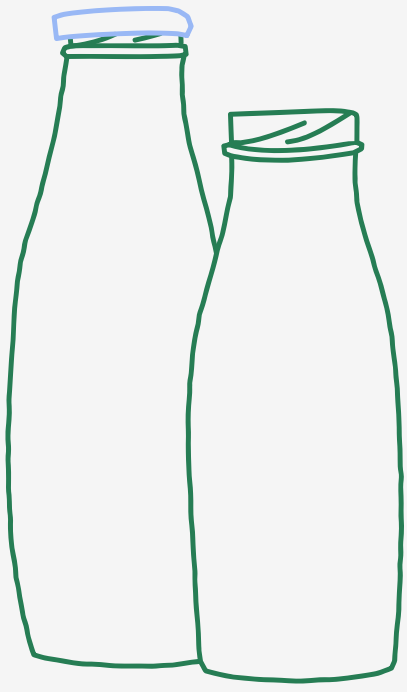
KEY IMPLICATIONS

Overall, the research found that across various indicators, reusable packaging systems can deliver positive impacts compared to single-use packaging systems. The nature and extent of the impact may depend on the type of reusable packaging system. However, data gaps make quantitative analysis across a range of indicators challenging. These findings underscore the need for all suppliers, producers, and retailers to be supported to keep better data on their packaging systems (whether single-use or reuse) and to report on this as part of Aotearoa New Zealand's broader waste minimisation agenda.

Fully realising the positive *potential* of reusable packaging systems is currently constrained. Reusable packaging systems are not yet widespread in the grocery sector (except for pallets for tertiary packaging) and thus lack economies of scale. The systems that do exist are primarily adopted by smaller retailers and producers/suppliers who struggle for viability in a market dominated by a supermarket duopoly. These factors reduce accessibility of reusable packaging systems (in terms of cost and availability), with flow-on effects across all indicators. Mainstreaming and normalising reusable packaging systems and dispersing their benefits will require direct regulatory and resourcing support for reusable packaging systems and the retailers and producers that adopt them. Larger retailers and producers/suppliers will also need to leverage their market power to increase their own uptake of reusable packaging systems.

These findings have implications for producers and retailers of food, beverage, and cleaning and personal care products; the groceries sector generally; and policymakers focused on addressing issues such as packaging waste, competition in the grocery sector, and food insecurity. These issues have heightened relevance in the present context where the supermarket duopoly is under increasing pressure to improve sustainability credentials, including reducing the packaging waste passed on to consumers, while providing access to essential items in the context of a cost-of-living crisis.

Our study has also highlighted gaps in integrating te ao Māori perspectives, and the essential role of Te Tiriti o Waitangi for everyone in Aotearoa New Zealand, into both reusable packaging research and reusable packaging practices in the grocery sector. This has implications for how future projects and initiatives are approached. The literature on waste colonialism, both locally and internationally, highlights that while a widespread shift towards reusable packaging systems may be one way to displace the use of single-use packaging and disrupt corporate influence over access to groceries and the waste this sector produces, upholding Te Tiriti o Waitangi, mana motuhake, and tino rangatiratanga is critical to more durable structural change and environmental justice in how food and other essential items are provisioned.

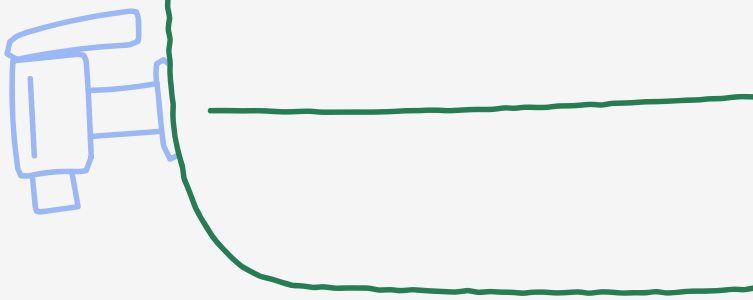


RECOMMENDATIONS

- **Improved data capture and reporting:** All producers, suppliers, and retailers should be required and supported to capture and report on key aspects of their packaging systems, including the quantity of packaging put to market (by both weight and units, and expressed with reference to the quantity of product contained), and actual recycling rates (for single-use) and actual reuse rates (for reusable packaging systems).
- **More specialist research is needed to:** quantify food waste impacts of different packaging systems in the supply chain and in consumers' homes; quantify job creation impacts of different packaging systems; and explore human health protection and risks associated with packaging materials in single-use and reusable systems. The latter includes the appropriateness of different packaging material types for certain

RECOMMENDATIONS *CONTINUED*

products and storage conditions, as well as any risks and mitigation measures associated with repeatedly washing and refilling containers and dispensers made of different materials in the context of reuse systems. Lifecycle Assessments that compare real-world single-use and reusable packaging systems (such as those considered in this study) and the producers/suppliers and retailers that operate them could also support ongoing improvements in the environmental efficiency of existing reusable packaging systems. Māori-led research projects and projects co-designed with Māori to ensure Māori expertise and priorities are embedded in future studies of reusable packaging are also critical.



- **Economic and regulatory instruments to support and grow reusable packaging systems to increase their adoption:** Reusable packaging systems in the grocery sector bring a range of social and environmental benefits, but at present, they are mostly operated by small- and medium-sized producers and retailers, making them both niche and precarious. Until single-use packaging systems are required to internalise their wider waste management costs (recycling, disposal and litter), reusable packaging systems will generally find it hard to compete. Economic policy and regulatory measures to help level the playing field between single-use and reuse, and to require the participation of large producers and retailers to increase economies of scale, would lift both the availability and viability of reuse and, in turn, unlock increased positive impact. To this end, ensuring reuse outcomes are part of any regulated product stewardship scheme for packaging is important.

- **Increase the performance of reusable packaging systems:** Existing reusable packaging systems could be further optimised to increase their positive impact. Returnable packaging systems would have increased return rates and lower logistical costs if producers collaborated to share standardised packaging and return logistics, and if larger retailers were willing to stock, and act as return points, for returnable packaging. Refill by bulk dispenser systems would have increased packaging avoidance if single-use packaging was not offered at dispensers, and if retailers and producers/suppliers collaborated to use returnable primary bulk packaging in the supply chain. Expanding retailers' RBBD sections and the product range sold via RBBD could increase the affordability of groceries and the choices available to consumers buying their groceries via this model. Retailers and producers could improve their cultural impact by investing in their understanding of how they can practically and meaningfully uplift and support Tāngata Whenua, Te Tiriti o Waitangi, tikanga Māori and tino rangatiratanga in their work.

- **Measures to assess and mitigate the impact of the supermarket duopoly should include sustainability (and packaging) considerations:** The supermarket duopoly in Aotearoa New Zealand is recognised to reduce competition in the grocery sector, negatively impacting the price of groceries and suppliers' ability to access the retail market or dictate terms of sale for their products. While advocacy organisations and public agencies, such as the Commerce Commission and its Grocery Commissioner, are investigating and/or promoting measures to alleviate these concerns, our research suggests the duopoly also has a negative impact on the viability of sustainable packaging innovation like reuse in the grocery sector. Measures to assess and mitigate this impact are justified, given that overpackaging, plastic usage and waste are consistently highlighted as issues of concern for New Zealanders, on which they would like to see businesses take greater action.

- **Increase public communication about alternative grocery packaging systems and retailers, and their potential positive impacts:** In light of the concern New Zealanders express about overpackaging and plastic pollution, the dissatisfaction with the current grocery sector in terms of meeting community needs for accessible and affordable groceries, and the precarity of alternative retailers that may be more values-aligned, we suggest more investment is needed to communicate about potential alternatives to the supermarket grocery model and single-use packaged products. This would be ancillary to (not in lieu of) economic and regulatory measures to create more favourable conditions for viable and affordable alternatives. This could involve supporting retailers and producers/suppliers that champion reusable packaging systems to communicate effectively about the positive impacts of these systems in a way that connects with the public's concerns, and placing greater emphasis on reuse, rather than recycling, in public information campaigns about packaging waste minimisation.

CONTENTS

SECTION 1:
INTRODUCTION

Reusable packaging systems are a small, but growing area of academic study, non-governmental advocacy, public interest, business model experimentation, and policy development (Blumhardt, 2023; Bradley & Corsini, 2023; Moss et al, 2022; United Nations Environment Programme (UNEP), 2022, p.53; Coelho et al, 2020). This growing interest is connected to increased focus on circular economy practices (Coelho et al, 2020). Reusable packaging systems are a classic circular business model, with potential value for tackling the plastic, waste, resource depletion and climate crises by reducing demand for single-use packaging (Brown et al, 2022, p.5). Single-use packaging is a linear product centred on disposability, inherently constituting a significant proportion of raw material consumption, over-contributing to waste and plastic pollution, and generating greenhouse gas emissions across its lifespan (Bradley & Corsini, 2023; Blumhardt, 2022a, ch. 1.1; Hekkert et al 2001; Global Plastics Policy Centre, 2023)[1]. While plastic packaging often receives most public and policymaker attention, other materials (e.g., paper, metals, glass) also pollute when utilised in linear, single-use formats, demonstrating the need for a systemic shift in packaging business models (Hekkert et al, 2001; Kurian, 2020, pp. 3-4; Global Plastics Policy Centre, 2023, p.19; Gordon, 2021, pp.23-27; Copello et al, 2022, p.32).

Packaging for groceries, including food, beverages, cleaning and personal care products, is a subset of packaging that justifies specific attention. Today's complex and distributed global grocery supply chains rely heavily on single-use packaging, particularly plastics, which have become "embedded in routine consumption and market practices" (Kemper et al, 2024, p.2). This dependence is commonly attributed to functional properties that help to reduce transportation costs, enable export and trade, communicate product information, and protect goods from damage and contamination (Hawkins 2018; Fuentes et al. 2019; Zeiss 2018; Beitzen-Heineke, Balta-Ozkan & Reefke, 2017; UNEP, 2022; Röjning & Petersson, 2020). Consequently, grocery items and grocery retailers are now key users of single-use packaging (Beitzen-Heineke, Balta-Ozkan & Reefke, 2017; Changing Markets Foundation, 2022). The United Nations Environment Programme (UNEP, 2022) notes that "there is hardly a part of the food value chain that is free from plastic" (p.2) and that "[s]ingle-use packaging dominates supermarket food packaging almost completely" (p.53). As such, groceries bring disposability practices into the daily lives of people across the globe, along with routine exposure to plastics and the harmful chemicals single-use packaging commonly contains (Muncke et al, 2020; Kemper et al, 2024; Changing Markets Foundation, 2022; Seref & Cufaoglu, 2025). Food and beverage packaging is also over-represented in plastic pollution outcomes (Morales-Caselles et al, 2021).

> ***"Supermarkets represent most people's primary touchpoint with single-use plastic packaging, with supermarket shelves stocked with convenient single-use packaging items – sometimes used only for seconds, disposed of and ending up in the environment for centuries." (Changing Markets Foundation, 2022, p.13).***

Single-use packaging, plastic pollution and the linear economy can also be understood as symptoms of "waste colonialism", which is one expression of corporate imperialism (Peryman et al, 2024). This framing draws attention to the "power structures and profit motives" (p.2) that drive how products are made and consumed, including how products might be accessed and the choice of and design of packaging. In the Aotearoa New Zealand context, the notion of waste colonialism helps to explain single-use packaging and the current grocery system as part of the ongoing legacy of settler colonialism here, and the continued failure of the Crown to uphold Te Tiriti o Waitangi. This affects all communities in Aotearoa New Zealand, but as Tāngata Whenua, Māori are differently and disproportionately affected (Peryman et al, 2024).

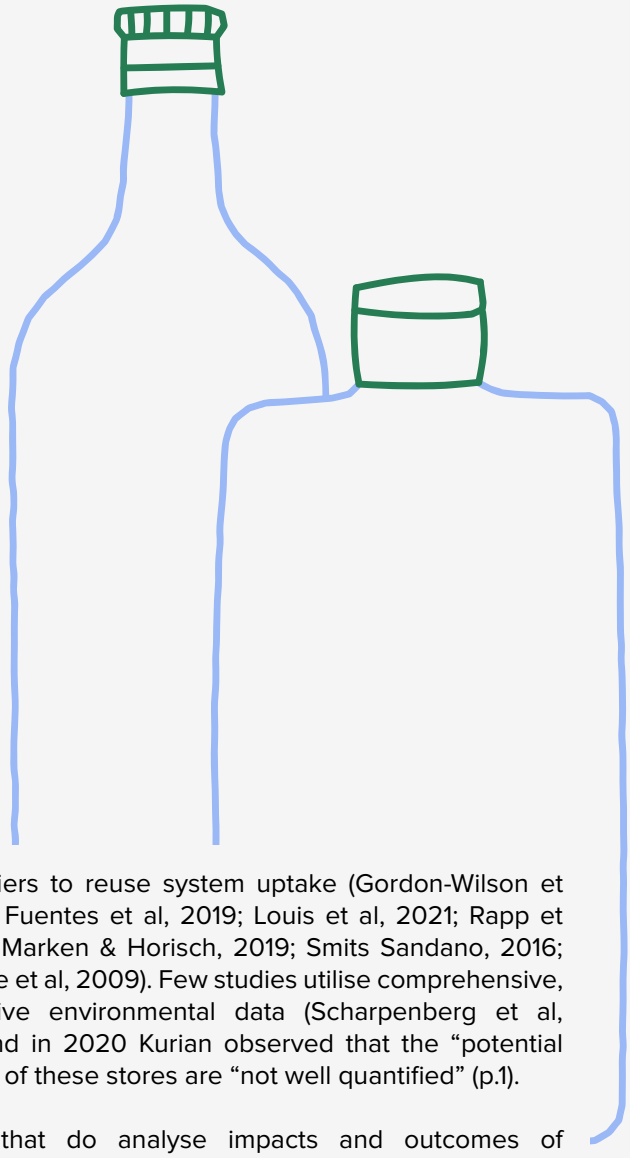
Growing concern about overpackaging and plastics in the grocery sector and within mainstream supermarkets has contributed to the (re)emergence of reusable packaging systems and the 'unpackaged movement' amongst grocery retailers, producers, suppliers, and a cohort of customers (Hawkins 2020; Fuentes et al. 2019; Kurian, 2020; Beechener et al 2020; Röjning & Petersson, 2020). In some cases, this has driven entirely new types of grocery retailers, packaging modalities and consumption practices, such as the 'packaging-free' or 'zero waste' store (Kurian, 2020; Beechener et al 2020; Blumhardt, 2022). In other cases, it has led to resurging producer interest in existing reusable packaging systems that were previously in decline, for example, Germany's MMP reusable jar system (Bielenstein, 2022). However, compared to single-use packaging, unpackaged and reusable packaged systems and products are still mostly niche and uncoordinated, in start-up phase, or limited to siloed trials within existing supermarkets (John Lewis Partnership, 2020; Minami et al, 2010; Beechener et al 2020; Moss et al 2022; Global Plastics Policy Centre, 2023; UNEP, 2022, p.53; Coelho et al, 2020; Röjning & Petersson, 2020). Packaging-free stores, while in growth phase, also remain marginal players in the wider grocery retail ecosystem (Beechener et al, 2020).

[1] For example, single-use plastic packaging consumes the largest share of the global plastic market, at 36%, and constitutes 46% of all plastic waste generated (Geyer, 2020); roughly a third of plastic packaging produced ends up escaping waste collection systems to pollute the environment (Bradley & Corsini, 2023, p.127).

Research, investment and collaboration is needed to reorganise established global grocery supply chains to accommodate reusable packaging systems, and to ensure these efforts are rewarded with positive outcomes across environmental, social and economic measures (Brown et al, 2022). A particular issue with the niche status of reuse systems and the retailers that champion them is the difficulty of scrutinising their impacts in a standardised way. Their oft-short-lived nature can also undermine their potential as a proof of concept because early-stage systems often demonstrate a gap between intentions and outcomes (especially if key assumptions are not tested) because they need time to optimise for economic and environmental efficiency (Kachook, 2022; Copello et al, 2021, p.4; Peeters et al, 2023, p.9). To ensure fair assessments of early performance, and to embed improvements over time, these systems should be subject to ongoing monitoring and iterative evolution. Appropriate metrics and indicators, backed by clear, evidence-based standards, are needed to guide such evaluation processes (Blumhardt, 2023; Kachook, 2022; Global Plastics Policy Centre, 2023; Copello et al, 2021, p.4).

However, studies and methodologies to measure the impact and outcomes of reusable packaging systems, in the groceries sector or otherwise, are still lacking and patchy (Coelho et al, 2020; Bradley & Corsini, 2023). Many studies take a more descriptive approach, such as: creating catalogues and taxonomies of existing systems (Ellen Macarthur Foundation, 2019; Ellen MacArthur Foundation, 2020; Moss et al, 2022); analysing how grocery consumption practices shift amidst wider infrastructures (Hawkins 2018, 2020; Beitzen-Heineke et al. 2017; Sattlegger et al. 2020; Diprose et al. 2022); exploring how the removal of single use packaging is managed in food retail (Fuentes et al. 2019); how the shift to reusable packaging might be framed, communicated, or promoted (Röjning & Petersson, 2020); or assessing the barriers and incentives to uptake for consumers, producers, and retailers (Blumhardt, 2022a, ch.4; Marken & Horisch, 2019; Lofthouse et al, 2009). Commonly, these descriptive studies cite benefits of reusable packaging systems without delving into whether they occur in practice, or they raise common criticisms without testing their veracity (Kachook, 2022).

For example, packaging-free grocery stores have attracted some specific research attention (Moss et al, 2022, Kemper, 2024; Gordon-Wilson et al, 2022; Diprose et al, 2023; Rapp et al, 2017; Louis et al 2021; Marken & Horisch, 2019; Smit Sandano, 2016; Kurian, 2020; Beitzen-Heineke et al, 2017). However, the impacts and outcomes of these stores' alternative packaging modalities is understudied (Sjolund, 2016; Kurian, 2020), with analysis often focusing on the perceptions, behaviours, and experiences of consumers, retailers, and supply chains, and the drivers



and barriers to reuse system uptake (Gordon-Wilson et al 2022; Fuentes et al, 2019; Louis et al, 2021; Rapp et al, 2017; Marken & Horisch, 2019; Smits Sandano, 2016; Lofthouse et al, 2009). Few studies utilise comprehensive, quantitative environmental data (Scharpenberg et al, 2010), and in 2020 Kurian observed that the "potential benefits" of these stores are "not well quantified" (p.1).

Studies that do analyse impacts and outcomes of reusable packaging systems are often quite technical and narrowly focused. For example, they may employ lifecycle assessments (LCA) that compare single-use and reusable packaging for individual products or parts of the supply chain, with an emphasis on greenhouse gas emissions (Global Plastics Policy Centre, 2023; Bradley & Corsini, 2023; UNEP, 2022; Coelho et al, 2020). Overall, fewer studies consider wider factors or assumptions, such as whether removing single-use packaging contributes to reduced consumption, plastic pollution, usage of chemicals of concern, and harm to human health (Kallis et al. 2018; Kachook, 2022; Gordon, 2021; Coelho et al, 2020). Economic impacts and indicators are still understudied, partly due to data gaps, leaving uncertainty about whether reusable packaging systems are viable or can support economic growth (Peeters et al, 2023). As with other circular economy research, socioeconomic and cultural implications of reusable packaging systems are also neglected in the literature (Bradley & Corsini, 2023; Brown et al, 2022).

Overall, more research is needed to understand a fuller range of environmental, socioeconomic, and cultural impacts and outcomes from reusable packaging systems in the groceries sector. This is especially so in Aotearoa New Zealand, where studies of reusable packaging systems are lacking, especially those incorporating Māori perspectives, and where the grocery sector is dominated by a supermarket duopoly that creates a particularly challenging environment for many types of innovation related to groceries.

This research addresses this gap by seeking to:

- Identify the reusable packaging system types already used in the groceries sector supply chain, using case studies in the Waikato and Wellington.
- Quantify the waste prevention and reduction impacts of reusable packaging systems for grocery retailers and producers.
- Identify how, and to what extent, reusable packaging systems are prompting changes across supply chains.
- Identify the socioeconomic and cultural impacts of reusable packaging systems for workers, consumers, and wider Aotearoa New Zealand society.
- Help retailers and suppliers communicate the impact of reusable packaging systems to communities, consumers, and others.

This report is structured as follows:

- **Section 2** introduces and defines reusable packaging systems, describes their place in Aotearoa New Zealand, and identifies the roles different actors play in their operation.
- **Section 3** summarises relevant literature and research that informed our selected impact indicators and research methods and approach
- **Section 4** outlines the methods used to gather primary data for measuring packaging systems against our chosen indicators, and identifies research limitations.
- **Section 5** summarises the findings in relation to each of the selected impact indicators and describes three other themes that emerged from the primary data.
- **Section 6** concludes with reflections on the implications of the research and specific recommendations regarding future research needs, reusable packaging system development, and policy measures to support uptake of reusable packaging in the grocery sector.

SECTION 2:
UNDERSTANDING REUSABLE PACKAGING SYSTEMS AND THEIR PLACE IN THE AOTEAROA NEW ZEALAND GROCERY SECTOR

2.1 UNDERSTANDING REUSABLE PACKAGING SYSTEMS

Reusable packaging is durable, sturdy packaging that is refilled multiple times (in its existing form) with the same type of purchased product for which it was originally designed, or for the same purpose, in a **system of reuse**. A system of reuse is the **established organisational, technical and/or financial arrangements** that ensure the packaging achieves a minimum number of trips or reuse cycles in practice, not just in theory (WasteMINZ, 2023a, p.1). In contrast, packaging is considered single-use if, after one use, it is repurposed (used again in its existing form for a different purpose), recycled or disposed of (ibid, pp.1-2).

Reusable packaging systems exist across many sectors of the economy and can be designed and operated in different ways. Furthermore, they can be consumer-facing (business-to-consumer, B2C) or operate 'behind-the-scenes' between businesses (business-to-business, B2B). They can exist for (Mahmoudi & Parviziomran, 2020):

- **Primary packaging:** the packaging that directly contains and touches the product (consumers most commonly interact with this layer);
- **Secondary packaging:** the packaging that contains groups of primary packages for ease of transport or storage, e.g., cardboard boxes; or
- **Tertiary packaging:** the outermost layer of packaging used to transport bulk quantities of products through the supply chain, e.g., pallets and shrink wrap.

Broadly speaking, reusable packaging falls into three main categories, all of which are present in local and global grocery supply chains (Coelho et al, 2020; Blumhardt, 2022a):

- Returnable packaging.
- Refill by bulk dispenser (RBBD)/'Unpackaged'.
- Reusable transport/transit packaging.

Table 2 outlines these categories, with examples from Aotearoa New Zealand's groceries sector.

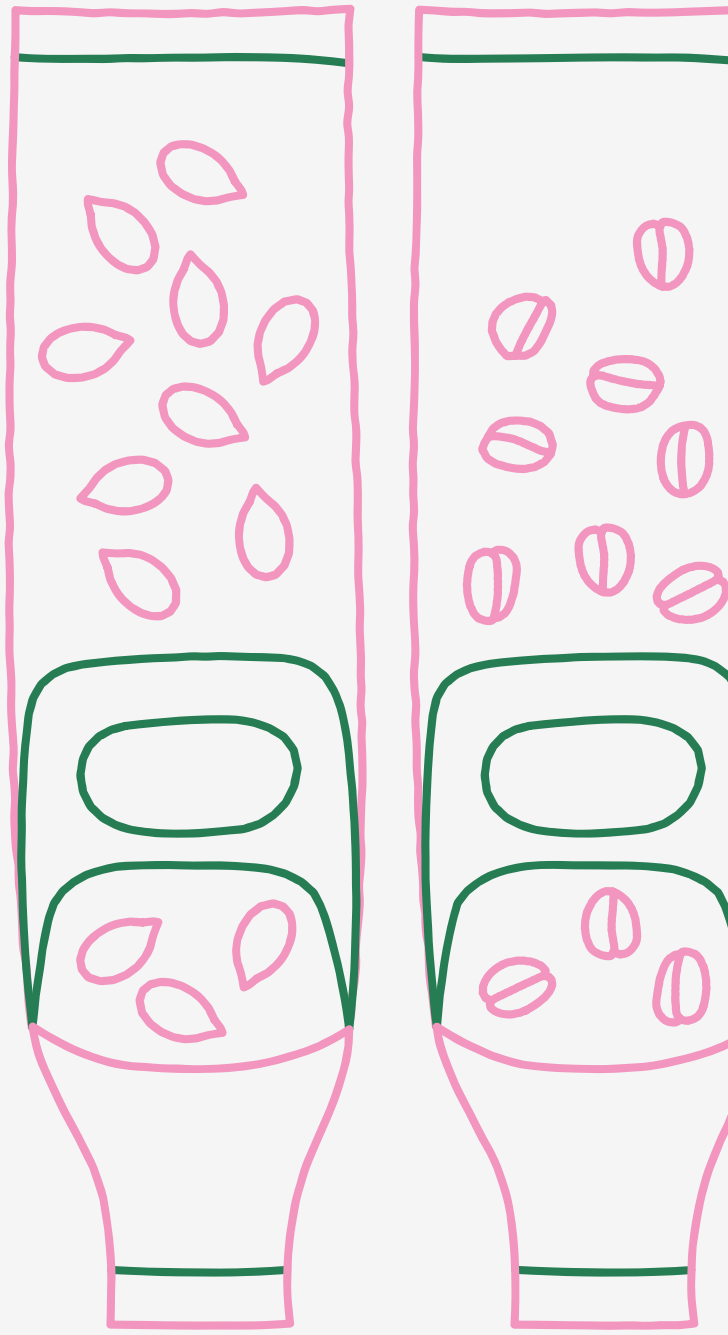


Table 2: Three Categories of Reusable Packaging
(based on categorisations in Coelho et al, 2020. See also UNEP, 2022, p.56)

Reusable Packaging System	How it works	Examples in Aotearoa New Zealand's groceries sector
Returnable packaging	Once empty, the product packaging is designed to be returned by the customer/final user of the product, to be washed, sanitised and refilled with the same product or product type. *NB: Returnable packaging can be B2B or B2C, and is usually primary packaging.*	**B2C returnable packaging:** Bottle or jar swap systems for food, drink, or personal care products, such as glass bottle milk swap systems or reusable jars for personal care products like toothpaste. **B2B returnable packaging:** Kegs, jerry cans, or pails for vending bulk quantities of liquids on tap, e.g., pails or kegs for in-store milk dispensers or 20L jerry cans at refill stations for personal care or cleaning products.
Refill by bulk dispenser (RBBD)/ 'Unpackaged'	Bulk dispensers enable product to be sold 'loose' or 'unpackaged'. Customers either fill their own reusable containers or purchase/use a new, empty container the first time they use the dispenser that they can bring back to refill for future purchases. *NB: Purchasing from a bulk dispenser is usually a B2C activity.* *The category can include a B2B reusable packaging component if retailers return the empty bulk dispensers to the original supplier for refill, e.g., kegs (see B2B returnable packaging, above) or fresh produce crates (see reusable transport packaging, below).* *The category can also include a returnable B2C component if the empty container available for the customer to fill into can be returned after use to be sanitised and returned to shelf.*	Loose produce in crates at supermarkets and greengrocers. Bulk bins or gravity feeders for dry goods at supermarkets or specialty grocers, such as bulk stores, organic shops or zero waste grocers/packaging-free stores. Sale of product 'on tap', e.g., from 20L jerry cans or metal dispensers, such as liquid foods like oil or refill stations for cleaning products and toiletries.
Reusable Transport/ Transit Packaging	Reusable versions of the outer layers of packaging (secondary or tertiary) that are used to contain or protect a product as it moves through the supply chain (e.g., from producer to warehouse to retail store), including boxes, pallets, pallet wrap, strapping, and padding. *NB: Reusable transit packaging is most commonly B2B, but it can be B2C, e.g., reusable courier bags for e-commerce.* *The category sometimes overlaps with the RBBD category if the retailer uses the transit package as the bulk dispenser. For example, reusable plastic produce crates as shelving in supermarkets or plastic jerry cans for selling cleaning products on tap.*	Third-party operated reuse systems for pallets are used across the groceries sector, and reusable plastic crates are commonly used to deliver fresh produce from farm to retail outlet. Reusable crates are also commonly used for delivering milk and bread to retailers.

2.2 WHY IT'S IMPORTANT TO DISTINGUISH REUSABLE PACKAGING SYSTEMS

Distinguishing between the different reuse categories, and whether they are B2B or B2C, is important because each system operates differently, with variable cost implications, complexity, and demands on each actor in the groceries supply chain (Coelho et al, 2020). Between the different systems, the packaging prevention/reuse elements can appear at different points of the supply chain or require distinct logistical or infrastructural arrangements to realise, so it's necessary to look beyond the retail shelf to understand whether or how reuse is operating. In the groceries sector, this nuance can be illustrated by the following examples of reusable transport packaging and RBBD models.

2.2.1 REUSABLE TRANSPORT PACKAGING IN THE GROCERY SECTOR

In Aotearoa New Zealand's grocery sector, reusable transport packaging systems (particularly reusable pallets and produce crates) are fairly normalised and operate at scale, with waste prevention, efficiency, and cost-saving impacts (Blumhardt, 2022, ch. 2.6; Blumhardt & Peke-Harris, 2024, pp.33-37). However, many of the items carried by reusable transport packaging are in single-use primary and secondary packaging. Therefore, the existence of a reusable transport packaging solution only tells part of the story about the items' overall packaging impact, and this story often unfolds at a point in the supply chain where the ease, cost, and impact of implementing reusable packaging differs significantly from the consumer-facing phase. On the other hand, focusing only on consumer-facing packaging misses any behind-the-scenes packaging that gets that product to shelf. For example, smaller retailers with extensive RBBD offerings may receive all products on single-use pallets because they and their suppliers sit outside the distribution systems that utilise reusable transport packaging.

2.2.2 REFILL BY BULK DISPENSER MODELS (RBBD) IN GROCERY RETAIL

In the grocery retail context, operationalising RBBD or 'unpackaged' models requires different infrastructural set-ups and workflows for retailers compared to both returnable and single-use pre-packaged products (Ellen Macarthur Foundation, 2023, p.5). RBBD systems also do not always guarantee reuse outcomes. In fact, some commentators argue refill/unpackaged models should be classified as 'packaging prevention' rather than 'reusable packaging' (see Global Plastics Policy Centre, 2023, pp.7–9). This study classifies RBBD systems as reuse models because when a full supply chain approach is taken, unpackaged models create the enabling conditions for packaging reuse for producers/suppliers and consumers. However, when analysing whether this reuse outcome is realised, it is necessary to consider whether RBBD models actually facilitate reuse at different points of the supply chain. For example:

- Do suppliers use B2B returnable bulk packaging?
- Do retailers provide empty B2C returnable, rather than single-use, containers for consumers to fill into at the dispenser?
- Do retailers actively incentivise consumers to BYO containers?

2.2.3 CASE STUDIES

In the international context, several case studies demonstrate efforts to stretch reusable packaging systems across supply chains by utilising the existing logistics operations, systems, and principles of reusable transport packaging.

The Refill Coalition (UK)

The Refill Coalition is a UK-based collaborative initiative between grocery retailers (Aldi and Ocado), a reusable packaging/logistics company (CHEP), and a reusable packaging consultancy (GoUnpackaged), funded by Innovate UK. The coalition developed a returnable B2B primary bulk packaging system to build behind-the-scenes reuse into the retailers' in-store RBBD model. The Refill Coalition's primary bulk packages are wide-mouthed plastic containers that can be filled with various dry and liquid grocery goods. In-store, these bulk packages slot into purpose-designed RBBD equipment, from which customers fill their own containers. The empty bulk packages are picked up by the logistics provider, sanitised at a wash facility, and then returned to producer/suppliers to refill.

By taking a supply chain approach to reuse in a RBBD system, The Refill Coalition's system enables customers to avoid retail packaging by filling their own container while also displacing the single-use primary bulk packaging otherwise used to fill bulk dispensers. At the time of writing, the system was in a trial phase in just one Aldi supermarket, but it was designed for scalability and wider adoption. For example, it uses standardised bulk packaging that is compatible with existing logistics processes in the groceries supply chain for reusable transport packaging (e.g., fitting onto pallets and inside transport cages).

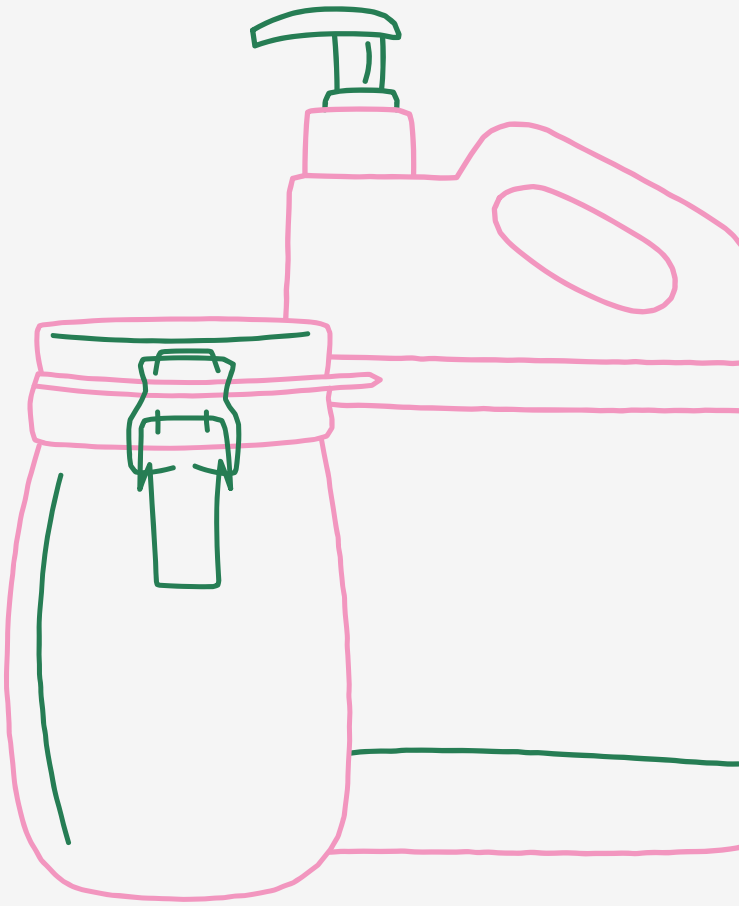
For more information, see https://www.refillcoalition.com/ and https://gounpackaged.com/refillable-packaging-solutions.

Miwa (Czech Republic, Germany, Netherlands)

Miwa is a company from the Czech Republic that focuses on RBBD equipment and technology with both B2B and B2C returnable packaging elements, thereby displacing single-use packaging at both ends of the supply chain. The system features reusable B2B 12-litre capsules or cartridges that slot into the in-store dispenser equipment. When empty, they are returned to MIWA for sanitisation before going to producer/suppliers for refill. Although the capsules are reusable, suppliers fill into a single-use inner liner, but this still eliminates outer layers of single-use packaging during product transportation.

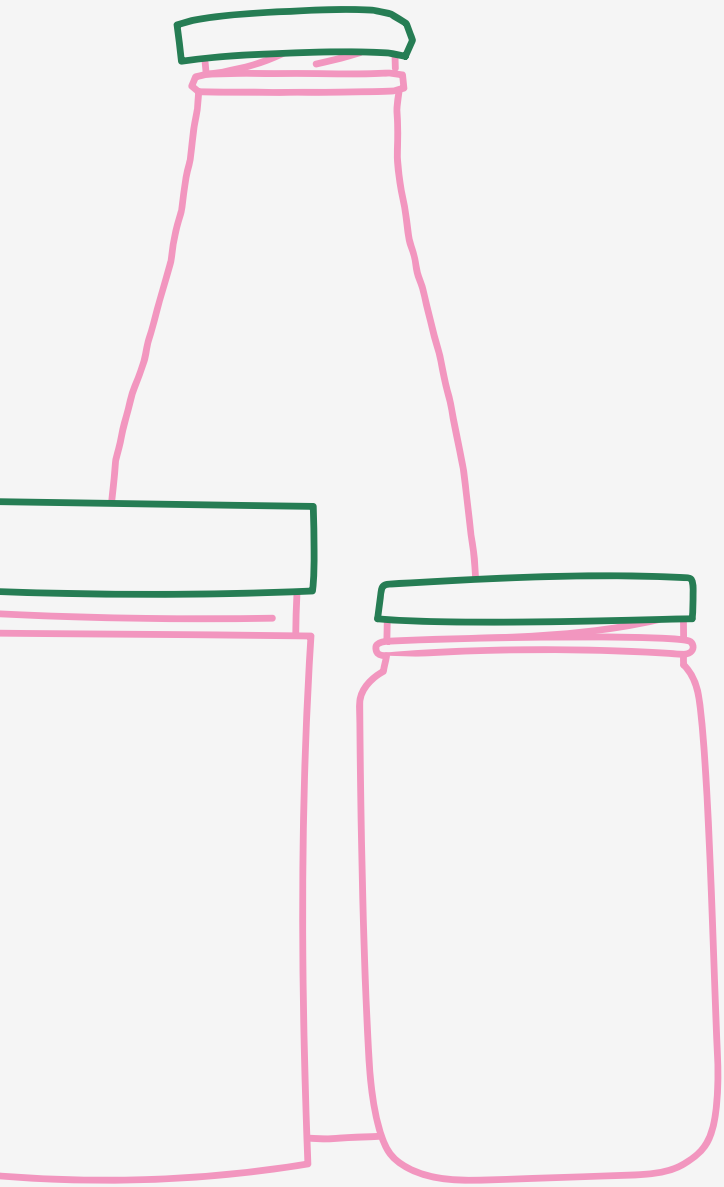
MIWA's system also includes B2C returnable cups that customers can borrow (for a refundable deposit) if they do not bring their own containers to fill into. These are embedded with NFC chips for trackability and to log product details (origin, contents, allergens, and expiration dates). Deposits are redeemed when the customer returns the container, which is then sanitised for further use.

For more information, see https://www.miwa.eu/.



2.3 THE ROLE OF CONSUMERS IN REUSABLE PACKAGING SYSTEMS

In consumer-facing reusable packaging systems (i.e. RBBD and B2C returnable packaging), reuse outcomes require consumer participation (Greenwood et al, 2021; Kachook, 2022; Grimes-Casey et al, 2007).[2] Consumers must first choose to purchase items in reusable packaging (where this is available), and then go on to engage in the appropriate steps to enable container reuse.



These steps depend on the reusable packaging system:

- **For returnable packaging,** consumers must return empty packaging so it can be prepared for reuse (inspection, washing/sanitisation) and refilled.
- **For RBBD/unpackaged products,** consumers must remember to bring their own containers to fill into or choose to use returnable/reusable containers (if provided by the store) rather than single-use containers.

Factors that affect consumers' willingness to choose and actively participate in reusable packaging systems can include (WEF & Kearney, 2021, pp.9-10; James Ross Consulting, 2007; Salkova & Regenerova, 2020; Greenwood et al, 2021; UNEP, 2022; Kemper et al, 2024; Grimes-Casey et al, 2007; Coelho et al, 2020; Marken & Horisch, 2019; Lofthouse et al, 2009):

- price;
- time;
- convenience and availability of reusable packaging options;
- impacts upon consumer choice and autonomy;
- perceptions of cleanliness, hygiene, and product quality; and
- individual's intrinsic values, including eco-consciousness.

[2] Note, however, that the centrality of consumer participation does not imply that consumers are responsible for facilitating their participation or the growth in reusable packaging systems, nor that they have the necessary influence to enable this growth within the grocery system and its supply chains (Munro, Kapitan & Wooliscroft, 2023; Changing Markets Foundation, 2022).

2.4 THE ROLE OF RETAILERS IN REUSABLE PACKAGING SYSTEMS

Retailer participation is essential for reusable packaging systems to function. Most consumers buy grocery items via retailer stockists rather than directly from producers/suppliers. Accordingly, retailers are society's "gatekeepers" for reusable packaging systems (Marken & Horisch, 2019, p.166; Smits Sandano, 2016, p.2).

Supermarkets hold particular influence over the success or failure of sustainable products and initiatives, including reusable packaging, because although grocery retailers are diverse,[3] this diversity is uneven, with supermarkets dominating groceries retail and commanding significant financial resources (Munro, Kapitan & Wooliscroft, 2023; Changing Markets Foundation, 2022; Blumhardt, 2022a; Smits Sandano, 2016, pp.2-3; Beitzen-Heineke, Balta-Ozkan & Reefke, 2017; Environmental Investigation Agency & Greenpeace, 2021, p.7). Supermarkets' influence is particularly pronounced in Aotearoa New Zealand where the retail grocery industry is "highly concentrated" in three players holding "significant market share" (Commerce Commission New Zealand, 2024, p.14).

Some of the gatekeeping powers that retailers (especially supermarkets) hold in relation to reusable packaging include the power to choose whether or not to:

- stock products in returnable packaging and/or accept empty packaging back to return to suppliers;
- invest in and allocate floor space to the fit-outs needed to sell loose/unpackaged products, e.g., bulk dispensing systems, or refrigeration and display units;
- handle deposits or bonds for reusable transport packaging or returnable packaging; and
- accommodate the workflows/activities required to manage reusable packaging systems, e.g., replenishing bulk bins, cleaning customer spillage, filling customer containers at delis, or sorting, storing and returning reusable packaging to suppliers.

Retailers are also critical to encouraging consumer participation in reusable packaging systems; a non-committal, reluctant or lacklustre approach to implementing and communicating about a reusable packaging system can cause system underperformance or failure. For example:

- **In a returnable packaging system,** retailers must be willing to implement a producer's scheme to incentivise returns, e.g., charging a deposit at the point of product purchase and redeeming it upon the empty container's return; offering rewards upon return (e.g., discount off future purchases); or pursuing trust-based strategies that require strong consumer-retailer communication.
- **In a RBBD model,** retailer strategies for motivating container reuse at bulk bins or refill stations can include discounts for BYO containers, signage welcoming BYO containers, charging for single-use containers or not providing single-use containers at all.

Recognising this influence, some jurisdictions have implemented laws to require retailers to cooperate and promote reusable packaging systems (see **Box 1**). Additionally, civil society organisations, including environmental NGOs, have called on large grocery retailers to take actions to tackle single-use plastics, including (Greenpeace UK, (2020, p.3); Changing Markets Foundation, (2022, pp.48-49); Environmental Investigation Agency & Greenpeace, (2021, pp.36-37)):

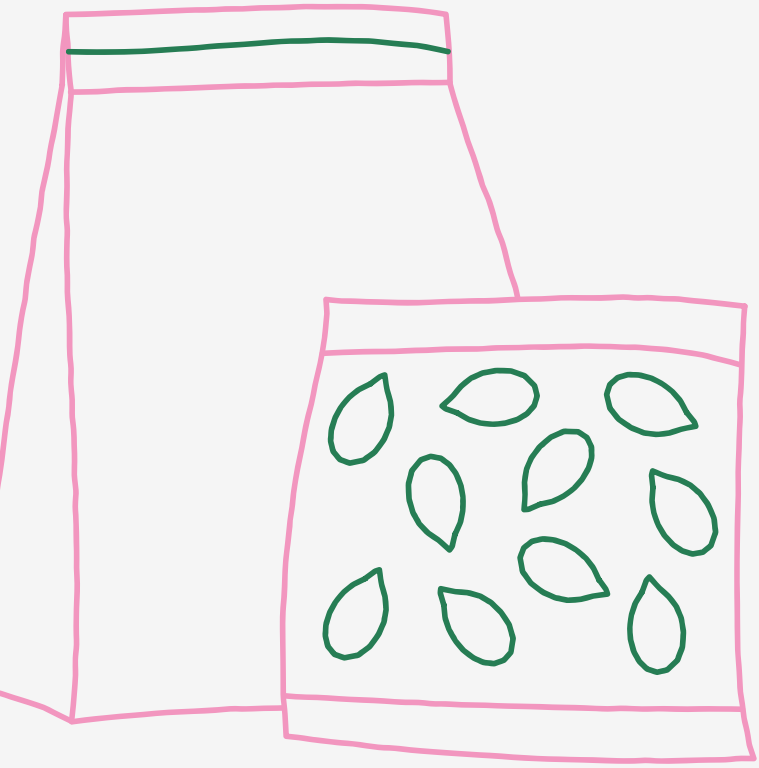
- accurately measuring and disclosing their plastic and packaging footprints;
- setting strong internal targets to reduce single-use plastic, supported by reuse targets and investment to ensure that the method for achieving these reductions prioritises reusable packaging systems;
- reporting on progress against these targets using a consistent and transparent methodology;
- collaborating across the supply chain to establish scalable, standardised reuse alternatives; and
- supporting rather than obstructing progressive government plastics and packaging policies aimed at the retail sector.

[3] For example: supermarkets; convenience stores; clearance stores; and specialty and single-category stores focused on selling particular product types, such as organic or wholefood stores, greengrocers, butchers, or bakeries (Commerce Commission New Zealand, 2024, ch. 3).

These organisations (ibid) have also called on governments to drive reusable packaging uptake amongst grocery retailers by:

- setting legally-binding, measurable, timebound and ambitious targets applicable to the retail sector (among other sectors) to reduce single-use plastics and increase reusable packaging systems;
- mandating corporate reporting on plastic and packaging consumption;
- implementing beverage container return schemes with mandatory return-to-retail;
- subsidising and financially incentivising retailers to adopt reusable packaging;
- establishing reusable packaging standards and design requirements to ensure best-practice reuse systems; and
- introducing other supportive policy mechanisms for reusable packaging, including building reduction and reuse outcomes into extended producer responsibility/ product stewardship (EPR/PS) schemes for packaging.

A 2020 study into packaging-free grocery retailers suggested the need for stronger EPR/PS schemes for packaging that fully internalise the costs of single-use packaging (not just for recovery, but also disposal and litter clean-up costs), combined with additional funding sources to incentivise retailers and consumers to use packaging-free retail systems (Beechener et al, 2020, p.28).



Box 1: Existing laws to require retailers to offer, facilitate and participate in reusable packaging systems

Overseas, policymakers who want to advance reusable packaging systems or packaging product stewardship often recognise the centrality of retailer participation for these schemes to function, but also mainstream retailers' reluctance to take on these roles voluntarily. Legislation may be used to require retailer participation (Changing Markets Foundation, 2022, pp.14-15, 33). Some examples of these laws include:

- Mandating return-to-retail for beverage deposit return systems, which is a feature of many of the systems that have high return rates, albeit generally for single-use packaging (Reloop, 2024).
- Requiring retailers to allocate a minimum floor space to reuse/refill systems. For example, both France and Spain have compulsory targets for supermarkets >400m2 to dedicate at least 20% of their floor space to bulk/unpackaged aisles by 2023 (Spain) and 2030 (France) (Blumhardt, 2023a, p.35).
- Requiring retailers who sell items without packaging to provide customers with reusable containers to fill into, and/or obliging acceptance of customer BYO containers (France) (Blumhardt, 2023a, pp.29-30).
- Stipulating that retailers must carry a minimum percentage of stock in reusable packaging. For example, Austria's Waste Management Act requires retail chains to ensure at least one third of their stores meet a supply quota for beverages in returnable packaging (increasing to 90% of stores by 2025), or that at least 25% of all beverages the retailers sell are in reusable packaging (Changing Markets Foundation, 2022, p.40). In Chile, at least 30% of beverage bottles displayed at point of sale in supermarkets must be reusable; retailers must take back the empty containers for the products they stock (Blumhardt, 2023a, p.35).
- Requiring retailers to provide in-store information to raise consumer awareness about the available reusable packaging options and how to participate. For example, in Chile, retailers must provide information and signage communicating that they sell beverages in reusable packaging, and the importance of consumers returning reusable bottles (Blumhardt, 2023a, p.56).

2.5 PREVALENCE AND ATTITUDE TOWARDS REUSABLE PACKAGING IN THE AOTEAROA NEW ZEALAND GROCERY SECTOR

2.5.1 PREVALENCE

The extent and scale of reusable packaging system uptake in Aotearoa New Zealand's grocery sector varies across product types and retailers, as do the motivations for utilising such systems. Reusable packaging systems have received some recent research attention in Aotearoa New Zealand, some of which has focused on the grocery sector (Diprose et al, 2022; Blumhardt, 2022a, ch 2.4; Kemper et al, 2024; Stewart, 2022). The latter studies confirm that reusable packaging systems for groceries exist, as do shoppers willing to participate in these systems (or even actively seek them out). Despite these "bright spots" (Kemper et al, 2024), available systems are generally niche offerings, peripheral to the mainstream grocery sector, underutilised by well-known brands and stores, and not available for all products. Consequently, their adoption often demands extra effort from producers, retailers and consumers, which is also observed in overseas studies (Kemper et al, 2024, pp.2-3).

No comprehensive, nationwide study of reusable packaging system prevalence in Aotearoa New Zealand's grocery sector has been undertaken. However, a Reuse Aotearoa stocktake of reusable packaging systems in the fast-moving consumer goods/grocery sector in the Waikato region found at least 95 discrete systems across the three reusable packaging system categories (Blumhardt & Peke-Harris, 2024). RBBD systems are the most numerous and diffuse, found in both large and small retailers. Reusable transport packaging is present in the supply chains of most large grocery retailers, and generally operated by third-party providers at significant scale, delivering cost and efficiency savings. In contrast, returnable packaging systems, particularly B2C systems, are overwhelmingly niche and vertically-integrated,[4] usually not stocked in large supermarkets, and mostly only used for a narrow range of product categories (milk, beer, artisanal/cottage industry goods).

Even if only as a small proportion of their overall packaging footprint, many Aotearoa New Zealand retailers do accommodate some level of reusable packaging system in their outlets, beyond reusable transport packaging. One international study noted, for example, the relative commonality of bulk dispenser vending systems in Aotearoa New Zealand, including in conventional supermarkets (James Ross Consulting, 2007, pp.9-10). For certain products, reusable packaging systems are normalised and therefore adopted by a wide range of retailers, e.g., dispensing loose, fresh produce directly from reusable crates.

This research and previous studies (Blumhardt, 2022a; Blumhardt, 2022b) have also shown that some retailers have strong values alignment with reusable packaging systems and devote a considerable proportion of their store to products in reusable packaging. However, they may balance provision of these options with provision of other specialty items in single-use packaging if those items align with other values. For example, organic stores may value the environmental and human health aspects of plastic-free products, but still choose to stock organic items in disposable packaging if alternatives are unavailable. Other specialty stores that have traditionally offered a wide range of unpackaged goods to cater for frugal customers may increase their packaged product lines if these are price competitive and thus align with their affordability values.

[4] That is, operated by the producers of the products contained in the packaging, rather than a third party reusable packaging company.

Aotearoa New Zealand also features 'packaging-free' stores whose entire business model is built around vending groceries via reusable packaging systems (Blumhardt, 2022a, ch. 2.4). In recent years, these stores have emerged across the world to meet consumer demand for radically reduced groceries packaging (Moss et al, 2022; Beechener et al, 2020; Kemper, 2024; Gordon-Wilson et al, 2022; Diprose et al, 2023; Kurian, 2020; Rapp et al, 2017; Louis et al. 2021; Marken & Horisch, 2019; Smits Sandano, 2016; Sjolund, 2016; Scharpenberg et al, 2021; Kurian, 2020; Salkova & Regnerova, 2020; Röjning & Petersson, 2020). These retailers represent "a countermovement to the mainstream supermarkets" (Smits Sandano, 2016, p.iii) by seeking to eliminate the disposable packaging passed on to consumers. They vend most (or all) of their products via RBBD systems and only stock pre-packaged products in returnable packaging. The first such store to open in Aotearoa New Zealand was GoodFor, in Ponsonby, Auckland, in 2017, closely followed by a branch of the Australian chain, The Source, in Kumeu, Auckland. Packaging-free stores have since spread around the country, with their numbers fluctuating from a high point of about 31 in 2020 (The Rubbish Trip, 2020) to around 12 at time of writing.[5]

2.5.2 ATTITUDES

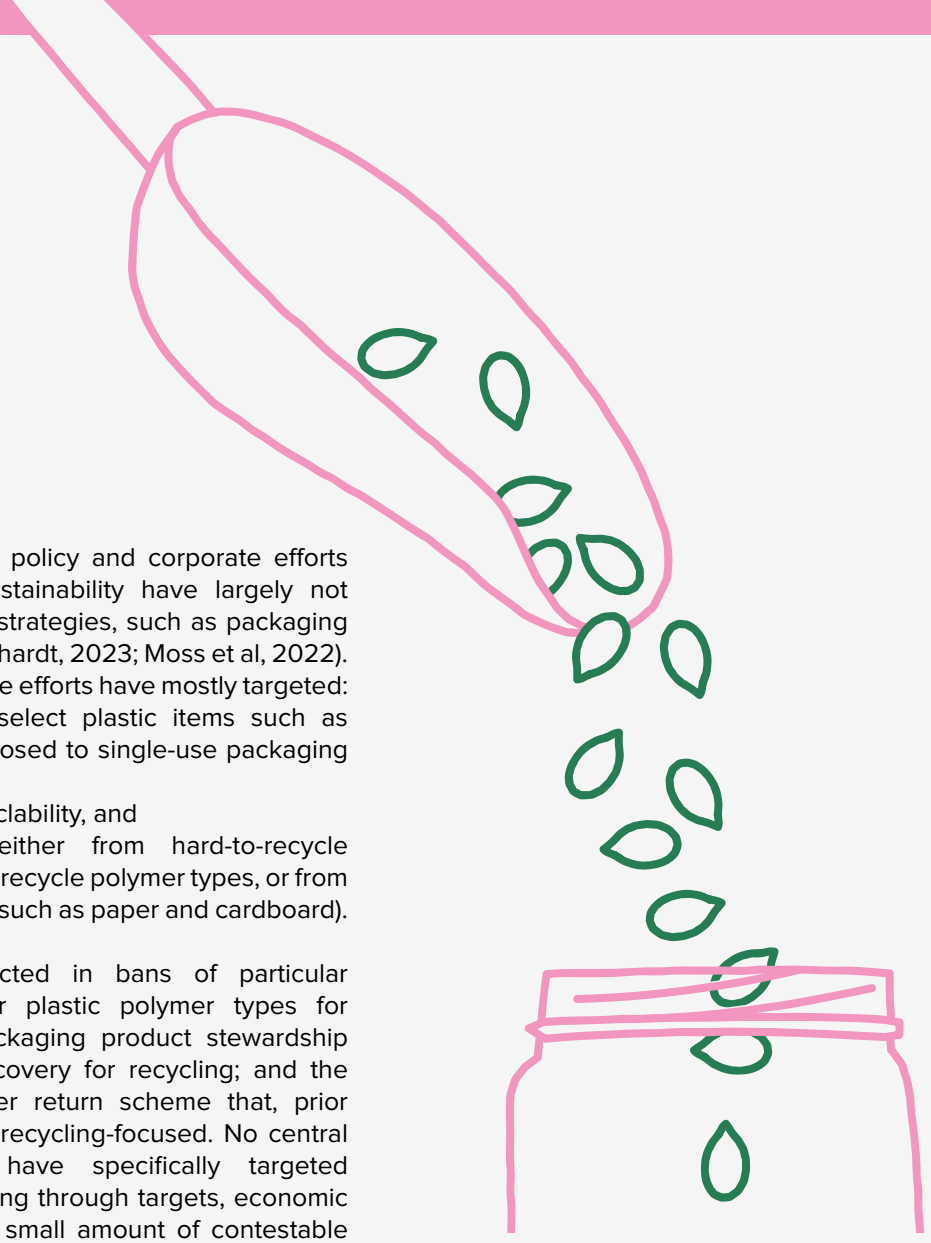
Successive annual surveys demonstrate that the Aotearoa New Zealand public is highly concerned about plastics in the environment; waste and landfilling; and perceived over-packaging (Kantar, 2024, p.10; Kantar, 2023, p.21; Kantar, 2022, pp.14-15), and that these issues influence purchasing decisions (Kantar, 2023, p.24). New Zealanders also believe that businesses have a responsibility (and could do more) to tackle environmental issues (Kantar, 2024, p.19; Kantar, 2023, pp.47-49; Kantar, 2022, p.30). However, these concerns do not necessarily translate to a strong demand for reusable packaging systems specifically. Both local and international studies have noted the public 'intention-behaviour gap' in relation to reuse and other types of sustainable grocery shopping (Greenwood et al, 2021; Munro, Kapitan & Wooliscroft, 2023; see also Kantar, 2024, pp.15-16; Kantar, 2022, p.38). The gap is partially attributable to a lack of awareness or understanding about particular solutions to identified issues, such as reusable packaging (Coelho et al, 2020). Indeed, other solutions (e.g., recycling and compostable packaging) often receive more emphasis in media and public conversations, and are normalised and reinforced by the organised waste and recycling systems that councils provide to households (Blumhardt, 2023). To date, only a small number of media articles have specifically profiled or discussed reusable packaging in Aotearoa New Zealand (see, for example, Graves, 2024; van Dyke, 2023).

However, more important may be the absence of opportunities to access products in reusable packaging, and the considerable shifts required in consumer practices to do so, especially in the context of a lack of available reuse options (Greenwood et al, 2021; Munro, Kapitan & Wooliscroft, 2023). Reinforcing this interpretation, Aotearoa New Zealand consumers have reported affordability and effort as barriers to making more sustainable choices, generally (Kantar, 2022, p.38; Kantar 2023, pp.27-28).

> ***"When it comes to buying things from the supermarket, there's not often a lot of choices that show you all the 'behind the scenes' ... I find it really hard to make choices in my everyday shopping to get something that is sustainable." Female, 30–39 years, Waikato (quote from Kantar, 2022, p.33).***

Furthermore, in Aotearoa New Zealand, public consternation about groceries and grocery retailers goes far beyond packaging to centre on the sector's lack of market competition. The supermarket duopoly, where Foodstuffs and Woolworths dominate 85-90% of the groceries market, has become a cross-party political issue, with accusations of price gouging and super-profits (Commerce Commission New Zealand, 2022; Commerce Commission New Zealand, 2024). The contemporary cost-of-living crisis and high inflation have escalated these concerns. Efforts to increase market competition may help to drive improvements in sustainability in the grocery sector. However, the focus of media commentary, advocacy and policy is on grocery pricing, not packaging. Consequently, conversations about regulating or driving change within the sector may include sustainability and packaging demands, but to win public approval, any such changes would likely need to align with the broader goals of increasing the affordability of grocery items.

[5] Your Shelf (Northland), Refill Nation (2 stores in Auckland), GoodFor (7 stores: 4 in Auckland, and 1 each in Wellington, Nelson and Christchurch), ReStore (Thames), and Bare (Hamilton).



In Aotearoa New Zealand, policy and corporate efforts to increase packaging sustainability have largely not included source reduction strategies, such as packaging prevention and reuse (Blumhardt, 2023; Moss et al, 2022). Instead, policy and corporate efforts have mostly targeted:

- Plastic packaging and select plastic items such as straws and bags (as opposed to single-use packaging generally)
- Recycling rates and recyclability, and
- Material substitution (either from hard-to-recycle polymer types to easy-to-recycle polymer types, or from plastic to other materials such as paper and cardboard).

These focuses are reflected in bans of particular plastic items or particular plastic polymer types for packaging; the plastic packaging product stewardship scheme's emphasis on recovery for recycling; and the ill-fated beverage container return scheme that, prior to its deferral, was largely recycling-focused. No central government regulations have specifically targeted uptake in reusable packaging through targets, economic incentives or otherwise. A small amount of contestable central government funding has been allocated to reusable packaging initiatives, primarily through the Plastics Innovation Fund, which is now disestablished.

The neglect of reuse is also apparent in the progress towards meeting the New Zealand Plastic Packaging Declaration,[6] a voluntary agreement made as part of the Ellen MacArthur Foundation's New Plastics Economy Global Commitment. The latter has the headline goal of 100% of plastic packaging being reusable, recyclable or compostable by 2025. Seventeen local companies signed the Declaration, including both supermarket chains (Woolworths, formerly Countdown, and Foodstuffs), and the local operations of several international companies in the fast-moving consumer goods sector.[7] Despite the inclusion of reuse in the Declaration, corporate action in Aotearoa New Zealand reflects international trends where "companies are leaning much more heavily on recycling and composting than reuse to achieve this goal" (Moss et al, 2022; see also Blumhardt, 2023; Changing Markets Foundation, 2022, p.5).

The trend of supermarkets falling short in implementing reuse systems and out-of-step with public opinion on packaging is also observed in other countries and jurisdictions (Changing Markets Foundation, 2022; Greenpeace UK, 2020). In a 2021 survey on plastic packaging of 130 retailers across 13 European countries, "none of the retailers was found to be performing well" on reusable packaging performance or commitments; instead, supermarkets tended to perpetuate false solutions and greenwashing while lobbying against Government policies that could help to reduce plastic usage and upscale reuse (Changing Markets Foundation, 2022, p.11). In a separate study in 2020, Greenpeace UK noted (p.8):

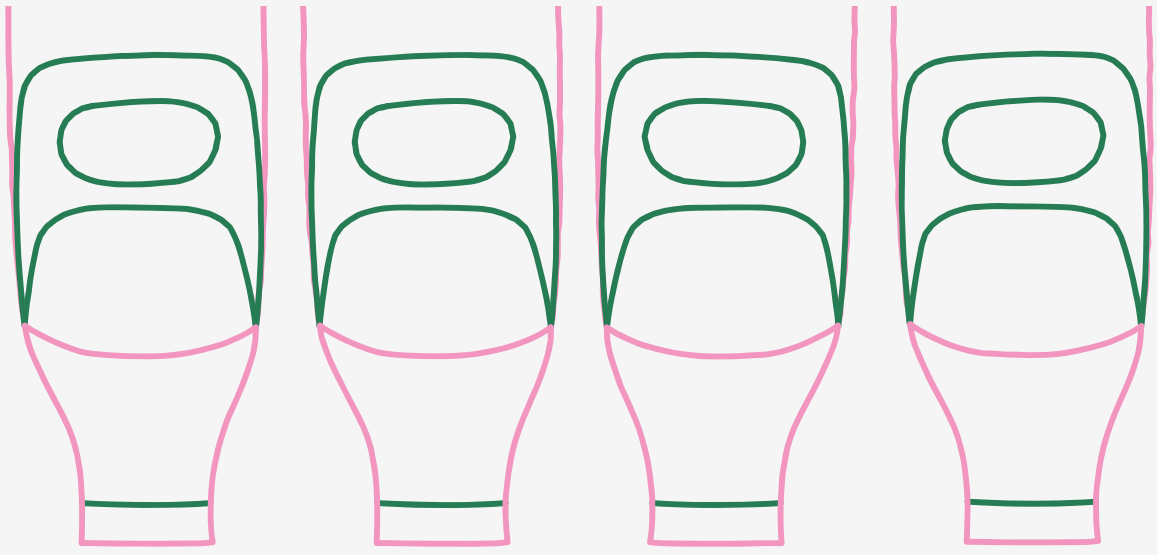
> ***A poll conducted by Populus revealed that over 90% of UK consumers support the idea of having products free of plastic packaging. Yet, despite strong public support and plenty of successful high profile reuse trials, the UK retail sector is lagging behind. While Sainsbury's and Aldi have announced plans to halve their single-use plastic packaging footprint and Iceland has pledged to eliminate plastic from its own brand ranges, only one UK supermarket (Morrisons) has so far set a specific target for reusable packaging.***

[6] See https://environment.govt.nz/what-you-can-do/campaigns/new-zealand-plastic-packaging-declaration/#companies-that-have-signed-the-new-zealand-declaration.

[7] Amcor, Danone, L'Oreal, Mars, Nestle, PepsiCo, The Coca-Cola Company and Unilever.

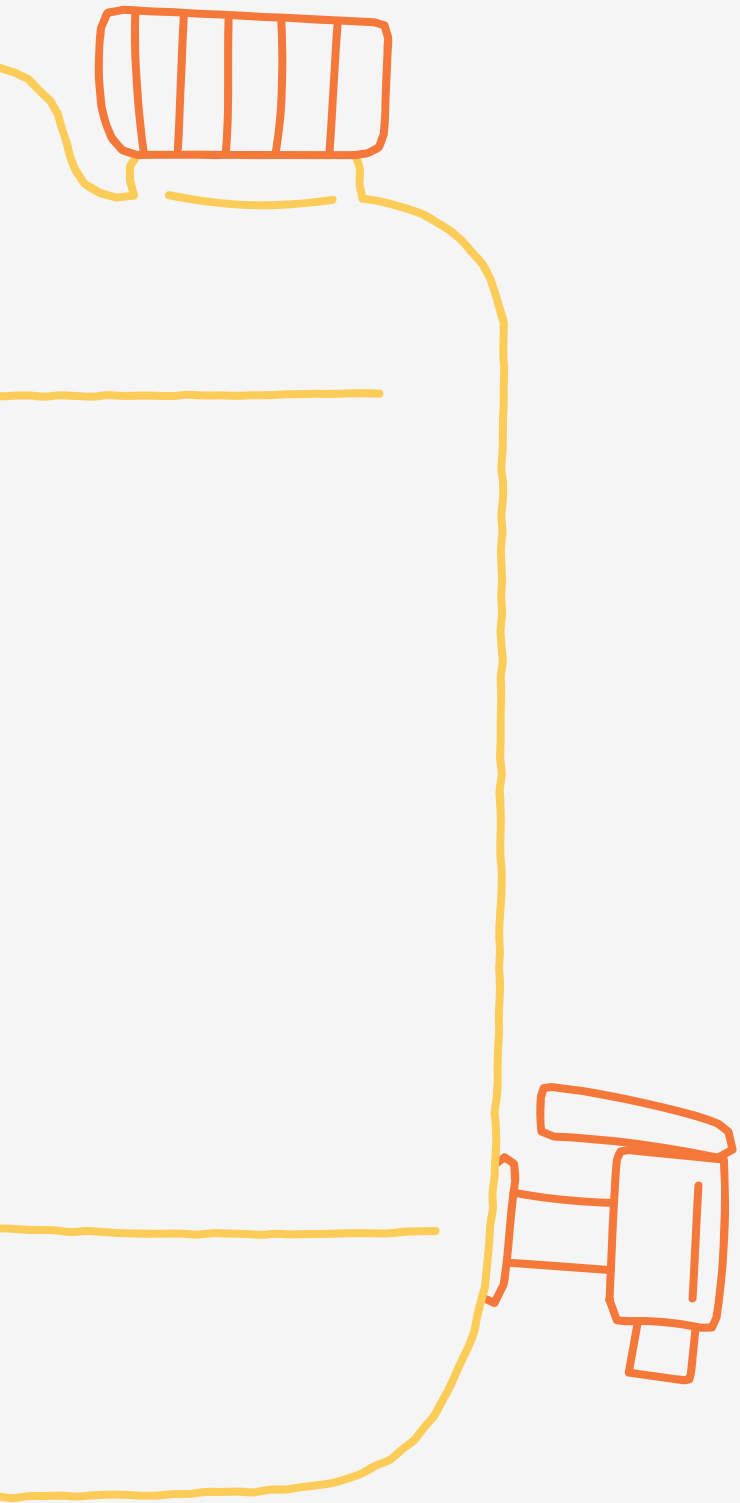
2.6 MAKING THE CASE: WOULD REUSABLE PACKAGING MAKE A DIFFERENCE TO SOCIAL, CULTURAL AND ENVIRONMENTAL SUSTAINABILITY IN THE GROCERY SECTOR?

Reusable packaging systems could potentially help to address the public concern about plastics and over-packaging. However, this needs to be set within the wider context of unaffordable grocery items and a resistance to more ambitious packaging sustainability measures from both government and the grocery sector. Whether and how a viable pathway towards reuse can be achieved is an open question. Research has a role to play in assessing whether reusable packaging systems can achieve desired outcomes around sustainability, such as reductions in plastics usage and over-packaging, alongside broader socioeconomic outcomes, such as the accessibility and affordability of groceries. Tools to measure the actual and potential impacts and outcomes of reusable packaging systems are critical if a case is to be made to increase their uptake in the grocery sector. Developing and applying such a methodology was this study's focus. The following section outlines the literature drawn upon to guide this process.



SECTION 3:
MEASURING IMPACTS AND OUTCOMES OF REUSABLE PACKAGING SYSTEMS

This research used a mixed-methods approach, bringing together quantitative analysis (gathering packaging data, product price reviews and customer surveys) with qualitative approaches (interviews and site observations). This methodology was guided by a preliminary review of the grey and academic literature that addresses aspects of the impacts and outcomes of reusable packaging systems.



This included literature that:

- applies an impact measurement methodology to actual or hypothetical reusable packaging scenarios;
- suggests impact metrics and indicators, without applying them;
- compiles or conducts research to highlight key features of high-performing and low-performing reusable packaging systems; and
- undertook literature reviews or meta-analyses of other studies to highlight learnings or gaps for future assessments of reusable packaging systems.

In addition to a literature review, development of the methodology also drew on a parallel kaupapa Māori study into the relationship between reuse and te ao Māori. This parallel study was critical because most reusable packaging literature comes from overseas, and therefore is not grounded in the knowledge, perspectives and context of Aotearoa, where this research was undertaken. Furthermore, Indigenous research and science is often marginalised in studies into waste, plastic pollution, packaging and circular practices (Peryman et al, 2024). Tāngata Whenua hold tino rangatiratanga in Aotearoa, and therefore ensuring research projects carried out here are informed (and ideally, grounded) in Māori perspectives is essential to ensure they are culturally contextualised and uphold our obligations to Te Tiriti o Waitangi, all of which enhances the quality and relevance of the research.

The kaupapa Māori study was undertaken by Matt Peryman of Ngai Tamawera and Ngāti Awa, a kaupapa Māori researcher, and involved its own literature review and semi-structured interviews with four Māori experts. Insights from this standalone study informed the development of the metrics and indicators for reusable packaging impact for this report. This includes a dedicated cultural impact indicator and metrics (in the form of interview questions) developed by Matt Peryman. At the time of writing this report, the kaupapa Māori study is still being finalised. Rather than summarise the report findings here, we note that the full report, with its broader research scope and purpose, will be available at a later date.

3.1 LITERATURE REVIEW PROCESS

To identify the relevant sources we undertook internet-based searches on the Google and Google Scholar search engines.

We combined variations of each of the following three groups of keywords:

1. "reusable packaging", "refillable packaging", "reuse", "refill", "plastic packaging", "packaging", "packaging-free stores", "zero waste shops", "packaging reduction", "packaging-free", "zero waste"
2. "groceries", "supermarket", "retailer", "store", "food", "beverage", "personal care products", "cleaning products", "supply chain", "distribution"
3. "impacts", "outcomes", "metrics", "measurements", "measuring", "social benefits", "environmental benefits", "economic benefits", "calculating", "indicators", "framework", "sustainability"

From the results, we sorted articles that either analysed reusable packaging impact; touched on the need to do so; and/or offered some comment on appropriate methodological approaches, metrics or indicators for impact measurement (even if these were not applied in the articles). Articles were then reviewed and further categorised according to:

- The **types of impacts** considered (e.g., social, environmental or economic);
- The **key indicators of positive impact** highlighted; and
- Any specific **tools or metrics** used or discussed to assess these indicators.

Most articles did not specifically mention the concepts of 'tools', 'metrics' or 'indicators', or may have used different language to explain similar concepts. Therefore, categorisations were based on the researchers' subjective assessment when reading each source.

The measurement tools or metrics used or suggested in the literature, and the indicators to which they apply, are set out in **Appendix 1**. This section focuses on high-level key insights from the literature review in terms of the importance, scope and approach to measuring reusable packaging impacts and outcomes.

3.2 KEY INSIGHTS

3.2.1 MORE STUDIES ARE NEEDED TO MEASURE THE IMPACT OF REUSABLE PACKAGING SYSTEMS

> ***"... it cannot be assumed that reusable packaging systems will be more sustainable than single-use alternatives" (Bradley & Corsini, 2023, p.126).***

The review confirmed that the impacts and outcomes of reusable packaging systems across a holistic set of metrics and indicators are understudied, as are the methodologies for undertaking these analyses (Coelho et al, 2020). Partly, this is because reusable packaging systems are still a niche business model (Coelho et al, 2020), and the literature on reuse systems is emergent, with most articles written in the last decade (Bradley & Corsini, 2023). Both the grey and academic literature on reusable packaging highlight knowledge gaps relating to impact measurement, suggesting this is an area worthy of study.

Various studies highlight that while reusable packaging can provide many benefits, this is not guaranteed and accurate means of verifying performance or guiding iterative system design improvements is necessary (Bradley & Corsini, 2023; Kachook, 2022). Impact measurement

helps to elucidate factors that can reduce a reuse system's positive impact, like costliness, impracticality or inconvenience (Bradley & Corsini, 2023; Kachook, 2022; WEF, 2021; Coelho et al, 2020; Brown et al, 2022), and to test certain perceptions commonly levelled against the use of reusable packaging systems. For example, concerns about higher prices, hygiene risks, lack of accessibility (Salkova & Regnerova, 2020, p.4; James Ross Consulting, 2007), or unintended environmental burdens, like increased emissions, food waste, water usage and other inefficiencies (Sjolund, 2016; UNEP, 2022, pp.64-65; Mahmoudi & Parviziomran, 2020).

Ultimately, measuring the impact and outcomes of reusable packaging systems against agreed indicators during their emergence and implementation will help lift consumer and business confidence, minimise unintended consequences, reduce inevitable early-stage inefficiencies or weaknesses over time, and work towards widely accessible systems with long-term viability (WEF & Kearney, 2021; Brown et al, 2022). A clear and accepted methodology would also help producers and retailers to track and report on progress against reusable packaging commitments or obligations (Changing Markets Foundation, 2022, p.33; Consumers Beyond Waste, 2022).

> ***"... the environmental benefits of reusable packaging remain aspirational until they can be accurately assessed and confirmed." (Kachook, 2022, p.18).***

3.2.2 IMPACT STUDIES SHOULD ASSESS AGAINST A BROADER RANGE OF INDICATORS

Sources that do consider or discuss reusable packaging impact most often do so from an environmental perspective (e.g., Coelho et al, 2020; UNEP, 2022; Kachook, 2022; Ellen Macarthur Foundation, 2023; Bradley & Corsini, 2023). However, studies increasingly highlight the importance of measuring social (e.g., WEF & Kearney, 2021; Beitzen-Heineke et al, 2017; Bradley & Corsini, 2023, p.136; Kember et al, 2024, p.9; Brazao et al, 2021; Brown et al, 2022; Beechener et al, 2020) and economic impacts too (e.g., Coelho et al, 2020; Mollenkopf et al, 2005; WEF & Kearney, 2021; Ellen Macarthur Foundation, 2023; Peeters et al, 2023; Upstream, n.d.; Brazao et al, 2021; Beechener et al, 2020; Mahmoudi & Parviziomran, 2020). Social, economic, and technical factors are not only intrinsically important but can also affect systems' overall environmental impact (Bradley & Corsini, 2023, p.133; Kachook, 2022; Greenwood et al, 2021; UNEP, 2022, pp.xi, 4-5, 65; Coelho et al, 2020).

Within the context of their proposed Reuse Viability Framework, The World Economic Forum and Kearney (2021) suggest that viable and scalable reuse solutions should assess impact relative to single-use alternatives against nine metrics across three categories: economic, environmental and social (p. 24). Similarly, Beitzen-Heineke et al. (2017) explored the impact of zero-packaging stores using nine impact categories that crossed both social and environmental considerations (p.1536). **Table 3** outlines the range of key indicators used or mentioned in the literature for determining positive impact.

The literature also supports analysis of a broader range of indicators within each category. For example, environmental assessments of reusable packaging have often been narrow in scope, with most such studies selecting LCA of greenhouse gas emissions as the tool of choice (Bradley & Corsini, 2023, p.127 and Coelho et al, 2020; eg Smits Sandano, 2016; Scharpenberg, 2021; UNEP, 2022). In contrast, wider eco-toxicity and plastic pollution considerations for all packaging systems are still understudied (Bradley & Corsini, 2023; UNEP, 2022). Human health impacts also deserve closer attention, including worker safety during handling of reusable containers, hygiene and food safety, and consumer exposure to chemicals of concern (UNEP, 2022, p.xi; Kachook, 2022; Beitzen-Heineke et al, 2017; Mahmoudi & Parviziomran, 2020). From an economic perspective, scientific studies of the lifecycle costs of reusable versus single-use packaging (e.g., comprehensive cost-benefit analyses) are still limited (Coelho et al, 2020; Peeters et al, 2023; Mahmoudi & Parviziomran, 2020), though, increasingly, grey literature in reusable packaging advocacy has considered cost savings for businesses that shift to reuse (Gordon, 2021; Peeters et al, 2023).

The sources recommending greater emphasis on social, cultural, equity, and inclusion impacts in reusable packaging research suggest inquiring into accessibility for different populations, and any effects on local economic development and community wellbeing (Bradley & Corsini, 2023, p.137; Brown et al, 2022; WEF and Kearney, 2021; Global Plastics Policy Centre, 2023, pp.49-50;

UNEP, 2022; Kemper et al, 2024, p.9; Kachook, 2022). For example, a report into a just transition to reusable packaging encourages assessing reuse systems against social dimensions to ensure that environmental gains do not occur at the expense of certain communities, be they consumers, businesses, or workers within the food production, retail, or waste and resource recovery sectors (Brown et al, 2022). This can include looking into the accessibility and availability of reusable packaging systems for consumers and less affluent communities; factors such as pricing, and the location of reusable packaging systems and low-waste retailers; and the extent to which SMEs with a more local focus can participate in reuse systems (Brown et al, 2022). Studies could also consider potential employment impacts, such as whether reusable packaging systems trigger job creation and/or significant changes to day-to-day activities for staff within grocery producers and retailers (Global Plastics Policy Centre, 2023; WEF & Kearney, 2021, p.24; Brazao et al, 2021, p.35; Brown et al, 2022; Beechener et al, 2020).

Table 3: Impact indicators from the reusable packaging literature

Environmental impact indicators	Reusable packaging results in: ▶ **Avoided, replaced, reduced single-use packaging, waste disposal and/or plastic pollution** (e.g., UNEP, 2022; Minami et al, 2010; Beitzen-Heineke et al, 2017; Kachook, 2022, p.44; John Lewis Partnership, 2020; Ellen Macarthur Foundation, 2023; Consumers Beyond Waste, 2022; Kachook, 2022; Gordon, 2021; Upstream, n.d.b.; Copello et al, 2021; Beechener et al, 2020; Tsiliyannis, 2005) ▶ **Conservation of natural resources and reduced greenhouse gas emissions** (e.g., UNEP, 2022; Minami et al, 2010; Beitzen-Heineke et al, 2017; Bradley & Corsini, 2023; WEF & Kearney, 2021; John Lewis Partnership, 2020; Ellen Macarthur Foundation, 2023; Gordon, 2021; Copello et al, 2021; Beechener et al, 2020; Mahmoudi & Parviziomran, 2020; Tsiliyannis, 2005) ▶ **Minimisation of food waste** (UNEP, 2022; Beitzen-Heineke et al, 2017; John Lewis Partnership, 2020; Sjolund, 2016)
Social impact indicators	Reusable packaging enables: ▶ **More affordable and accessible groceries** (e.g., UNEP, 2022, pp.xi, 60; Beitzen-Heineke, 2017; Kachook, 2022; Marken & Horisch, 2019; Lofthouse et al, 2009; Brown et al, 2022; Beechener et al, 2020) ▶ **New, quality employment opportunities** (e.g., WEF & Kearney, 2021; Brazao et al, 2021, p.35; Brown et al, 2022; Beechener et al, 2020) ▶ **Augmented consumer/community wellbeing, experience and connection with the groceries/food system** (WEF & Kearney, 2021, p.24; Beitzen-Heineke, 2017; Kachook, 2022; Brown et al, 2022) ▶ **Protection of human health, including from toxicity or hygiene risks, or by promoting less processed food** (e.g., UNEP, 2022; Kachook, 2022; Beitzen-Heineke, 2017; WEF & Kearney, 2021, p.24; Gordon, 2021; Coelho et al, 2020)
Economic impact indicators	Reusable packaging systems display: ▶ **Profitability or financial viability** (e.g., WEF & Kearney, 2021; Kachook, 2022; Peeters et al, 2023; Ellen Macarthur Foundation, 2023; Upstream n.d.a; Upstream, n.d.b.; Gordon, 2021; Brazao et al, 2021; Brown et al, 2022; Beechener et al, 2020; Mahmoudi & Parviziomran, 2020) ▶ **Accessibility for suppliers, local producers and SMEs** (e.g., WEF & Kearney, 2021; Brown et al, 2022; Beechener et al, 2020) ▶ **Operational ease of adoption by producers/retailers** (Kachook, 2022, p.46)

3.2.3 IMPACT STUDIES SHOULD TAKE A MIXED-METHODS APPROACH

The measurement tools or metrics used or suggested in the literature, as set out in **Appendix 1**, can be:

- **qualitative**, such as deriving information from interviews or making observations during store visits; and/or
- **quantitative**, such as gathering detailed data, through surveys or observations, to input into agreed formulas or frameworks to calculate numeric impacts.

The literature review generally supports the view that reusable packaging impact measurement should adopt more mixed-methods approaches that combine quantitative and qualitative assessments; that analyse and compare case studies grounded in real-world data, stakeholder behaviour, and supply chain/logistics analysis; and that feature greater contributions from the social sciences, arts, and humanities fields (Coelho et al, 2020; Bradley & Corsini, 2023, pp.136-137).

While some studies incorporate both qualitative and quantitative data,[8] overall, quantitative and technical approaches dominate the studies of reusable packaging system impact, with most such studies relying on LCA to assess secondary and tertiary packaging in supply chains (Bradley & Corsini, 2023; Coelho et al, 2020; Mahmoudi & Parviziomran, 2020). Quantitative analysis in these contexts is often narrow in scope, so data to quantify a broader range of impacts and indicators is still lacking, such as economic data to perform cost-benefit analyses (Coelho et al, 2020; Brazao et al, 2021; Peeters et al, 2023) or employment data to help quantify job creation potential (Brown et al, 2022).

In contrast, the smaller number of studies that consider primary packaging tend to use qualitative methods, such as case studies, surveys and focus groups, interviews, and workshops (Bradley & Corsini, 2023, p.128). Many of these studies focus on describing existing systems (e.g., case studies), outlining the barriers and opportunities to uptake of these packaging systems for producers and retailers, and consumer willingness to participate. Similarly, many of the studies that explore 'unpackaged' retail systems rely on interviews without quantitative data (Beitzen-Heineke et al, 2017; Diprose et al, 2022; Blumhardt, 2022; Röjning & Petersson, 2020). Where impacts are considered, they tend to be derived from interviewees' perception rather than empirical data. In their interview-based study of the social and environmental impacts of zero-packaging stores, Beitzen-Heineke et al recognised this limitation and, when reflecting on future research pathways, noted that (2017, p.1539):

> ***Quantitative studies are also needed to measure the impact: e.g., generation and prevention of packaging waste and food waste (at supplier, store and consumer level), as well as impacts on local economies and small producers.***

Similarly, in their 2020 study of European packaging-free stores, Beechener et al called for more quantitative and standardised approaches for measuring: packaging avoided and emissions impacts from these stores, and the prevalence of stores and the volume of product/number of units they sell in reusable packaging in order to compare against conventional grocery retailers (p.36). This study also highlighted the need for more understanding of qualitative factors, such as why packaging-free stores stock certain products over others, how the nature of jobs change in these stores over time, and why some customers choose to shop in packaging-free stores (p.36).

[8] For example, combining quantitative measurement of factors such as packaging avoided, the number/prevalence of packaging free stores, sales data, price/costs or greenhouse gas emissions, with interviews with experts about the barriers or opportunities to reusable packaging systems, or customer surveys and exit interviews that asked qualitative questions about how customers feel about the shopping experience, benefits or drawbacks they perceived, or their motivations for choosing reusable packaging options (John Lewis Partnership, 2020; Salkova & Regnerova, 2020; Minami et al, 2010; James Ross Consulting, 2007; Brazao et al, 2021; Beechener et al, 2020). One study that undertook packaging and price comparisons between packaged and unpackaged groceries also undertook interviews with store owners to understand the impacts to the retailer, the consumer and the environment of RBBD systems (James Ross Consulting, 2007, pp.10-11). Mixed-methods approaches are also used in assessments of reusable packaging systems outside the groceries sector (Greenwood et al, 2021; Brazao et al, 2021).

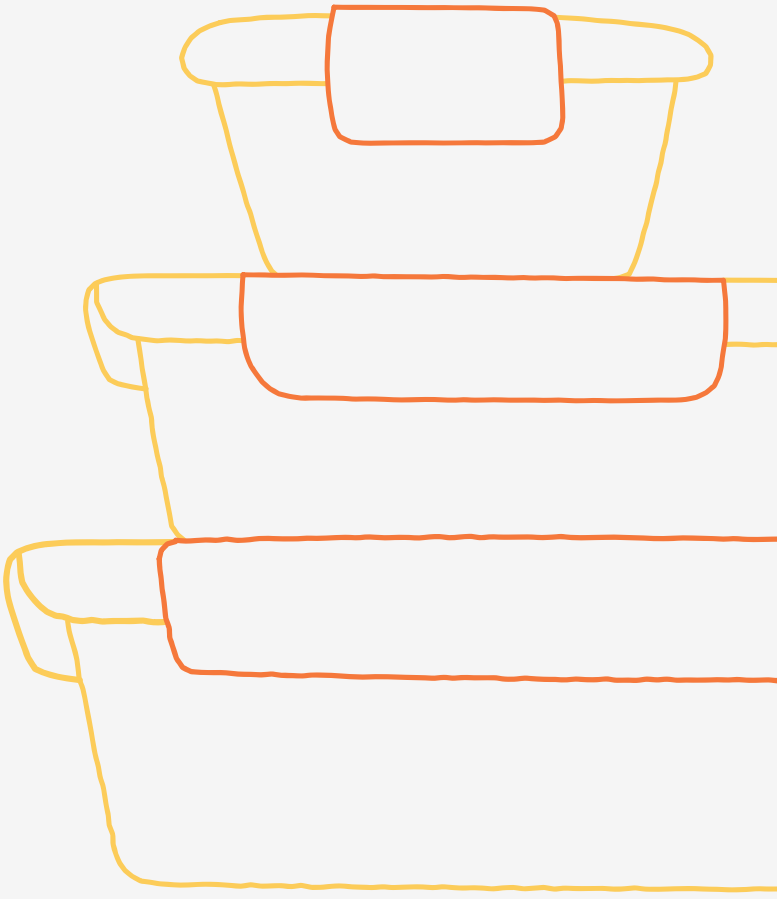
3.2.4 IMPACT STUDIES SHOULD ASSESS THE FULL SUPPLY CHAIN AND COMPARE AND CONTRAST PACKAGING TYPES

The impact measurement framework should take a holistic approach, capable of spanning across supply chains and including all reusable packaging system types (UNEP, 2022, pp.xi, 59). To date, assessments have been inconsistent in scope. For example, some studies that measure packaging consumption in single-use or reuse systems calculate and compare only the packaging passed on to the consumer within each system (Greenpeace, 2020; Salkova & Regnerova, 2020; James Ross Consulting, 2007), while others also consider the supply chain packaging to bring product to store for the different consumer-facing packaging systems (John Lewis Partnership, 2020; Dolci et al, 2016; Minami et al, 2010; Scharpenberg et al, 2021). Beechener et al (2020) note the need for more studies into the supply chains of packaging-free stores to understand where "blockages" and opportunities lie for both packaging and cost effectiveness (p.36).

Most studies quantifying reuse system impact have focused on points in the supply chain, particularly secondary and tertiary reusable transport packaging. Meanwhile, consumer-facing primary packaging reuse systems have been understudied (Bradley & Corsini, 2023; Coelho et al, 2020; Mahmoudi & Parviziomran, 2020). While consumer-facing reusable packaging systems should receive more attention, studies should still consider the rest of the supply chain (Scharpenberg et al 2021; UNEP, 2022, p.59) because what appears on the retail shelf represents only part of the packaging required to get that product to the consumer.

Methodologies that assess packaging types across the supply chain should also be sensitive to different reusable packaging models and accommodate these within the impact assessment so that these models can be compared and contrasted against each other, as well as against single-use packaging (Bradley & Corsini, 2023, p.136; Coelho et al, 2020; UNEP, 2022, p.xi, p.59). Differentiation is critical because different models can produce different outcomes, requiring some considerations to receive greater analytical emphasis than others. For example, return rates and reverse logistics are critical to the overall cost and environmental impact of a returnable packaging system (UNEP, 2022, p.xi, Coelho et al, 2020), whereas RBBD models require a supply chain focus to assess whether reuse (as opposed to packaging prevention), is even occurring (Global Plastics Policy Centre, 2023; UNEP, 2022, pp.xi, 42).

However, currently, much of the literature does not sufficiently differentiate between reusable packaging models when analysing various aspects such as design, performance, uptake, impacts and outcomes. For example, studies focused on primary packaging often do not differentiate between RBBD and returnable models (Bradley & Corsini, 2023, p.128). Sjolund (2016) and Scharpenberg et al (2021) are examples of studies that investigated the environmental impact of a packaging-free store, comparing both the RBBD and the returnable packaging model. In its meta-analysis of supermarket food packaging LCA, UNEP (2022) differentiated studies that considered reusable packaging based on the two models and presented the meta-analysis findings accordingly.



3.2.5 COMPARING DIFFERENT RETAIL CONTEXTS IS RELEVANT WHEN STUDYING REUSABLE PACKAGING SYSTEM IMPACT IN THE GROCERIES SECTOR

Given the role of retailers as "gatekeepers" of the groceries sector, sitting at the interface between consumers and suppliers (Marken & Horisch, 2019, p.166; Smits Sandano, 2016, p.2), studies into packaging systems in this sector commonly place retailers as a focal point of analysis. This involves interrogating not only the impacts and outcomes of different packaging systems for particular products, but also the impacts and outcomes of the retail contexts, structures, and modalities within which those packaging systems operate. This can be compared with studies that select individual products (UNEP, 2022; Dolci et al, 2016) or particular reusable packaging models (James Ross Consulting, 2007), as the focal point. Placing retailers at the centre of a study can enable a more holistic analysis of impacts and outcomes that is sensitive to wider contexts. Furthermore, where retailer participation is secured (or retailers have commissioned the study), researchers may have access to more detailed data than might otherwise be the case, reducing the need to rely on assumptions.

For example, several studies focus specifically on supermarkets' contribution to packaging waste. These studies seek to use real-world single-use packaging information to model what outcomes might be expected from a hypothetical increased uptake of reusable packaging systems in supermarkets (e.g., Greenpeace UK, 2020; EIA & Greenpeace, 2021). Other studies have focused on an established conventional supermarket that hosts a dedicated RBBD area in order to evaluate the impact of this initiative compared to the single-use packaged equivalents in the same store using metrics such as price, packaging avoided and consumer responses (John Lewis Partnership, 2020; Minami et al, 2010; Marken & Horisch, 2020). Meanwhile, studies focused on the impact of packaging-free stores may identify one specific packaging-free store with whom the researchers work closely. Researchers may compare the impact of purchasing a representative sample of products from the identified packaging-free store (usually via a RBBD modality) with the impact of purchasing the same/similar product in single-use packaging from a mainstream retailer (e.g., Salkova & Regnerova, 2020; Kurian, 2020; Scharpenberg et al, 2021). As the retail modality is itself novel, many studies will also analyse the prevalence and viability of the retail model specifically (Beechener et al, 2020; Louis et al, 2021) or its socioeconomic impacts for customers, suppliers, employees, and the wider community (Beitzen-Heineke et al, 2017; Fuentes et al, 2019; Gordon-Wilson et al, 2022).

3.2.6 DEPTH OF ANALYSIS IN BROAD, HOLISTIC STUDIES MAY REQUIRE A 'FOCUS PRODUCT' APPROACH

Groceries contexts are vast and complex, with tens of thousands of different product lines, considerable brand diversity within product categories, and long supply chains. Where a study assesses just one impact metric, it may be reasonable to include a wide range of products. For example, Greenpeace UK (2020) looked at 54 different retail product categories when testing the potential B2C packaging avoidance if supermarkets increased use of reusable packaging systems (p.23). However, researchers may need to identify a smaller, representative range of products to make manageable and realistic broader studies that look across the supply chain, compare and contrast distinct reuse packaging types, and/or consider a range of impacts and metrics. For example, Corona et al's (2019) literature review evaluating 19 tools for measuring circularity found there is a tradeoff between the scope of analysis each tool performs and the practical usability of the tool, leading to more comprehensive tools often being applied to more narrow areas of focus.

Selecting focus products for a comprehensive analysis is often the approach taken for LCA (e.g., Kurian, 2020; Sjolund, 2016; Dolci et al, 2016; UNEP, 2022; Scharpenberg et al, 2021), especially those studies that compare packaging-free grocery stores against conventional retailers. The latter tend to focus on a small number of specific products and follow them through the supply chain, from producer to store shelf, for both single-use and reuse systems (see, for example, Sjolund, 2016; Scharpenberg et al, 2021; Kurian, 2020). Generally, these studies also work with a small number of retailers, such as one packaging-free store and one conventional store. Studies comparing packaging consumption of reusable and single-use packaging systems also often take a targeted approach, comparing the packaging used to sell a certain amount of focus products in a single-use package versus through a reusable packaging system (Minami et al, 2010; Salkova & Regnerova, 2020; James Ross Consulting, 2007). Overall, this selectivity is necessary, as a full study of all grocery items across multiple types of stores would be unwieldy.

If a focus product approach is taken, criteria to justify the selected focus products is required. Some of the criteria used in the literature for focus product selection included:

- Basic wholefood categories that are considered commonly-used or staple foods, e.g., rice, flours, cereals, oils, pulses/legumes, tea/coffee, condiments and spices (Minami et al, 2010; Salkova & Regnerova, 2020).
- Products that are generally available in packaging-free stores and/or via the different types of reusable packaging systems (given it can be assumed these products will also be available in the much larger product range available in conventional stores). This ensures all reusable packaging system types can be fairly considered (Scharbenberg et al, 2021), and it allows equal evaluation and comparison of the niche packaging-free store model with the conventional supermarket model (Kurian, 2020, p.9).
- Availability of data and case studies in relation to the product being provided via reusable packaging systems (Brazao et al, 2021, p.10).
- Where a hypothetical reusable packaging model is being generated, researchers may choose product groups where reusable packaging systems would have highest positive impact, i.e., where, on the one hand, single-use packaging waste generation is high (based on factors like the level of consumption of the product, packaging weight and materials, rates of recycling and littering etc.), while on the other hand, barriers and tailwinds to implementing alternative reuse systems are lower and higher, respectively (Brazao et al, 2021, p. 10; Copello et al, 2022, p.8).

SECTION 4:
OUR CHOSEN INDICATORS AND METHODS

Based on the findings of the literature review and kaupapa Māori study, we opted to trial a holistic mixed-method quantitative and qualitative approach to measuring the impacts and outcomes of reusable packaging systems. The approach would separately assess the performance of different packaging systems (single-use, RBBD and returnable packaging) in the context of different retail approaches (packaging-free stores; stores with reliance on single-use and reuse; and conventional supermarkets) against seven indicators covering environmental/health, socioeconomic, and cultural themes (**Table 4**). Primary, secondary and tertiary packaging were all included in the analysis scope to ensure a supply chain perspective.

The research methods included:

- Interviews with retailers and their producers/suppliers.
- Site visits to interviewees as well as other retailers and recycling centres to gather data about primary, secondary and tertiary packaging.
- Searching retailer websites to gather focus product prices and further packaging information not gathered from site visits.
- An online and hard copy survey for customers at participating retailers.
- Using publicly available data (Google maps) to gather information on the socioeconomic accessibility of retailers.

Given the holistic range of indicators, and the decision to compare different packaging systems across the supply chain, we opted to restrict the range of retailers and products considered (as with other studies undertaking similarly comprehensive analyses). For retailers, we took a case study approach based on in-depth interviews with four retailers. For products, we analysed six focus products sold via different consumer-facing packaging systems in the retailers we interviewed. During interviews we discussed the supply chain packaging used to get that product to store, and where possible, followed this up with interviews with the producers/suppliers of those products.

Interview questions with both retailers and producers/suppliers were developed to help draw out relevant information for each of the chosen indicators, based on the metrics identified in the literature review. After the interviews, packaging data gaps were filled through publicly available information (internet searches) or through purchasing/sourcing samples from stores or recycling centres.

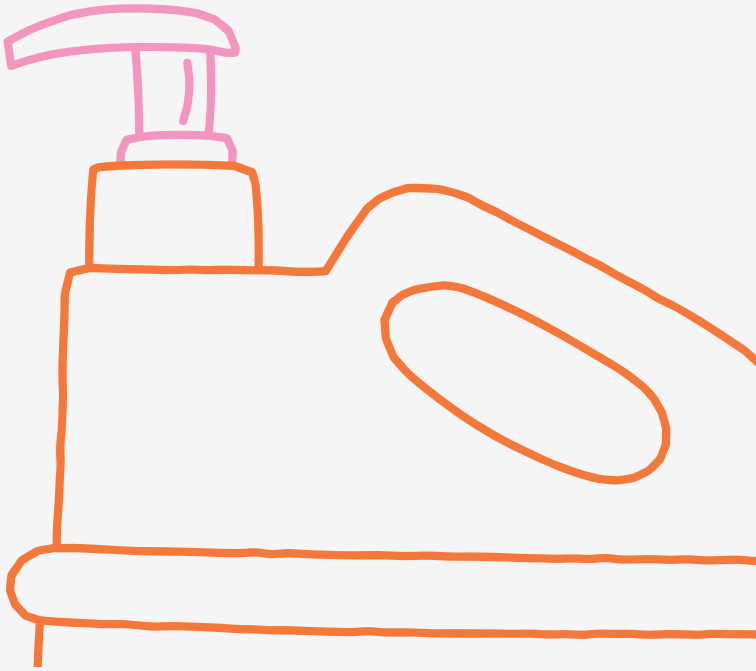


Table 4: Our chosen indicators

Environmental/health	Packaging is avoided
	Packaging systems protect physical health
	Food waste is avoided
Socioeconomic	Accessibility (cost, ease, availability/options) of groceries is increased
	New, quality jobs are created
	Community wellbeing and engagement is enhanced
Cultural	Collective wellbeing is improved

4.1 RETAILER PARTICIPATION SELECTION

To select retailer participants, we created a longlist of groceries retailers based in two areas of Aotearoa New Zealand: Waikato and Wellington.

We selected two regions to increase the representativeness of the results. We chose Waikato and Wellington because the research team is located across these two regions, so in-person interviews and site observations could occur without requiring carbon-intensive travel. For each region, we aimed to represent:

- A mainstream/single-use packaging retailer (those who primarily sell products in single-use packaging);[9]
- A packaging-free/zero waste grocer (those who primarily sell products via reusable packaging systems as a key part of their business model);
- A specialty retailer (those who provide a mixture of both single-use and reusable packaging systems and tend to also offer specialty products such as organics and culturally specific food).

In addition, we aimed for a mix of retailers to ensure that across our interviewees, there were in-store examples of both single-use and reusable packaged options for each of the six focus products, in each region. We relied on The Rubbish Trip regional zero waste guides to identify stores (The Rubbish Trip, n.d.).

4.2 FOCUS PRODUCT SELECTION CRITERIA

To select the focus products, we applied the criteria in **Table 5**. These criteria were informed by the literature in terms of focusing on essential, basic products that are commonly available in both single-use and reusable packaging, packaging-free stores, and supermarkets in order to enable a real-world comparison using existing data and case studies (Minami et al, 2010; Salkova & Regnerova, 2020; Kurian, 2020, p.9; Brazao et al, 2021, p.10).

We also added the criterion that all products must have both locally produced and internationally produced options, in case production location had any effect on the impacts we were considering.

The selection process involved working through various potential product options and doing online checks to ensure that each product met the criteria and could be analysed against our selected indicators (e.g., packaging avoidance, cost, accessibility, etc). To reduce complexity, focus products were limited to the unprocessed, wholefood version of the product. For example, we did not consider infused olive oil, or oats containing berries or other ingredients.

After identifying focus products and retailers, we shortlisted producers/suppliers to interview from those selling focus products in our selected retailers. We prioritised producers/suppliers based in Waikato and Wellington, though some were based in other regions. Suppliers import and/or distribute products, and are often involved in packaging the products before sending them to retailers, whereas producers manufacture the products. In some cases, these categories overlap when producers distribute their own products. For the purposes of this study we merged this category of interviewee as producer/supplier.

[9] Retailers in this category often do sell products in both single-use and reusable packaging. For example, many supermarkets sell some products via RBBD. However, the majority of their products are single-use, so we categorised them accordingly.

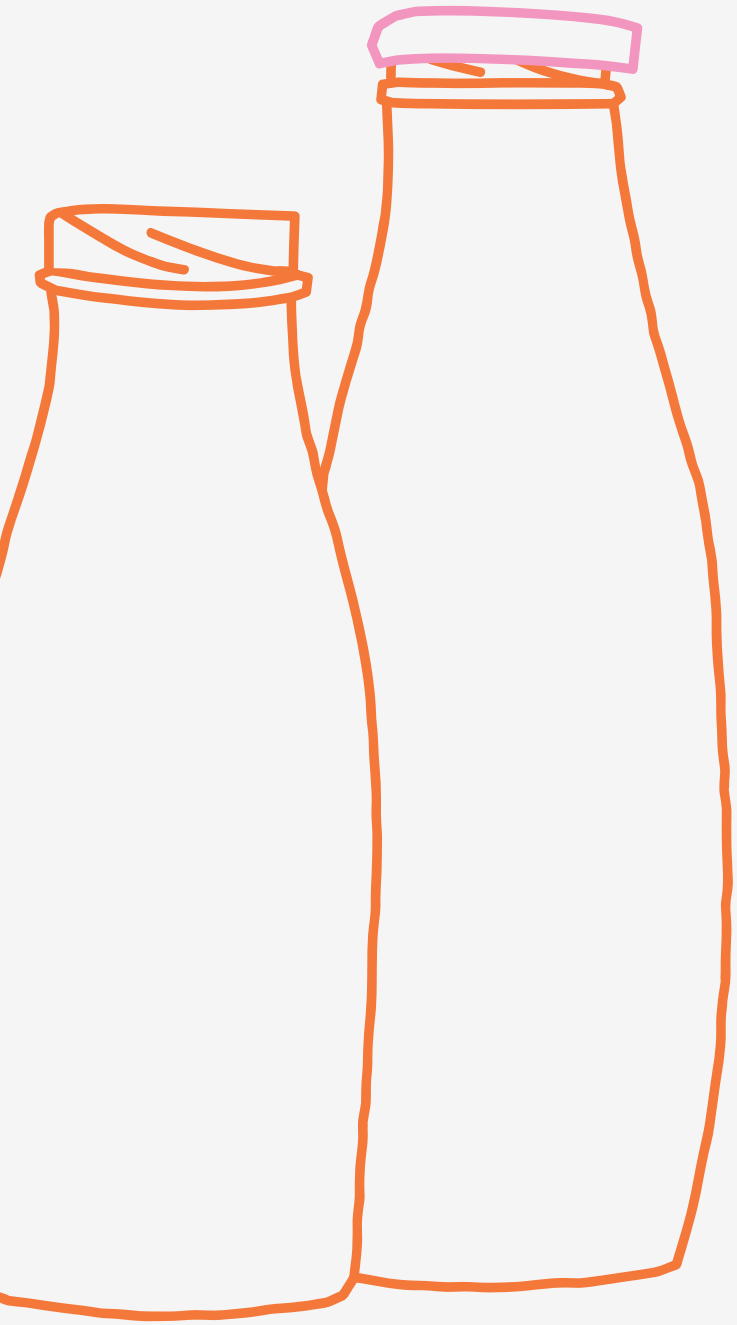
Table 5: List of focus products and selection criteria

Criteria	Products					
	Milk (cow)	**Toothpaste**	**Olive oil**	**Pumpkin seeds**	**Oats**	**Dishwashing liquid**
Offered in both single-use packaging, and RBBD/ returnable packaging systems to enable comparisons	✓	✓	✓ (except B2C returnable)	✓ (except B2C returnable)	✓ (except B2C returnable)	✓ (except B2C returnable)
Represents the range of commonly purchased products in NZ	✓	✓	✓	✓	✓	✓
Includes both 'liquid' and 'dry' products to understand implications for packaging	✓ Liquid	✓ Liquid	✓ Liquid	✓ Dry	✓ Dry	✓ Liquid
Have different 'shelf lives' to understand implications for packaging	✓ Short	✓ Long	✓ Long	✓ Long	✓ Long	✓ Long
Not highly processed or modified to help ensure fairer comparison between products	✓	✓	✓	✓	✓	✓
Generally regarded as a staple or non-luxury item to ensure relevance to a range of consumers	✓	✓	✓	✓	✓	✓
Grown/processed/ manufactured in NZ and imported to ensure comparisons along supply chains	✓[10]	✓	✓	✓	✓	✓

[10] New Zealand milk imports are only 0.000448% of milk consumed in New Zealand (source: https://www.renews.co.nz/nz-has-so-many-cows-why-do-we-import-millions-of-tonnes-of-dairy/).

4.3 RESEARCH PARTICIPANTS

We approached our longlist of potential retailer and producer/supplier interviewees by email, phone, and in-person to invite them to participate in the research. We interviewed nine participants: four retailers and five producers/suppliers. We also obtained emailed information on product packaging from one additional producer/supplier and drew on previous interviews from relevant producers/suppliers (with their permission) to supplement interview content or where we were unable to secure an interview for this particular project. In total, there were 11 research participants.



We aimed to interview a retailer and producer/supplier for each of the six focus products across all three packaging types (single-use, returnable and RBBD) to understand the primary, secondary, and tertiary packaging associated with each product along the supply chain. **Table 6** outlines the research participants who were interviewed or who provided information. The table describes the participants' role (retailer or producer/supplier), position in supply chain, location, indication of the scale/size of their operation, the different types of packaging systems they utilise, and whether a site visit was completed. In line with our social ethics requirements, we have not named participants and instead used numbered pseudonyms. While we managed to interview participants that could speak to all of the focus products, these were not necessarily representative of the full range of producers/suppliers.

Participants were either small or medium-sized enterprises. As the research progressed, we found interviews with these sized organisations were more manageable, and consequently focused our recruitment efforts on them. The feedback we received from larger retailers and producers/suppliers who declined to participate was that they either did not have time or were focused on their own sustainability priorities.[11]

[11] Small-medium retailers and producers/suppliers may have found it less time-consuming to participate because they stock or produce a smaller range of products with less complex supply chains and can therefore answer questions about packaging more easily. However, these enterprises often have fewer employees, so participating was still a commitment.

Table 6: Research Participants

Participant number	Role	Position in supply chain	Location	Scale/size	Packaging options	Site visit
1	Retailer	Retail - business to consumer	Wellington region	Medium - multiple stores	Single-use; Returnable; RBBD	Yes
2	Retailer	Retail - business to consumer	Wellington region	Small - one store	Single-use; Returnable; RBBD	Yes
3	Retailer	Retail - business to consumer	Waikato	Small - one store	Single-use; Returnable; RBBD	Yes
4	Retailer	Retail - business to consumer	Waikato	Small (one store but franchise)	Single-use; Returnable; RBBD	Yes
5	Supplier/ producer	Producer/vendor*	Wellington (but national distribution)	Small	Returnable; RBBD	No
6	Supplier/ producer	Producer/vendor*	Whanganui (but national distribution)	Small	Single-use	No
7	Supplier/ producer	Producer/vendor*	Waikato (but national distribution)	Small	Returnable; RBBD	No
8	Supplier/ producer	Producer/vendor*	Waikato	Small	Returnable	No
9	Supplier/ producer	Producer/vendor*	Waikato	Small	Returnable; RBBD	No
10	Supplier/ producer	Producer/vendor*	Auckland (but national distribution)	Medium	Single-use	No
11	Supplier/ producer	Producer/ Distributor	Auckland (but national distribution)	Medium	Single-use; Returnable; RBBD	No

*Includes some ancillary retail components (either physical stores or online sales).

4.4 INTERVIEWS AND SITE VISITS

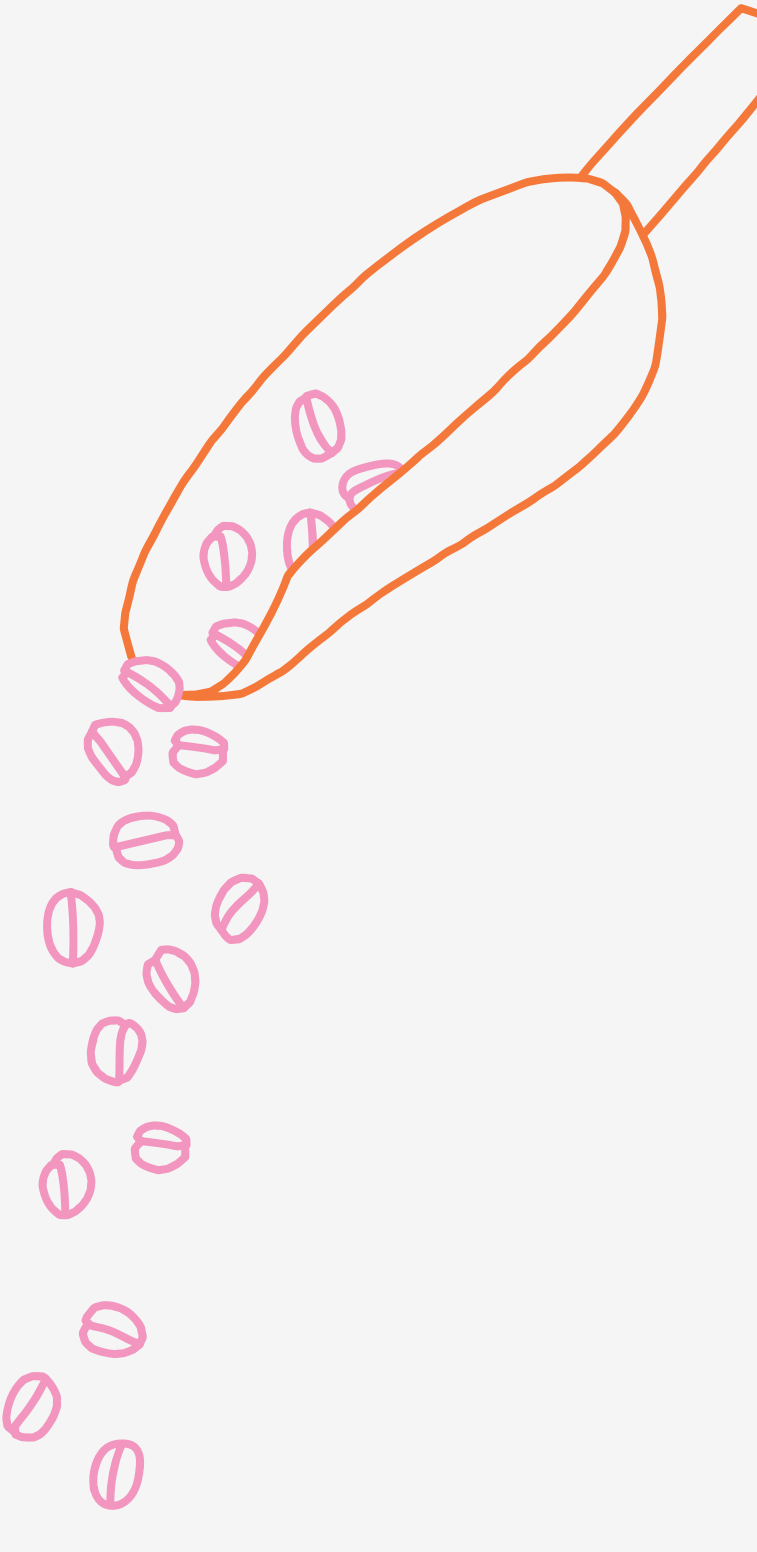
We used a structured interview schedule with slightly different questions for participants depending on whether they were retailers or producers/suppliers and the type of packaging systems they operated. Our interview questions were grouped according to the impact indicator they related to and were designed to draw out the types of information our literature review had highlighted as relevant to assessing each indicator (see **Appendix 1**). **Table 7** thematically summarises the questions.

We conducted all retailer interviews in-person, whereas producer/supplier interviews were conducted online or participants provided email responses. In-person retailer interviews involved a site visit where research team members located all on-shelf versions of each of the six focus products and recorded:

- The product price;
- The type of packaging system (single-use, returnable, RBBD); and
- The material, weight and size of primary, secondary and tertiary product packaging.

During these site visits, in addition to providing responses to qualitative questions about environmental, socioeconomic, and cultural aspects related to packaging, retail participants showed research team members around their stores and described any reusable packaging systems, associated in-store signage, and other supporting materials (e.g., bins, dispensers, single-use and reusable jars and other containers). Where possible, members of the research team photographed the primary, secondary and tertiary packaging for each focus product during the site visit. The interviews and site visits took between 1.5–3 hours and often involved multiple visits to obtain all the relevant information, particularly related to quantifying packaging.

We analysed interview and site visit data differently depending on the kind of data. For data related to more qualitative questions (perceptions, narratives, and reflections) we used an iterative thematic analysis approach guided by our choice of indicators. Quantitative data relating to 'packaging avoided' was input into a spreadsheet to enable analysis.



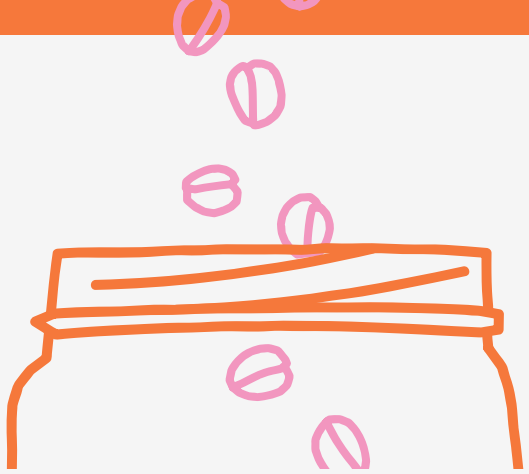


Table 7: Thematic summary of questions asked for each indicator

Indicator	Question themes
Packaging is avoided	▶ For each of the focus products stocked, supplied or manufactured, interviewees were asked to share the weight, material, capacity, and dimensions of the primary, secondary and tertiary packaging used to get that product from the producer/supplier to the retail shelf, and to note whether each layer of packaging is single-use or reusable. ▶ Questions to help quantify reuse rates for returnable/RBBD systems, e.g., return rates, percentage of customers that BYO containers, the packaging provided for customers to fill into, marketing/signage to promote or explain how customers can engage in reuse, and use of rewards, discounts, or other incentives. ▶ Questions about the share of reusable packaged products in the context of interviewee's overall products sold (by volume and unit) and total sales.
Packaging systems protect physical health	▶ Questions about any public health risks (perceived or real) relating to any product packaging they use or have considered using, any associated practices they have for managing these risks, the reasons for the materials they have chosen for their packaging system, and any customer feedback regarding these topics.
Food waste is avoided	▶ Reflections on whether the packaging/packaging system used has any impact on food or product wastage, as well as the processes employed to avoid or manage unsold product.
Accessibility (cost, ease, availability, options) of groceries is increased	▶ Questions about any one-off or ongoing incentives, deposits, or rewards associated with products in any packaging system. ▶ Questions about physical or economic accessibility of their store or products/packaging systems and, if relevant, to describe any accommodations to increase accessibility.
New, quality jobs are created	▶ Questions about both the nature (voluntary, part-time, full-time) and quantity of jobs for their business activities, including any associated specifically with their packaging systems. ▶ Questions about how easy it is to find, retain, and recruit staff, and any health and safety considerations associated with the jobs staff undertake for them, particularly associated with their packaging systems.
Community wellbeing and engagement is enhanced	▶ Questions about why they started their business or packaging system and/or about who owns the business and its assets; their evaluation of the benefits or downsides of different packaging systems for people and communities; any actions they take to promote reuse, sustainability, wellbeing, or connection to the wider community; the topics emphasised in their marketing and comms; and any customer feedback they get about the packaging systems they use. ▶ Retailers were asked about their product range, including the proportion that are branded and proportion that are perishable, and the distance travelled by the products from the producer/supplier to their store.
Collective wellbeing is improved	▶ Questions related to the cultural aspect of the packaging system, including whether the interviewee had a cultural advisor to help inform their packaging systems or had considered cultural practices (e.g., tikanga, halal, kosher) in the design of the packaging systems; whether their business practices support tino rangatiratanga, kaitiakitanga, and kotahitanga; and any wider relationship they perceive between packaging systems and the nature of food systems.

4.5 QUANTIFYING PACKAGING CONSUMPTION ACROSS PACKAGING SYSTEMS

To calculate whether reusable packaging systems avoid packaging across the supply chain, and if so, of what magnitude, we needed to collect data to calculate packaging consumption for all consumer-facing packaging systems (single-use, returnable, RBBD) for each focus product.

The literature review showed inconsistency in how different studies communicated packaging consumption, with some prioritising weight (James Ross Consulting, 2007; Kurian, 2020; Beechener et al, 2020), others product units (Peeters et al, 2023), and some adopting a mixture (Greenpeace, 2020; Salkova & Regnerova, 2020, pp.5-6; Minami et al, 2010; Gordon, 2021; Copello et al, 2022), including breaking product units down further to list number of components, e.g. bottles and caps (Greenpeace, 2020). Furthermore, while some studies considered all the layers of packaging required to get a product to store (John Lewis Partnership, 2020; Dolci et al, 2016; Minami et al, 2010), some focused on consumer-facing primary packaging only (Greenpeace, 2020; Salkova & Regnerova, 2020; James Ross Consulting, 2007).

We adopted a comprehensive approach that measured and recorded packaging consumption by weight (differentiated by material type) for primary, secondary and tertiary packaging, and the number of packaging units and components for primary and secondary packaging. Our starting point was to identify and measure the real-world packaging consumption of all the examples of the focus products on the shelves of our retailer interviewees. We started with the consumer-facing packaging, and worked backwards through the supply chain to identify, measure and weigh the primary, secondary and tertiary packaging required to get that product to shelf, in the following ways:

- For the **consumer-facing primary packaging for single-use and returnable packaging systems**, we identified the total capacity of the package, the number and type of components (e.g., glass bottle and metal lid, sealed plastic bag), and the weights of each component.
- For **consumer-facing RBBD dispenser systems**, we identified and weighed any empty packaging the retailer provided to consumers to fill into (e.g., paper bags or snaplock plastic bags), and identified, measured and weighed all material components of the primary packaging used to deliver the bulk product to the retailer (e.g, multi-walled sacks, plastic jerry cans, buckets, bladders), noting if that bulk packaging was single-use or returnable.
- For **all consumer-facing packaging types**, we identified, measured and weighed any secondary packaging (e.g., cardboard boxes or crates), noted if it was single-use or returnable, and inquired about tertiary packaging (e.g., pallets and shrink-wrap) and noted if it was single-use or returnable.

Some producers/suppliers use upcycled containers for primary bulk packaging or secondary packaging (e.g., plastic ice cream containers or secondhand cardboard boxes) that may or may not be sent back for reuse. Similarly, some retailers offer donated glass jars at their bulk bins for consumers to fill into instead of, or in addition to, single-use bags. In our packaging consumption spreadsheet, all upcycled packaging was recorded as having a zero value for weight, units and components because new packaging had not been created or consumed.

We cross-checked our results from retailer site-visits with the producers/suppliers that we interviewed.

Given our retailer participants were all of small or medium-size, the range of single-use packaged products carried was smaller than that of mainstream supermarkets, both in relation to brands stocked and package sizes. To identify, measure and weigh a broader range of single-use packaged items to generate a robust single-use baseline, we adopted the approach of studies such as Salkova & Regnerova (2020) and visited mainstream supermarkets to purchase examples of packages that we had not had the opportunity to measure with our retail participants. We had already identified the gaps during our web-based searches of brands and package sizes when undertaking our price comparison study (see below). Because focus products in single-use packaging come in a wide range of sizes, we grouped these into common sizes to enable comparisons.[12]

The data for all layers of packaging for every example product were input into a spreadsheet (with different tabs for each focus product) from which we summed the total packaging across the supply chain per gram of product delivered. For RBBD systems where customers may purchase variable quantities to fill into the available packaging, we assumed a product quantity that was realistic for the particular product (based on single-use package sizes) and also able to be accommodated by the size of the refill packaging provided at bulk dispensers. For each product these were:

- Milk, 1L
- Toothpaste, 100g
- Pumpkin seeds, 300g
- Oats, 500g
- Olive oil, 500ml
- Dishwashing liquid, 1L

[12] By 'common' we simply mean sizes that seem to be most commonly stocked.

4.6 PRODUCT PRICE DATA TO ASSESS SOCIOECONOMIC IMPACTS

Price comparisons of equivalent products in single-use and reusable packaging systems, and in mainstream retailers and retailers with a greater focus on unpackaged groceries, is one metric for assessing the accessibility impacts of different packaging systems and retailers (Beitzen-Heineke, 2017; Salkova & Regnerova, 2020; Minami et al, 2012; Marken & Horisch, 2019, p.171; Brown et al, 2022).

To make price comparisons, we collected price data for our six focus products from a range of retailers using searches of online shopping websites, in-store visits, and/or phone calls over a short time frame (19–21 December 2023) to reduce the impacts of inflationary price changes. We collected price data from 10 different retail stores including mainstream supermarkets, packaging-free stores, and specialty stores (offering a mix of reusable and single-use packaged goods) in Waikato and Wellington.

From each of these retailers, we collected prices for every example of our six focus products packaged in returnable or RBBD systems (noting that only some retailers sold all six products via reusable packaging systems). Where returnable packaging systems utilised a financial deposit or reward, this was separately noted but not included in the final product price. For single-use packaged products, we obtained prices for all of the focus products stocked in small–medium-sized retailers, but only the first 30 examples returned for each focus product search on the mainstream retailers' websites (given the many different brands and product sizes stocked by these retailers). For each product, we converted the total price into a price per standardised weight (grams or kilograms) or volume (millilitre or litre).

We organised the collected price data for single-use packaged products into three package size categories – small, medium, and large – to control for the significant price variations due to retailers stocking different brands and sizes. **Table 8** outlines these three categories and their corresponding sizes for each product.[13] We then created box-and-whisker graphs for these three categories of single-use packaged products (small, medium, and large), for products in returnable packaging, and for products sold through RBBD. We then analysed the price range and distribution for each focus product based on size (for single-use packaged products) and packaging system. While imperfect, the box and whisker approach (with median prices) enabled us to identify the potential variations of product differentiation, quality, and other factors that affect price (e.g., organic vs non-organic, imported vs locally made, etc).

Table 8: Single-use packaged products size categories

Product	Category and size		
Milk	NA - one size (2L)[14]		
Toothpaste	Small (85-95g)	Medium (100-140g)	Large (150-200g)
Olive oil	Small (500ml)	Medium (750ml)	Large (1L)
Pumpkin seeds	Small (70-125g)	Medium (250-325g)	Large (500g-3kg)
Oats	Small (450-600g)	Medium (700-850g)	Large (1-1.5kg)
Dishwashing liquid	Small (400-600ml)	Medium (750ml-1L)	Large (2L)

[13] We did not organise price data for reusable packaged products into categories because each retailer usually only stocked one option (if any) in returnable packaging, while RBBD systems already price products by weight/volume.

[14] We did not divide milk into different categories. Instead, we only focused on the 2L size as this is a commonly purchased size. Milk is only sold in reusable packaging in 1L quantities in Aotearoa New Zealand because this is the size of the reusable glass bottles. We converted the raw price data to price per 100ml for single-use packaged and reusable packaged milk for easy comparison.

4.7 SURVEY FOR CUSTOMERS AT PARTICIPATING RETAILERS

One means of understanding the accessibility and community engagement achieved by different reusable packaging systems is to look into the demographics of customers who engage with reusable packaging systems (Beechener et al, 2020; Brown et al, 2022). Customer willingness to engage has also been highlighted as relevant to the viability and environmental impact of a reusable packaging system (Greenwood et al, 2021; Kachook, 2022).

We developed a short survey specifically for our retailer participants to promote to their customers over a 4-week period, three of whom agreed to do so. As these retailer participants were all stores that use reusable packaging systems to a greater degree than conventional retailers (including two packaging-free stores and one store that included a mix of single-use and reusable packaging systems), the survey was intended to help us understand more about the customers who choose to shop with these retailers, and their values and practices in relation to packaging. Therefore, the results represent the views of a relatively specific group rather than the wider Aotearoa New Zealand population.

We provided retailer participants with in-store hard copies customers could complete in-person and QR codes that linked directly to an online version of the survey. The survey asked questions about the participant's demographic information, their views on different packaging systems, their associated practices relating to reusable packaging, and why they shopped in that particular store. We analysed survey data by counting responses to closed and multi-choice questions, and we performed thematic analysis for open-ended questions.

4.8 DATA ON THE SOCIOECONOMIC ACCESSIBILITY TO RETAILERS

The comparative availability and convenience of mainstream retailers versus retailers with a greater portfolio of reusable packaged goods is relevant for assessing the accessibility of packaging systems and their associated products.

Studies might assess availability and convenience in terms of number of options and the demographics of their location, e.g., rural/urban, urban centre/periphery, affluent/marginalised, etc. (Salkova & Regnerova, 2020; Moss et al, 2022; Marken & Horisch, p.171; Lofthouse et al, 2009; Brown et al, 2022; Beechener et al, 2020). Factors we also considered relevant that were not raised in the literature included the surrounding transport networks, car parking, and opening hours.

To undertake this comparison, we selected a representative (rather than exhaustive[15]) sample of 44 grocery retailers in Waikato and Wellington. The sample retailers were chosen to reflect:

- A diversity in size and scale, ranging from large supermarkets to small owner-operated specialty grocery stores.
- Different socioeconomic profiles, ranging from retailer locations in higher socioeconomic to lower socioeconomic areas.

[15] The two major supermarket chains have the largest number of grocery stores in each region. Woolworths operates 29 Woolworths and Fresh Choice stores in Waikato and 24 in Wellington (based on regional council boundaries). Foodstuffs North Island (a cooperative) operates 15 New World and PAK'nSAVE stores in Waikato and 25 in Wellington.

- Different packaging system focus, ranging from primarily single-use packaging systems (e.g., large supermarkets), mixed packaging systems (e.g., specialty stores), to primarily reusable packaging systems (e.g., zero waste stores).

We gathered data focusing on two key aspects of the areas in which each of the 44 retailers were located:

1. The socioeconomic deprivation profile, using the New Zealand Index of Deprivation, which measures deprivation of small areas using nine New Zealand Census variables (NZDep, N.D.).
2. The surrounding transport network/infrastructure, including the roading network (e.g., whether the retailer was located off an arterial road),[16] public transport routes, and car parking options. We gathered this data using publicly available online information.

We analysed the socioeconomic accessibility data according to whether the selected retailer was a mainstream/single-use packaging retailer, a packaging-free/zero waste grocer; or a speciality retailer. We then converted our descriptive/qualitative socioeconomic and accessibility data into indicators with numerical categories (see **Table 9**), thereby creating a measure of accessibility to identify broad trends. Finally, we calculated averages across all the numerical categories for the three retailer groups to identify high-level trends and enable comparisons. While imperfect, the approach was a relatively fast way to analyse some key measures of accessibility for different types of retailers and, by extension, products in different packaging systems.

[16] For each retailer location, we used the relevant district plan maps to identify (where possible) the status of the road. We then converted these into a standardised 1–6 categorisation using the New Zealand Transport Authority's One Network Road Classification (ONRC) criteria. These criteria ensured consistency, as territorial authorities use different terms to describe their road networks.

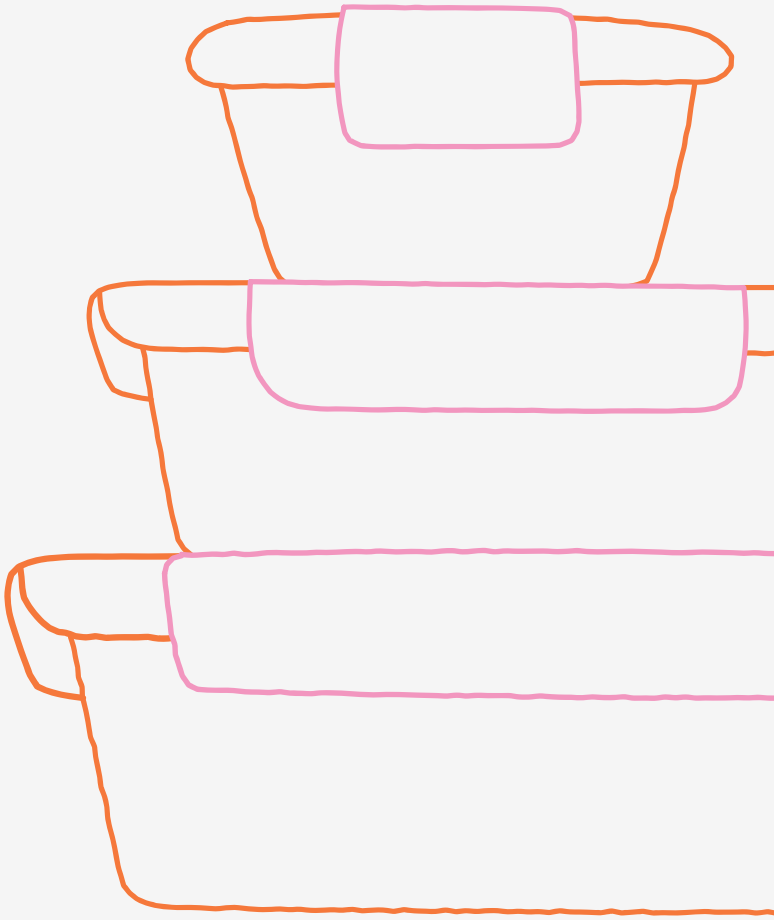
Table 9: Converting indicators into numerical categories

Raw data			
NZDep number	**Surrounding Roading network**	**Public transport proximity**	**Surrounding parking**
Ranges from 1–10 with 1 being least deprived and 10 being most deprived	Qualitative description that describes location of retailer in relation to main road or secondary (side) road	Qualitative description of how close public transport networks are to the retailer	Qualitative description of surrounding car parking (e.g., dedicated car parks, on-street car parking only)
Converted numerical categories to create an accessibility measure			
Retained existing 1–10 categories	Modified to 6 categories based on NZTA's One Network Road Road Classification: ▸ 1 = retailer accesses a nationally significant road ▸ 2 = retailer accesses an arterial road ▸ 3 = retailer accesses a regional road ▸ 4 = retailer accesses a primary collector road ▸ 5 = retailer accesses a secondary collector road ▸ 6 = retailer accesses an access road	Modified to: ▸ 1 = public transport located directly outside retailers ▸ 2 = Public transport located within 5 minute walk of retailer ▸ 3 = No public transport located close to retailer	Modified to: ▸ 1 = More than 10 dedicated car parks for retailer ▸ 2 = Less than 10 dedicated car parks for retailer ▸ 3 = No dedicated car parks for retailer (e.g., only on-street public car parks, or no public parking at all)

4.9 RESEARCH CHALLENGES AND LIMITATIONS

Reflecting other studies, we experienced challenges trialing aspects of this methodology in Aotearoa New Zealand, which have contributed to limitations. First, the real-world complexity of applying our methodology reflects the comprehensive scope of the indicators we were considering, covering environmental, social, and cultural dimensions, and the mixed-methods approach. Other research has highlighted how more comprehensive tools or frameworks for measuring circularity usually end up focusing on narrow aspects of the circular economy, especially environmental considerations, with a smaller number also considering economic and social aspects (Corona et al, 2019). Our decision to persevere with a broader scope did create complexity and reduced the ability to gather and analyse detailed data (especially quantitative) across all the indicators. As different team members focused in greater detail on different indicators, at times it was also difficult to coordinate and integrate findings across the project.

Access to relevant, robust, and comprehensive data was another difficulty we faced that also made quantitative analysis difficult for several indicators. This lack of underlying data and the resulting need to rely on assumptions to assess packaging systems against various indicators has also been noted in various studies (e.g., Copello et al, 2021; Brazao et al, 2021; Brown et al, 2021; Beechener et al, 2020), particularly in relation to socioeconomic indicators, e.g., assessing economic impact (Copello et al, 2021) or quantifying job creation potential (Brown et al, 2022). Part of the challenge is that industries often do not collect and retain packaging-related data because of minimal reporting requirements; if they do, they may be unlikely to share it due to commercial sensitivity (Copello et al., 2021; Brazao et al., 2021; Brown et al., 2022). In other cases, trying to fill knowledge gaps may be challenged by low participation rates in the research process, e.g., surveys or interviews (Beechener et al, 2020). Reflecting other studies, we managed this limitation either by making assumptions about some aspects or noting where data is lacking.



4.9.1 FULLY INTEGRATING KAUPAPA MĀORI STUDY FOLLOWING METHODOLOGY DESIGN

> ***"According to Te Tiriti, Māori should have authority in decisions that affect them, especially those that affect Māori food sovereignty" (Peryman et al, 2024, p.6)***

This study took place in Aotearoa New Zealand, recognising the lack of reusable packaging literature specific to this place. As Tāngata Whenua hold tino rangatiratanga in Aotearoa, and in accordance with Te Tiriti o Waitangi, it follows that a study specific to Aotearoa should at the least include and be informed by Māori perspectives, although ideally studies would be co-designed or led by Māori, not merely include Māori as a stakeholder (Peryman et al, 2024, p.3). However, it needs to be recognised that "imbalanced power structures... impede equal representation of Māori in policymaking, business, and science." (ibid, p.6). Awareness of this imbalance is important for all researchers in order for proactive steps to be taken to redress the imbalance.

In the case of this research project, a kaupapa Māori researcher was part of the team from the outset, and supported with the development of all the indicators we considered, as well as aspects of the methodology, particularly interview questions. However, the weakness in our approach was that the research project they undertook into the relationship between te ao Māori and reuse occurred in parallel with the research for this report.

Early in the project when the methodology was being developed, we undertook regular project meetings, shared initial research, and worked collaboratively to develop the methodology. However, following the development of the research methodology, the two research streams moved in parallel and there was less interaction between the researchers. This was predominantly a matter of practicality as different team members dedicated time and focus to the areas of the project they were leading. However, the approach resulted in difficulties with fully integrating the findings and perspectives from the kaupapa Māori research into this report, particularly during the analysis of data and the report write-up. In particular, the parallel research approach had the unintended effect of partially marginalising Māori perspectives within a silo in the context of the broader project. Furthermore, from a temporal perspective, the parallel research approach made it difficult for all members of the team to fully grasp the kaupapa Māori research results in order to integrate them more deeply into this report. In hindsight, it would have made more sense to undertake the kaupapa Māori research project first, and then embark on the wider project. This would also have enabled the kaupapa Māori researcher the capacity to be involved in the drafting of this report, rather than a review role near the end of this report project.

4.9.2 CHALLENGES WITH RECRUITING RESEARCH PARTICIPANTS AND CUSTOMER SURVEY RESPONDENTS

Other studies that involved external researchers applying a similar methodology to this study to measure and compare impacts of single-use and reusable packaging systems for various grocery products across a supply chain were often commissioned, co-designed and/or led by an industry partner (retailers and producers/suppliers). In these studies, industry partners provided detailed information about product packaging, particularly the packaging associated with back-of-house and/or business-to-business logistics and distribution systems (Kurian 2020; John Lewis Partnership, 2020; Minami et al, 2010).

This was an independent study without preexisting relationships with industry. Difficulties with participant recruitment impacted more detailed data collection (including tracing focus product packaging up all supply chains), and meant we had to make assumptions and extrapolate results. We also struggled to secure interviews or site visits with a representative sample of our long-listed retailers and producers/suppliers, particularly larger enterprises. Our participants were all small-medium businesses with relatively short and simple supply chains, and usually reflected more niche markets, such as the organics sector. We have used the data gathered from these participants to extrapolate to the more conventional grocery sector, which is not necessarily always representative. While this was clearly a limitation, we note that other studies that were not commissioned by the relevant industry and faced similar challenges with participant recruitment, also managed this by using assumptions to generate baseline single-use packaging data or extrapolated from partial real-world datasets (see Brazao et al, 2021; Copello et al, 2022; Greenpeace, 2020).

Responses to our customer survey were also limited (n=65),[17] and 82% of responses came from one small packaging-free/zero waste grocer in Wellington. Consequently, the sample reflects a specific set of customers shopping at one store in one geographic location. However, the responses are still useful for the intended purpose of understanding the demographics, motivations, and practices of customers already prioritising reusable packaging options for their grocery shop.

4.9.3 LIMITATIONS AND ASSUMPTIONS OF OUR PACKAGING CONSUMPTION DATASET

Measuring real-world packaging consumption in order to calculate packaging avoided, particularly secondary and tertiary packaging, proved particularly challenging. In part, this stemmed from the sheer range of products available for each product category and the complexity of modern packaging and supply chains. Additionally, our research participants did not have access to all secondary or tertiary packaging (nor full knowledge of supply chains), and most were not collecting the data needed to calculate packaging consumption, especially for reuse systems. Therefore, while we worked closely with our research participants to gather as much real-world packaging as we could for our focus products, we still needed to restrict the system boundaries of our study in terms of packaging types included. For example:

- We did not separately measure the weight of selected products' labels that are added to primary, secondary or tertiary packaging because it was either too complicated or the labels/data were unavailable
- We focused on the packaging involved to get the product to the retailer from the penultimate location (whether a distribution centre, third party distributor, or direct from the producer). We did not include the packaging associated with product import, on-shore repacking of imported product, or palletisation at wholesale and retailer distribution centres (where pallets may be broken up and repacked, resulting in multiple reapplications of plastic pallet wrap before the product is sent to final point of sale).
- We did not include packaging associated with transporting focus products in their raw form (e.g., olives or individual ingredients of dishwashing liquid) from growers or producers to processing, manufacturing, and packaging sites.

For these reasons, our data on supply chain packaging is conservative and likely underestimates what is actually used for most of our focus products, especially those sold in single-use packaging that are part of more complex and/or globalised distribution systems.

Data gaps also meant we needed to make a number of assumptions or use representative data to extrapolate a

[17] This could be due to customer disinterest and feedback culture fatigue, time limitations, and/or lack of promotion by retail staff.

best estimate.[18] For example:

- We used one glass bottle as the standard 'milk bottle' for RBBD and returnable systems (rather than measuring the bottle of every brand using a reusable glass bottle).
- Measuring packaging consumption of returnable packaging systems depends on the reuse rates for individual containers (which depends on return rates). For all returnable packaging examples, we sought to work with retailers and producers/suppliers to calculate real-world reuse and return rates according to the recommended calculations in the PR3 Standards for Systems Operations & Performance.[19] However, because only one participant could provide accurate data from which we could perform this calculation, we had to assume reuse rates. Similar to other studies we have assumed a reuse rate for each product based on observations and information of the system operation and design gained during interviews and/or site visits. We specify what this reuse rate is (and the underlying reason for the assumption) in the results.
- For RBBD packaging, the level of packaging consumption depends on whether customers bring their own containers. None of the four retailer interviewees tracked the percentage of customers that brought their own containers, even those retailers that provide discounts for BYO. However, most were able to estimate a percentage. Furthermore, in some cases, alternative containers were not provided, so customers could only refill if they brought their own containers. Most of the retailers were taking steps to encourage BYO containers, whether through signage, charging for single-use refill packaging, or offering discounts for BYO packaging. Consequently, for RBBD systems where single-use refill packages were provided, we assumed a BYO rate of 50% and a BYO rate of 100% where no single-use refill packages were provided.
- Single-use secondary packaging (cardboard boxes) was the most difficult packaging type to acquire for all products; we acquired secondary packaging for roughly half (44%) of the products analysed. For the remainder, we estimated the weight of the cardboard box used by employing the calculation *mass = density x volume*. To calculate volume, we estimated the box's likely size based on the dimensions of the primary packaging and the number of primary packages our research participants told us are normally contained (or assuming the box held either 6 or 12 primary packages). Density was assumed based on a common type of cardboard used for secondary packaging.
- For tertiary packaging, we were only able to weigh shrink wrap from a full pallet at one retailer. We have used this figure across all products that arrived to store on a pallet. Our figures also assumed that all pallets are full, rather than half, pallets. The weights for reusable pallets are based on the average of the weight of two reusable wooden pallets widely used in the Aotearoa New Zealand market, which are readily available on the company websites. The weight of the single-use pallet is based on the weight provided for a softwood simple/one-way pallet in a life cycle assessment comparing one-way and pooled pallet alternatives (Bengtsson & Logie, 2015, p.415).

4.9.4 LIMITATIONS OF ACCESSIBILITY INDICATORS AND METHODS

Our accessibility indicators and methods have three key limitations. First, data relating to our accessibility indicators is not standardised. For example, different councils categorise road networks using different criteria and terms. We therefore undertook our own analysis to categorise roads using the Waka Kotahi NZ Transport Agency's ONRC criteria. Secondly, our selected accessibility categories may not reflect the realities on the ground, or different people's physical ability and mobility preferences, their access to resources, and/or transport. For example, our accessibility indicators are premised on private car ownership and/or public transport using roads. If a retailer is located off a main road, has multiple dedicated car parks, or is close to public transport, it would be considered 'more accessible'. Consequently, our accessibility criteria did not take into account active transport options or people's preference for these. Third, the sampling size of 44 retailers for the accessibility indicators only provides an indicative snapshot of the total number of grocery retailers in each region. Further research with a larger sample size would help to verify or strengthen claims about the accessibility of grocery retailers.[20]

[18] The interviews with site visits were intense and time consuming. Most of the interviews with retailers were done during business hours, so our participants were doing their 'day jobs' while answering our questions. This inevitably resulted in some data gaps where participants either did not know an answer or did not have time to find out, and we had to make informed estimates.

[19] At time of writing, this document is still in development and currently not available on the website for viewing: https://www.pr3standards.org/the-pr3-standards

[20] See, for example, The Healthy Location Index in Aotearoa New Zealand, which maps supermarket accessibility for the entire country. However, this does not appear to include smaller grocery retailers. Reference: https://www.arcgis.com/apps/dashboards/04c40689c2f2456da5249fa25da57f82

SECTION 5: RESULTS

This section presents our results according to each of our chosen impact indicators, as set out in **Table 10**.

Table 10: Our chosen impacts to measure

Environmental/health	Packaging is avoided
Environmental/health	Packaging systems protect physical health
Environmental/health	Food waste is avoided
Socioeconomic	Accessibility (cost, ease, availability/options) of groceries is increased
Socioeconomic	New, quality jobs are created
Socioeconomic	Community wellbeing and engagement is enhanced
Cultural	Collective wellbeing is improved

5.1 ENVIRONMENTAL/HEALTH INDICATOR 1: PACKAGING IS AVOIDED

In interviews, the participants who offer reusable packaging systems (returnable or RBBD) generally explained that they did so to avoid single-use plastic packaging and reduce the associated waste, plastic pollution, resource depletion, and greenhouse gas emissions. One participant also explained that they use returnable packaging because they did not want to use plastic packaging, but recognised that the energy involved to manufacture their chosen alternative material (glass) required it to be reused in order to have an overall positive impact.

In order to test whether the desired impact of avoiding single-use and plastic packaging was eventuating, we applied the methodology outlined earlier to calculate the packaging consumption of all participants' reusable packaging systems (both returnable and RBBD), and the packaging consumption of equivalent products in single-use packaging. The single-use packaged items considered were those stocked by the retailer participants (if they stocked single-use packaged products), and the collected samples of single-use packaged products stocked by mainstream retailers. In total, we measured the packaging used by 73 differently packaged products across the six focus product categories, including 42 single-use packaged products, four returnable products, and 27 products sold via RBBD systems (of which six included returnable bulk primary packaging in their supply chain).

For each of the focus products, we identified the quantity of product that was being delivered by 'one' package in the reusable packaging systems (based on assumed return rates for consumer-facing returnable packaging, or the capacity of the largest bulk primary package in the RBBD system), and then compared the total amount of primary, secondary and tertiary packaging that would be needed to deliver this equivalent amount of product via each of the single-use and reusable packaging systems we identified.

The results are presented by focus product in the sections below. Each section describes the different packaging types identified for each focus product, and any assumptions made in the calculation of packaging consumption and the quantity of product considered. This is followed by three graphs setting out the packaging consumption data for the focus product according to the consumer-facing systems (single-use, returnable, or RBBD) along the x-axis. Each graph sets out different information about the packaging consumption on the y-axis:

1. The weight of the total packaging consumed by each packaged product, broken down by primary, secondary and tertiary packaging.
2. The weight of the total packaging consumed by each packaged product, broken down by material type.
3. The number of primary and secondary packaging units and components used by each packaged product (tertiary packaging was excluded as the numbers were all much less than one).

Each section then concludes with a brief analysis of the results in the graphs.

5.1.1 MILK

We identified and modelled the packaging used for nine differently packaged milk products. The packaging systems included:

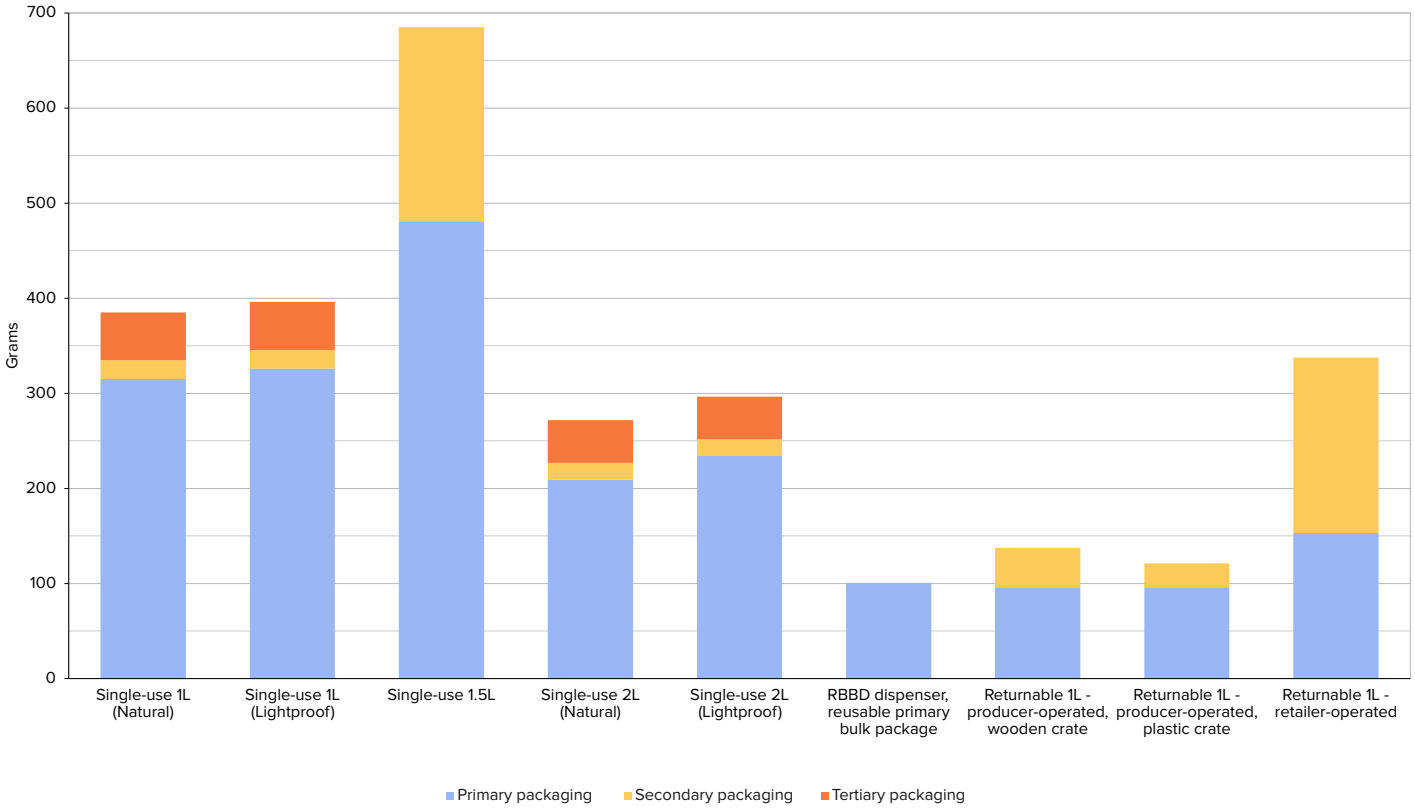
- Five single-use packaged products, all of which used plastic bottles and lids, with a tearaway plastic seal under the lid. Most of these were 1L or 2L HDPE bottles delivered directly to stores in reusable plastic crates, or in these reusable crates on reusable wooden pallets. One exception was a 1.5L PET bottle, delivered to the retailer in a single-use cardboard box.
- Two producer-operated consumer-facing returnable systems, using 1L glass bottles with a single-use metal lid. One producer delivered bottles to store using reusable plastic crates, and one used reusable wooden crates.
- One retailer-operated consumer-facing returnable system, using 1L glass bottles with a single-use metal lid. This system involved the retailer filling bottles in-store from a bulk primary package (a 10L single-use plastic bladder) sent to them by the producer/supplier in a single-use cardboard box (two bladders per box).
- One RBBD system where customers could purchase and fill a 1L glass bottle with milk from an in-store tap. The tap was connected to the primary bulk package sitting in a fridge (a 10L returnable plastic pail).

For the reusable packaging systems, we assumed the following return/reuse rates:

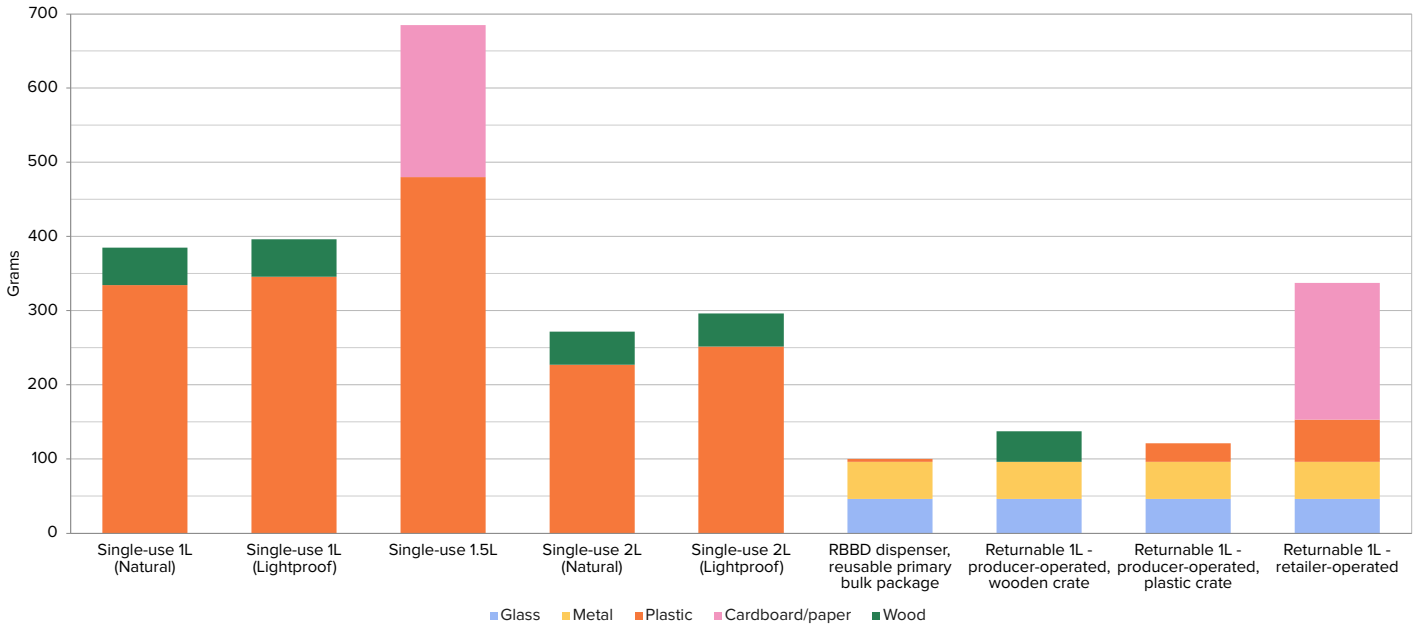
- For the consumer-facing primary packaging we assumed a return rate of 90% (equating to 10 uses per bottle) because all of the systems we identified had relatively high deposits on the bottles (in some cases similar to the cost of the product itself). Given the size of the deposit, this assumption is conservative and may underestimate the return rate.
- For the consumer refill packaging in the RBBD system, we also assumed a 90% return rate because customers could not bring their own bottles and had to purchase the bottles provided in-store. The purchase price of the bottle was the same as the deposit for a returnable.
- For the reusable bulk primary packaging in the RBBD system, we also assumed a 90% return rate (or 10 uses), though this is likely conservative given that supply chain packaging just moving between retailer, distributor and/or producer is likely to have a high return rate.
- We assumed reuse rates of 50 for reusable crates and reuse rates of 10 for reusable pallets based on assumptions in an Australasian lifecycle analysis of beverage packaging (Warmerdam & Vickers, 2021, pp.46-47).

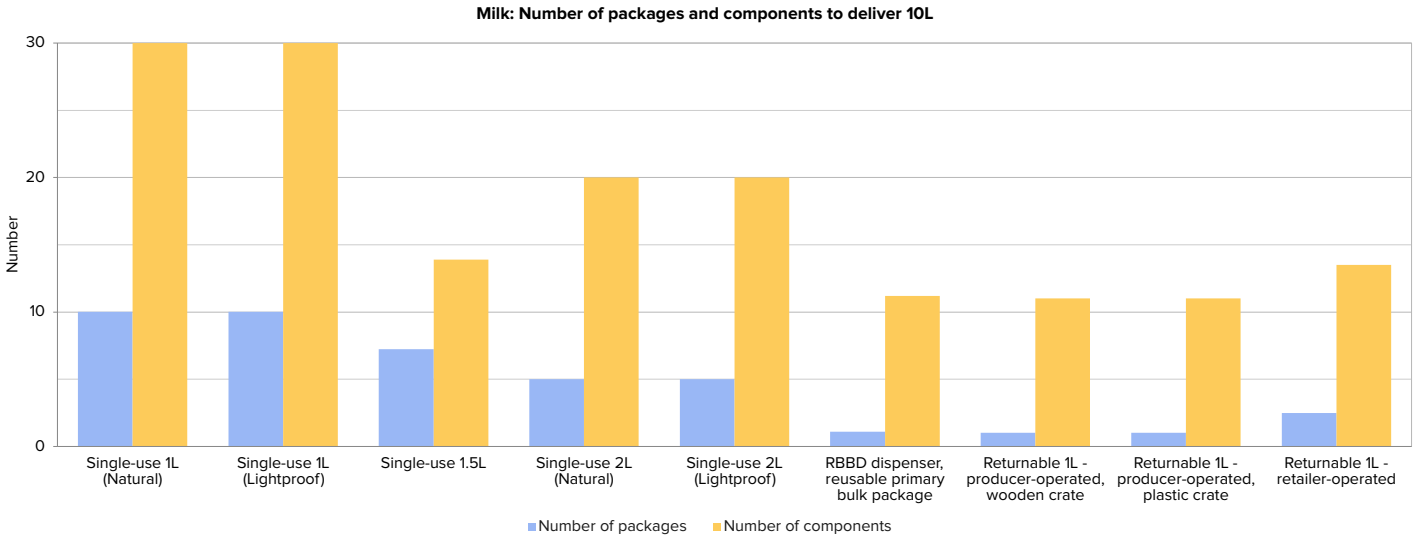
Our assumptions mean that each consumer-facing reusable bottle can deliver 10L of milk over its life. Therefore, we compared the packaging consumption of each system to deliver 10L of milk to a consumer, in order to understand the packaging avoided by the reusable packaging systems.

Milk: Total packaging weight by primary, secondary, and tertiary to deliver 10L



Milk: Packaging materials by weight to deliver 10L





We found that reusable packaging systems for milk use significantly less packaging than single-use packaged products, in terms of both total weight and number of packages. The reuse systems we modelled all greatly reduce plastic usage, with one system being entirely plastic-free. With the exception of one reuse system, this plastic avoidance impact comes without an overall increase in packaging weight, despite the material used in the reuse systems being a heavier material (glass). Reuse systems also reduce the number of components, even though the bottle lids in these systems are single-use. We note that these results are based on fairly conservative return and reuse rates and that the real-world packaging avoidance impact is likely greater.

Our results also illustrate how different approaches to supply chain packaging can affect overall packaging consumption, reinforcing the relevance of looking beyond the packaging passed on to the consumer. Of the four reuse systems, the RBBD system uses the least packaging in terms of weight due to the reusable bulk container. In contrast, the retailer-operated returnable packaging system uses the most primary packaging of all the reuse systems due to the bulk primary package being single-use. This system also uses more packaging by weight than some of the single-use options because of the single-use cardboard box that the bulk packages are delivered in. Despite this, the overall plastic weight, and the number of packages, is still less than all the single-use alternatives due to the benefit of the larger bulk primary package compared to multiple smaller single-use containers. These different supply chain approaches highlight the packaging avoidance value of reusable primary bulk packaging in RBBD systems, and of returnable secondary packaging across all systems.

5.1.2 TOOTHPASTE

We identified and modelled the packaging used for 14 differently packaged toothpaste products. The packaging systems included:

- Twelve single-use packaged products, ten of which were a plastic tube, with plastic lid, in a cardboard box, one of which was a metal tube, with plastic lid in a cardboard box, and one of which was a glass jar with a plastic lid. The majority (nine) of the toothpastes packed into tubes featured both an outer and inner layer of secondary packaging (the tubes were packed into a box of 12, which was usually shipped to store in another, larger cardboard box). These secondary packages were palletised for shipping to retailers (which includes both the pallets and the plastic shrink wrap). The remaining two tubed toothpastes were shipped in a single cardboard box not on a pallet. The toothpaste in a glass jar was shipped in an upcycled cardboard box.
- One consumer-facing returnable system using glass jars with a single-use metal lid, which were delivered to stores in upcycled/repurposed cardboard boxes with upcycled/repurposed paper inside for padding.
- One RBBD system where toothpaste is dispensed from a bespoke machine and customers bring their own containers to be filled. The bulk primary packaging was an upcycled/repurposed 2L ice cream container, which was shipped to the store in an upcycled/repurposed cardboard box.

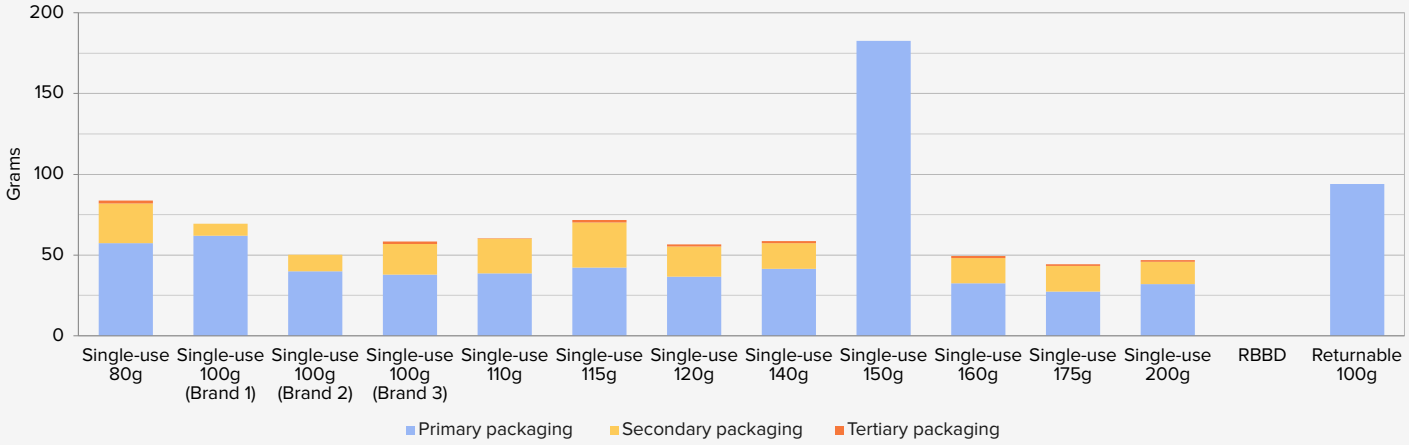
For the reusable packaged products, we assumed the following return/reuse rates:

- For the returnable glass jar, we assumed a return rate of 50% or 2 uses per jar because the jars in this system do not carry a deposit. Although the producer/supplier offers a loyalty card scheme where a customer gets a free toothpaste for every 12 jars returned, we would not expect this to lead to the 90%+ return rates associated with reuse systems that employ a deposit on each package. We also observed that the loyalty card scheme was not promoted consistently by the retailer participants selling this product, compared to how a deposit would be promoted. We consider a 50% return rate to be a generous estimate.
- For the RBBD system, no empty refill containers are provided to customers, either free of charge or for sale, so we presumed a 100% BYO rate.
- We assumed reuse rates of 10 for reusable pallets based on Warmerdam & Vickers (2021, pp.46-47).

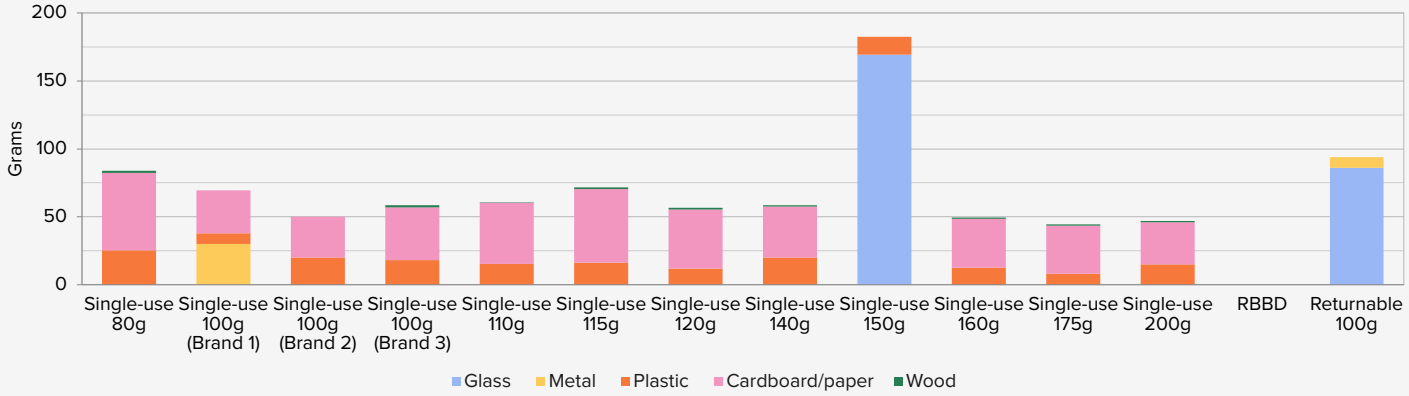
Upcycled/repurposed packaging was used for the secondary packaging of one single-use packaged product and for the returnable jars. The primary bulk packaging for the RBBD was also upcycled/repurposed. We have assumed a zero value for all upcycled/repurposed packaging.

Our assumptions for the returnable jar system means that each jar can deliver 200g of toothpaste over its life. Therefore, we compared the packaging consumption of each system to deliver 200g of toothpaste to a consumer, in order to understand the packaging avoided by the reusable packaging systems.

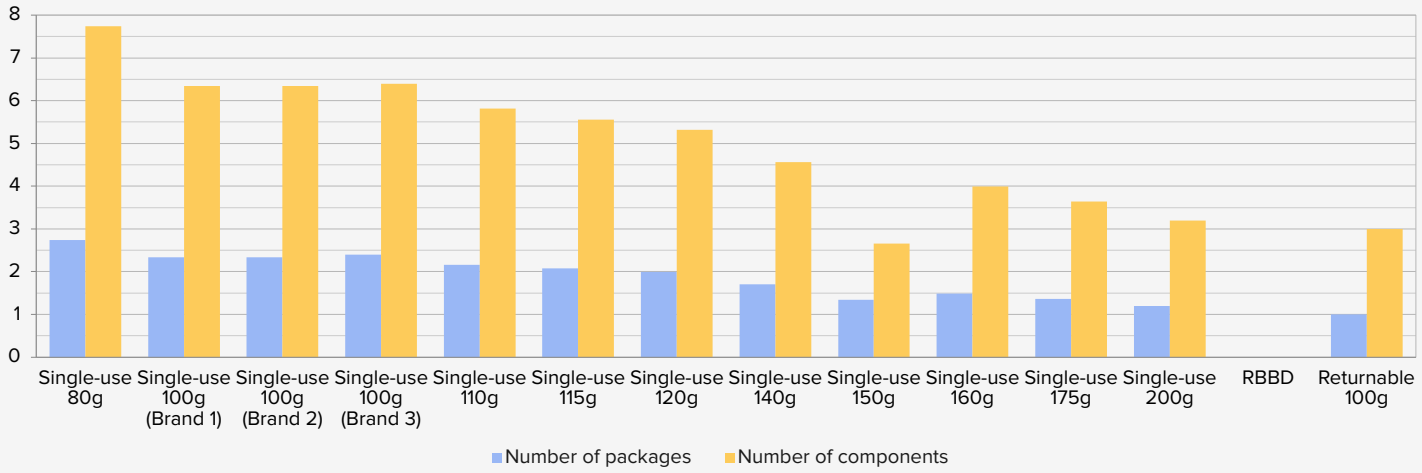
Toothpaste: Total packaging weight by primary, secondary, and tertiary to deliver 200g



Toothpaste: Packaging materials by weight to deliver 200g



Toothpaste: Number of packages and components to deliver 200g



The three graphs show that reusable packaging systems for toothpaste can use less packaging than single-use packaged products, but our results reinforce that the extent of packaging avoided depends on how the system is structured and the return/reuse rates in practice. For example, the RBBD system effectively creates no packaging waste because the supplier provided the product to the retailer in upcycled/repurposed secondary packaging (repurposed ice cream containers and cardboard boxes) and the customer must bring their own container to fill into. For the returnable system, although the system does entirely avoid the use of plastic packaging, the return rate of 50% is not sufficient to avoid packaging based on weight, compared to single-use systems (apart from the single-use glass container). However, achieving just one or two more uses would tip the balance. This reinforces the importance of ongoing efforts to measure and lift return rates in order to ensure continual improvements in returnable packaging system performance.

The graphs also show that the way packaging consumption is calculated can impact conclusions about system performance. A focus on weight creates less of a packaging avoided impact in this case where the material for the reusable (glass) is heavier than the material used for the single-use packaging (plastic and cardboard). However, when packaging avoided is measured by the comparative number of packages consumed to deliver 200g of product, the returnable jar uses fewer primary and secondary packages than any of the single-use packaging alternatives (even larger sized primary packages, such as the 200g tube), after just one reuse of the jar. The returnable jar also requires fewer primary and secondary components than all the single-use systems (except the single-use jar), despite the jar lid being single-use. This reflects the fact that almost all the primary packaging for the single-use packaged toothpastes we identified included at least three components (tube, lid and a cardboard box), and the secondary packaging included an inner and outer box.

Similar to milk, the results for toothpaste illustrate that adopting reuse systems, particularly returnable packaging systems, does decrease plastic usage and facilitates a shift towards more inert and readily recyclable materials, e.g., glass and metal, compared to the single-use equivalent (a plastic toothpaste tube).

5.1.3 PUMPKIN SEEDS

We identified and modelled the packaging used for 16 differently packaged pumpkin seed products. The packaging systems included:

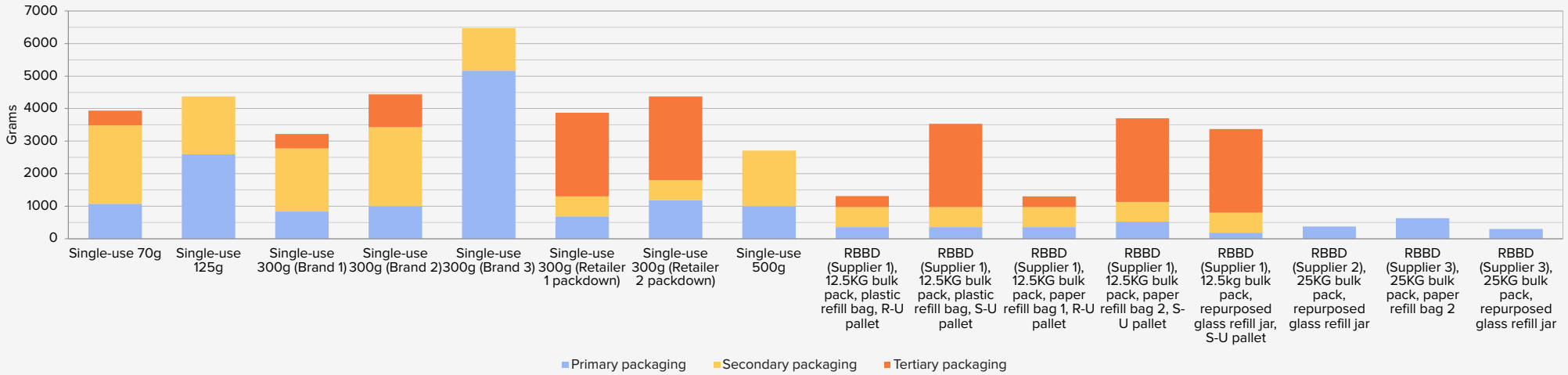
- Eight single-use packaged products, six of which were sealed or resealable soft plastic bags, one of which was a plastic jar with a tearaway metal internal seal and a plastic lid, and one of which was a cellophane bag. Two of these single-use packaged products were retailer “packdowns”, where a retailer pre-fills single-use packaging from the bulk primary packages that they also decant into their bulk dispensers for their RBBD systems. All of the single-use packaged products arrived to retailers in secondary packaging. One product had both an inner and outer layer of secondary packaging. Six arrived on pallets, which includes both the pallet and the plastic shrink wrap.
- Eight RBBD systems, featuring the product of three different producers/suppliers. The eight systems are distinguished based on:
  - the bulk primary packaging used by the different producers/suppliers, which was either a 12.5KG plastic bag, packaged two to a secondary cardboard box, a 25KG triple-lined paper sack, or a 25KG double-lined woven polypropylene sack;
  - the refill packaging offered to consumers by the retailers, which could be single-use plastic bags, single-use paper bags (two types), or repurposed glass jars; and
  - whether the product is shipped on a pallet and, if so, if the pallet is single-use or reusable.

For the reusable packaged systems, we made the following assumptions:

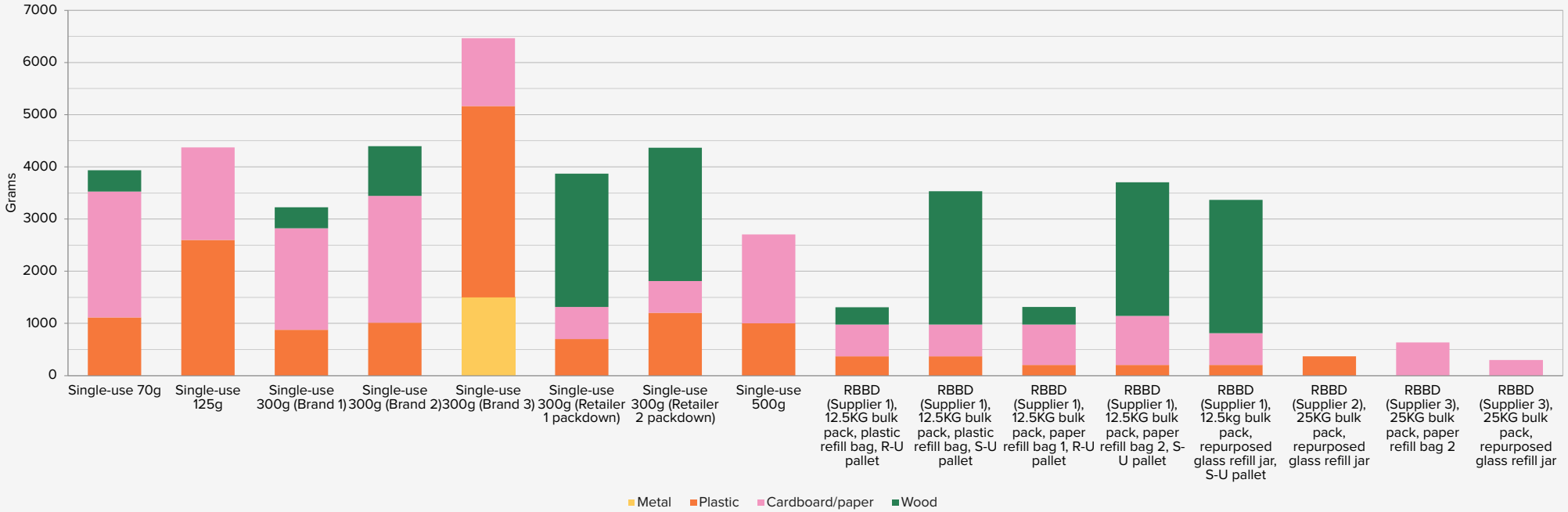
- For the customer refill packaging, we assumed a BYO rate of 50%, except where upcycled/repurposed glass jars were offered, in which case we accorded a zero value for packaging, which is the same as a 100% BYO rate.
- The refill quantity customers purchased from RBBD systems was 300g.
- Reuse rates of 10 for reusable pallets based on Warmerdam & Vickers (2021, pp.46-47).

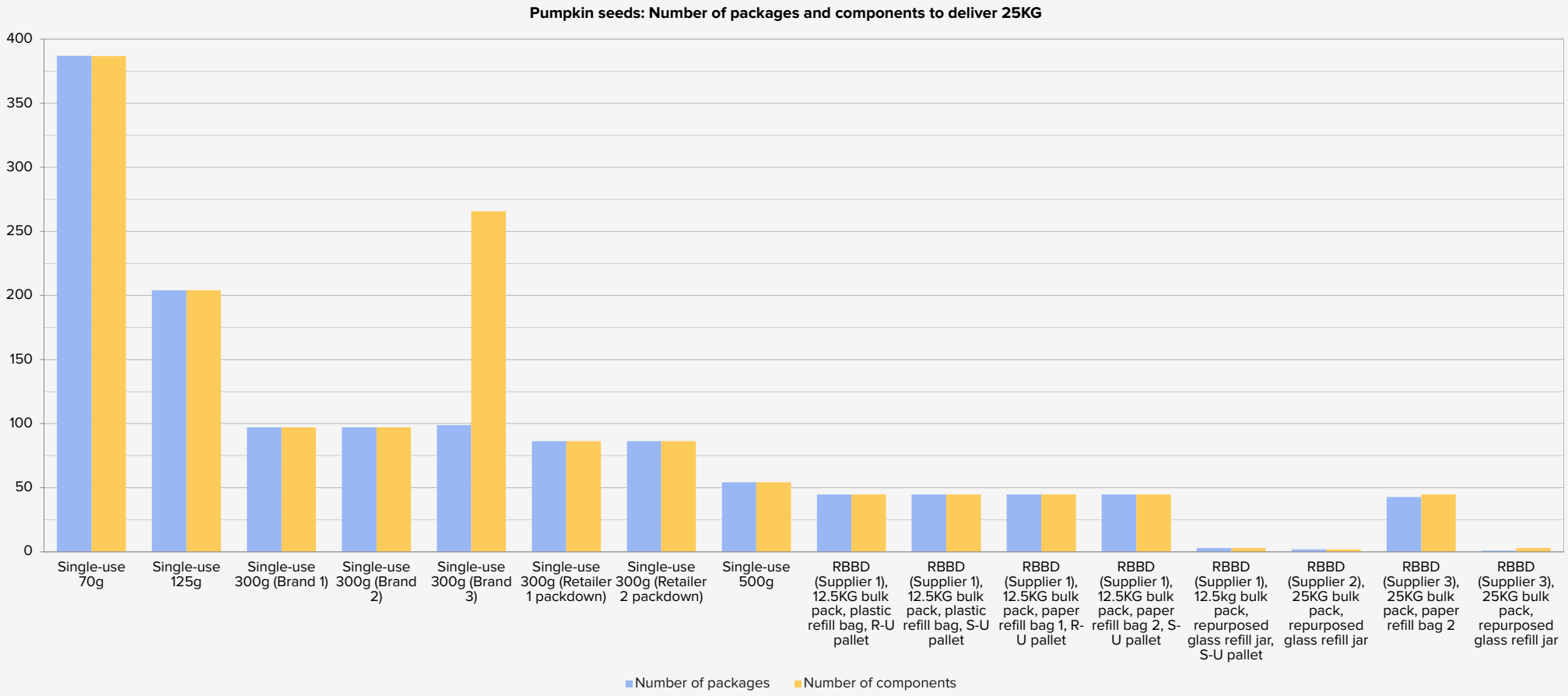
The largest sized bulk primary packaging for pumpkin seeds is 25KG. Therefore, we compared the packaging consumption of each system to deliver 25KG of pumpkin seeds to a consumer, in order to understand the packaging avoided by the RBBD systems.

Pumpkin seeds: Total packaging weight by primary, secondary and tertiary to deliver 25KG



Pumpkin seeds: Packaging materials by weight to deliver 25KG




Pumpkin seeds: Number of packages and components to deliver 25KG
400
350
300
250
200
150
100
50
0
Single-use 70g
Single-use 125g
Single-use 300g (Brand 1)
Single-use 300g (Brand 2)
Single-use 300g (Brand 3)
Single-use 300g (Retailer 1 packdown)
Single-use 300g (Retailer 2 packdown)
Single-use 500g
RBBD (Supplier 1), 12.5KG bulk pack, plastic refill bag, R-U pallet
RBBD (Supplier 1), 12.5KG bulk pack, plastic refill bag, S-U pallet
RBBD (Supplier 1), 12.5KG bulk pack, paper refill bag 1, R-U pallet
RBBD (Supplier 1), 12.5KG bulk pack, paper refill bag 2, S-U pallet
RBBD (Supplier 1), 12.5kg bulk pack, repurposed glass refill jar, S-U pallet
RBBD (Supplier 2), 25KG bulk pack, repurposed glass refill jar
RBBD (Supplier 3), 25KG bulk pack, paper refill bag 2
RBBD (Supplier 3), 25KG bulk pack, repurposed glass refill jar
Number of packages
Number of components

The three graphs show that the RBBD packaging systems for pumpkin seeds that feature reusable pallets or no pallets in their supply chain all use considerably less packaging by weight, number of packages and components than all single-use packaged products. However, even the RBBD systems with single-use pallets avoid packaging compared to most of the single-use packaged systems. All of the RBBD systems also use much less plastic packaging than single-use systems, even the RBBD systems that offer consumers plastic refill bags and that use plastic bulk primary packaging. With the exception of the plastic jarred product, the plastic that is avoided is mostly soft plastics, which is harder for consumers to recycle than rigid PET and HDPE packaging that is collected at kerbside. Single-use packaged systems (with the exception of the retailer packdowns) also have considerably more secondary packaging (in the form of cardboard) in their supply chain than the RBBD systems.

Amongst the RBBD systems, the packaging consumption results vary based on the refill packaging provided to consumers, and the supply chain packaging. RBBD systems that offered upcycled/repurposed glass jars to consumers only generated a packaging footprint in their supply chain (bulk primary packaging, secondary packaging, and tertiary packaging). For those RBBD systems that provide customers with single-use paper or plastic bags, increasing the use of BYO containers would further increase the packaging avoidance impact. The supply chain focus of this study also sheds a light on the impact of tertiary packaging for overall packaging avoidance. A considerable proportion of the packaging footprint of the RBBD systems that use the most packaging comes from single-use pallets. In contrast, some of the RBBD systems with the smallest footprint have no secondary or tertiary packaging as the bulk primary package is couriered as is. Both these ends of the spectrum occur in smaller retailers who are more likely to source small quantities directly from local suppliers, or who may not have access to the reusable pallet pools that are common in the mainstream grocery sector.

5.1.4 OATS

We identified and modelled the packaging used for 17 differently packaged oat products. The packaging systems included:

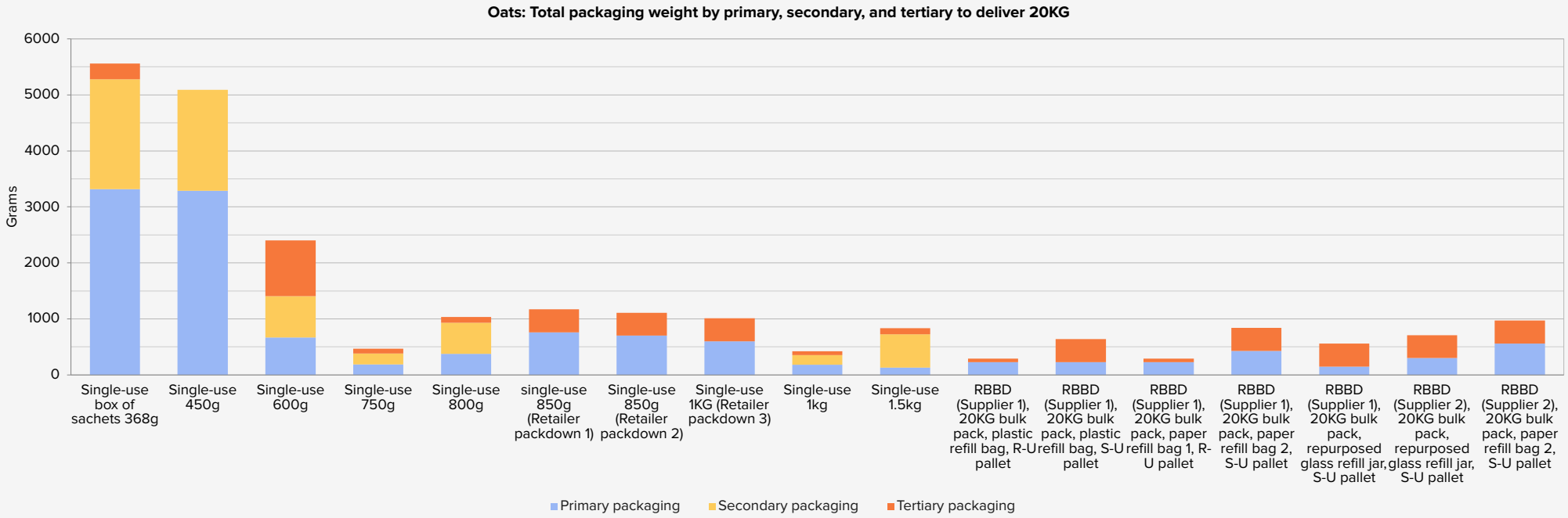
- Ten single-use packaged products, eight of which were a variety of sealed or resealable bags that were either paper, soft plastic, or a paper-plastic composite. There was also a plastic jar with a tearaway metal internal seal, and a plastic lid. The remaining single-use packaged product was a cardboard box of 8 sachets; the sachets were a paper-plastic composite. Three of the single-use packaged products were retailer "packdowns", where a retailer pre-fills single-use packages from the bulk primary packages that they also decant into their bulk dispensers for their RBBD systems. All of the single-use packaged products, except for the retailer packdowns arrived to retailers in secondary packaging. One product had both an inner and outer layer of secondary packaging. All but one of the products arrived on pallets, which includes both the pallet and the plastic shrink wrap.
- Seven RBBD systems, featuring the product of two different suppliers. The seven systems are distinguished based on:
  - the bulk primary packaging used by the different suppliers, which was either a 20kg triple-lined paper bag, or a 20kg triple-lined bag with one layer of plastic between two layers of paper;
  - the refill packaging offered to consumers by the retailers, which could be single-use plastic bags, single-use paper bags (two types), or upcycled/repurposed glass jars; and
  - whether the pallet the product was shipped on was single-use or reusable.

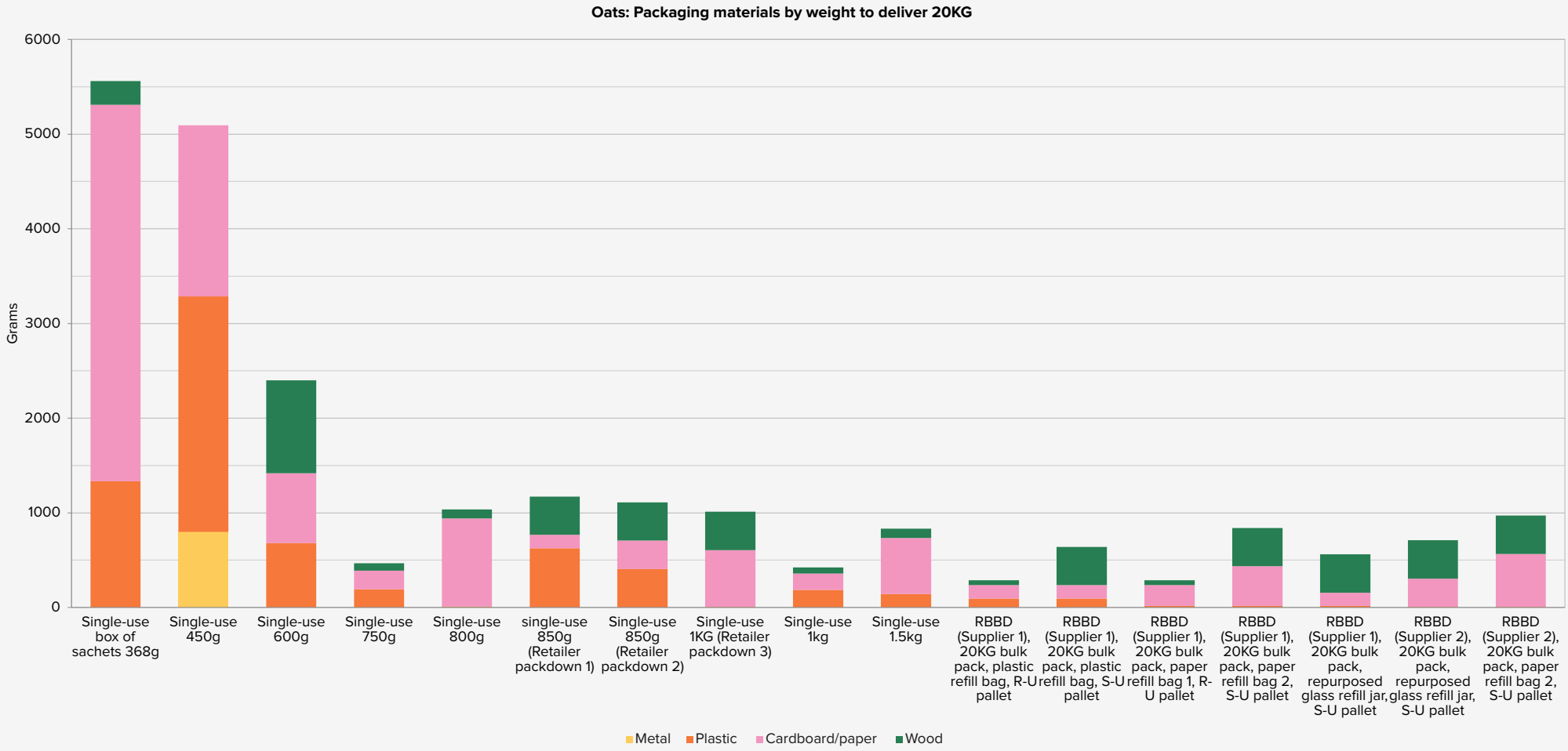
For the reusable packaged systems, we made the following assumptions:

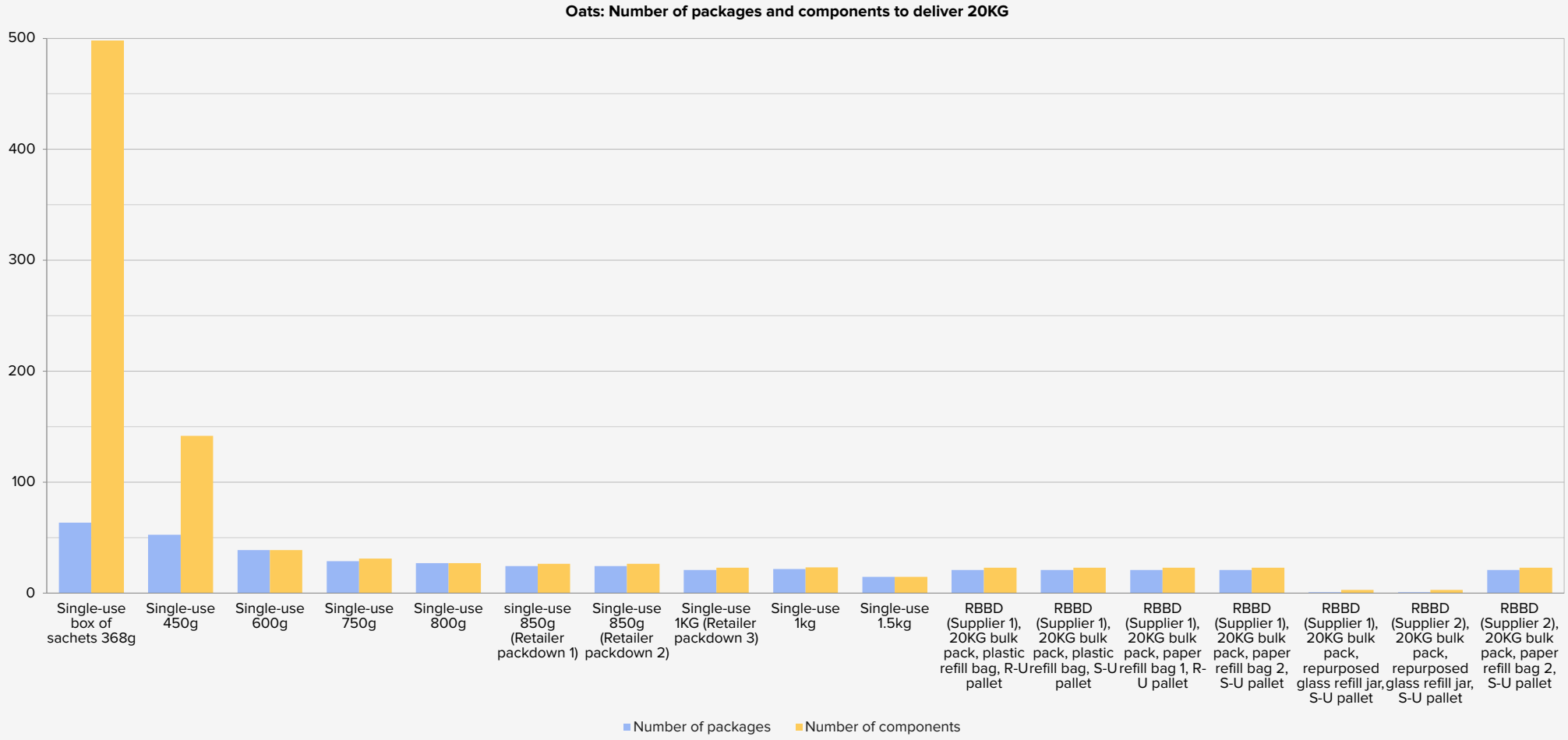
- For the customer refill packaging, we assumed a BYO rate of 50%, except where upcycled/repurposed glass jars were offered, in which case we accorded a zero value for packaging, which is the same as a 100% BYO rate.
- The refill quantity customers purchased from RBBD systems was 500g.
- Reuse rates of 10 for reusable pallets based on Warmerdam & Vickers (2021, pp.46-47).

Additionally, for the two single-use packages that were a paper-plastic composite where the layers were not possible to separate, their material weight was recorded as plastic.

The largest sized bulk primary packaging for oats is 20KG. Therefore, we compared the packaging consumption of each system to deliver 20KG of oats to a consumer, in order to understand the packaging avoided by the RBBD systems.


Oats: Total packaging weight by primary, secondary, and tertiary to deliver 20KG
Grams
6000
5000
4000
3000
2000
1000
0
Single-use box of sachets 368g
Single-use 450g
Single-use 600g
Single-use 750g
Single-use 800g
single-use 850g (Retailer packdown 1)
Single-use 850g (Retailer packdown 2)
Single-use 1KG (Retailer packdown 3)
Single-use 1kg
Single-use 1.5kg
RBBD (Supplier 1), 20KG bulk pack, plastic refill bag, R-U pallet
RBBD (Supplier 1), 20KG bulk pack, plastic refill bag, S-U pallet
RBBD (Supplier 1), 20KG bulk pack, paper refill bag 1, R-U pallet
RBBD (Supplier 1), 20KG bulk pack, paper refill bag 2, S-U pallet
RBBD (Supplier 1), 20KG bulk pack, repurposed glass refill jar, S-U pallet
RBBD (Supplier 2), 20KG bulk pack, repurposed glass refill jar, S-U pallet
RBBD (Supplier 2), 20KG bulk pack, paper refill bag 2, S-U pallet
Primary packaging
Secondary packaging
Tertiary packaging


Oats: Packaging materials by weight to deliver 20KG
Grams
6000
5000
4000
3000
2000
1000
0
Single-use box of sachets 368g
Single-use 450g
Single-use 600g
Single-use 750g
Single-use 800g
single-use 850g (Retailer packdown 1)
Single-use 850g (Retailer packdown 2)
Single-use 1KG (Retailer packdown 3)
Single-use 1kg
Single-use 1.5kg
RBBD (Supplier 1), 20KG bulk pack, plastic refill bag, R-U pallet
RBBD (Supplier 1), 20KG bulk pack, plastic refill bag, S-U pallet
RBBD (Supplier 1), 20KG bulk pack, paper refill bag 1, R-U pallet
RBBD (Supplier 1), 20KG bulk pack, paper refill bag 2, S-U pallet
RBBD (Supplier 1), 20KG bulk pack, repurposed glass refill jar, S-U pallet
RBBD (Supplier 2), 20KG bulk pack, repurposed glass refill jar, S-U pallet
RBBD (Supplier 2), 20KG bulk pack, paper refill bag 2, S-U pallet
Metal
Plastic
Cardboard/paper
Wood


Oats: Number of packages and components to deliver 20KG
500
400
300
200
100
0
Single-use box of sachets 368g
Single-use 450g
Single-use 600g
Single-use 750g
Single-use 800g
single-use 850g (Retailer packdown 1)
Single-use 850g (Retailer packdown 2)
Single-use 1KG (Retailer packdown 3)
Single-use 1kg
Single-use 1.5kg
RBBD (Supplier 1), 20KG bulk pack, plastic refill bag, R-U pallet
RBBD (Supplier 1), 20KG bulk pack, plastic refill bag, S-U pallet
RBBD (Supplier 1), 20KG bulk pack, paper refill bag 1, R-U pallet
RBBD (Supplier 1), 20KG bulk pack, paper refill bag 2, S-U pallet
RBBD (Supplier 1), 20KG bulk pack, repurposed glass refill jar, S-U pallet
RBBD (Supplier 2), 20KG bulk pack, repurposed glass refill jar, S-U pallet
RBBD (Supplier 2), 20KG bulk pack, paper refill bag 2, S-U pallet
Number of packages
Number of components

The three graphs show an obvious avoidance of packaging from RBBD systems in relation to smaller capacity single-use packaged products and the box of sachets. However, larger single-use packaged products also show a significant packaging avoidance potential vis-a-vis these products too. It is worth noting that our assumed quantity of oats purchased by consumers via refill (500g) was lower than many of the single-use packaged capacities, which may partially explain the more marginal packaging avoidance in relation to these single-use options.

For oats, the packaging avoidance from RBBD systems is most notable where reusable pallets are used. In fact, the only RBBD systems that outperform all the single-use packaged alternatives are those that have reusable pallets in the supply chain. The provision of upcycled/repurposed glass jars rather than single-use paper or plastic bags to consumers for RBBD systems had an impact, but was less likely to improve the overall packaging avoidance of a system than the use of reusable rather than single-use pallets. Regardless, all RBBD systems are more likely to avoid plastic packaging (often soft plastics, except for the plastic jarred product) than single-use systems, and also more likely to avoid secondary packaging (except in relation to retailer packdowns for the latter).

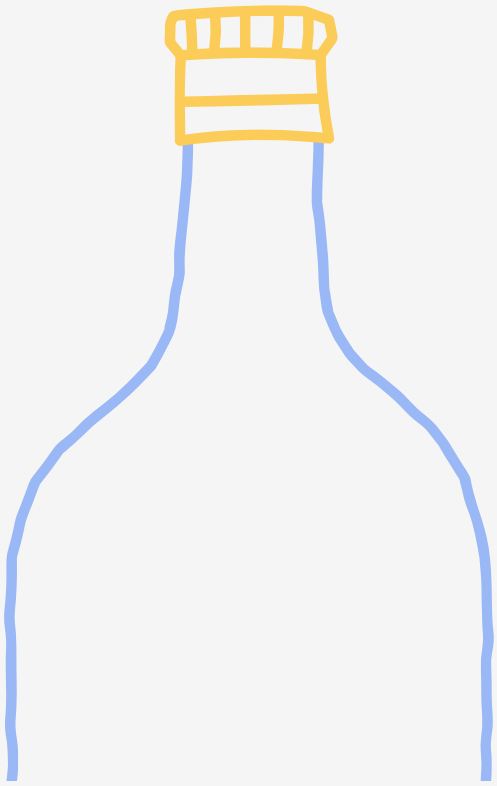
5.1.5 OLIVE OIL

We identified and modelled the packaging used for nine differently packaged olive oil products. The packaging systems included:

- Four single-use packaged products, all of which used variously sized glass bottles with a metal lid and an internal plastic pourer. All four products were delivered to retailers in a secondary cardboard box on a pallet, which includes both the pallet and the plastic shrink wrap.
- Five RBBD systems, all of which rely on customers bringing their own bottles/containers or using upcycled/repurposed glass jars. Each system is supplied by a different producer/supplier that uses different bulk primary packaging. Two systems use returnable primary bulk packaging, one of which uses a 5L plastic bottle, and one of which uses a 20L plastic jerry can. One system uses a single-use 20L plastic jerry can. Two systems use single-use bladders in a box with a tap, one of which is 12L capacity and one of which is 15L capacity.

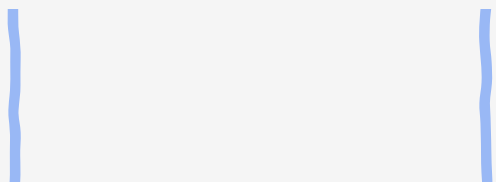
For the reusable packaging systems, we assumed the following return/reuse rates:

- For the consumer refill packaging in the RBBD system, we assumed a 100% return rate because the only free options were for customers to bring their own bottles/containers or use a repurposed glass jar.
- For the reusable bulk primary packaging in the RBBD systems, we assumed a 90% return rate (or 10 uses), though this is likely conservative given that supply chain packaging just moving between retailer, distributor and/or producer is likely to have a high return rate.
- The refill quantity customers purchased from RBBD systems was 500ml.

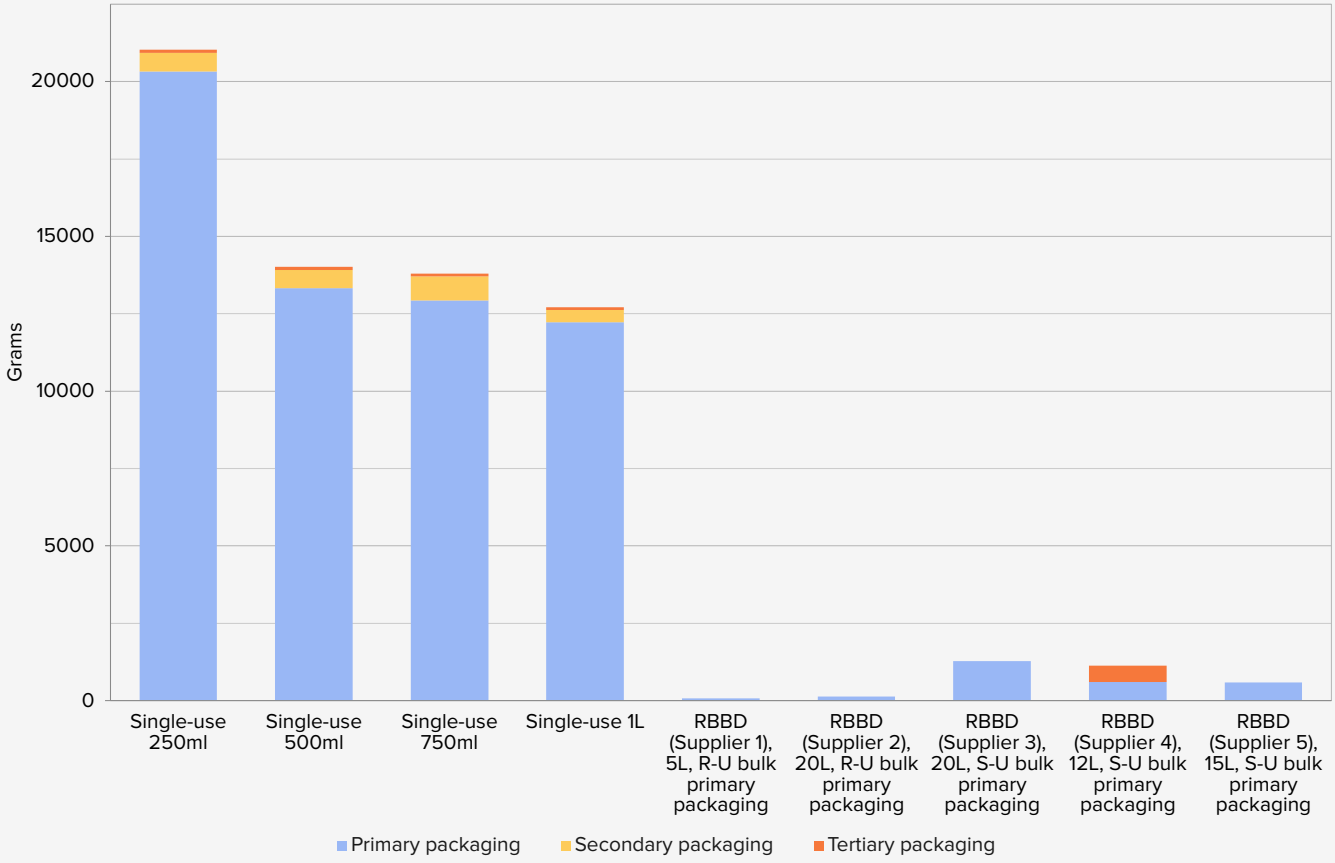


- We assumed reuse rates of 10 for reusable pallets based on assumptions in an Australasian lifecycle analysis of beverage packaging (Warmerdam & Vickers, 2021, pp.46-47).

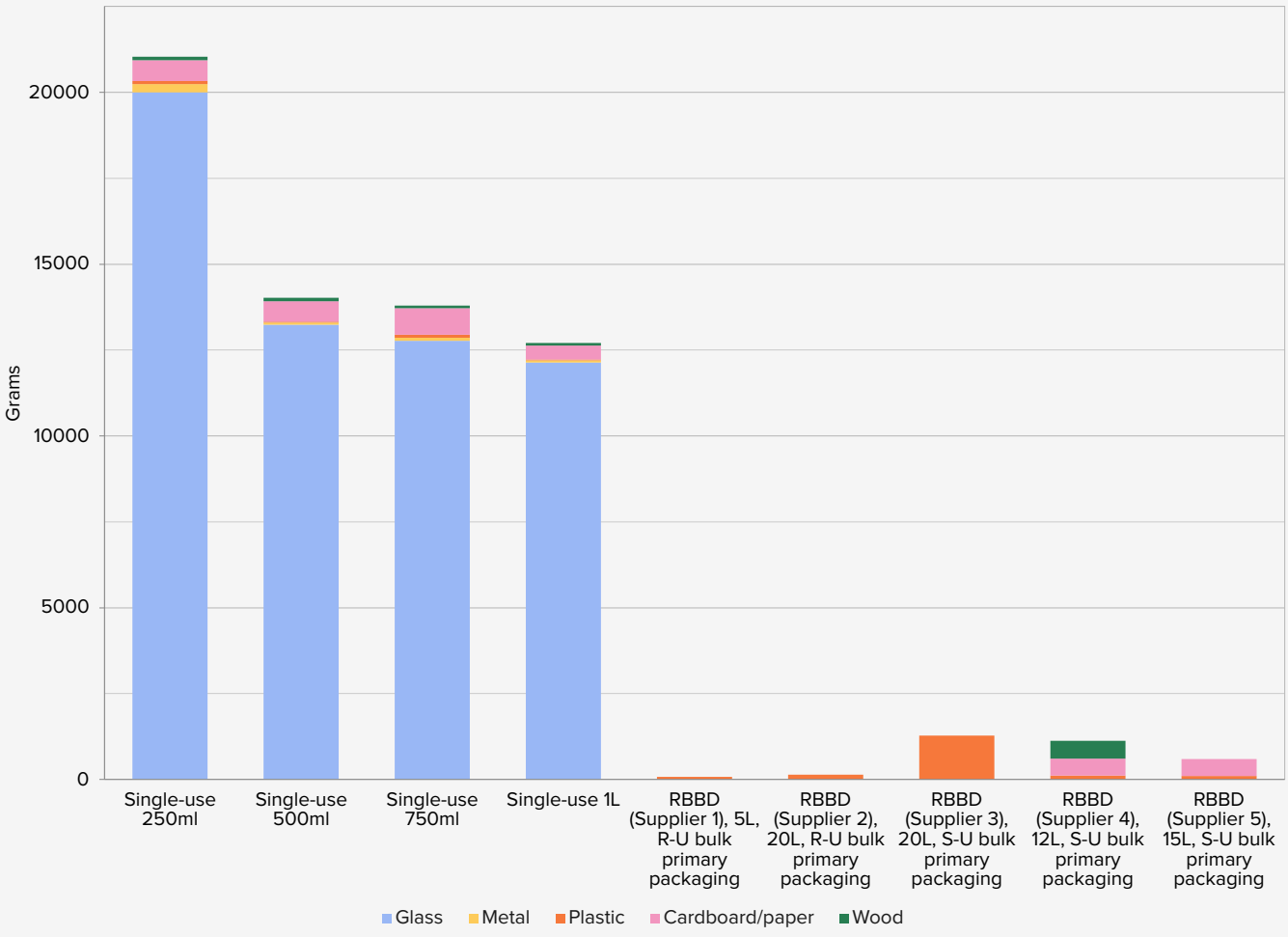
The largest sized bulk primary packaging for olive oil is 20L. Therefore, we compared the packaging consumption of each system to deliver 20L of olive oil to a consumer, in order to understand the packaging avoided by the RBBD systems.

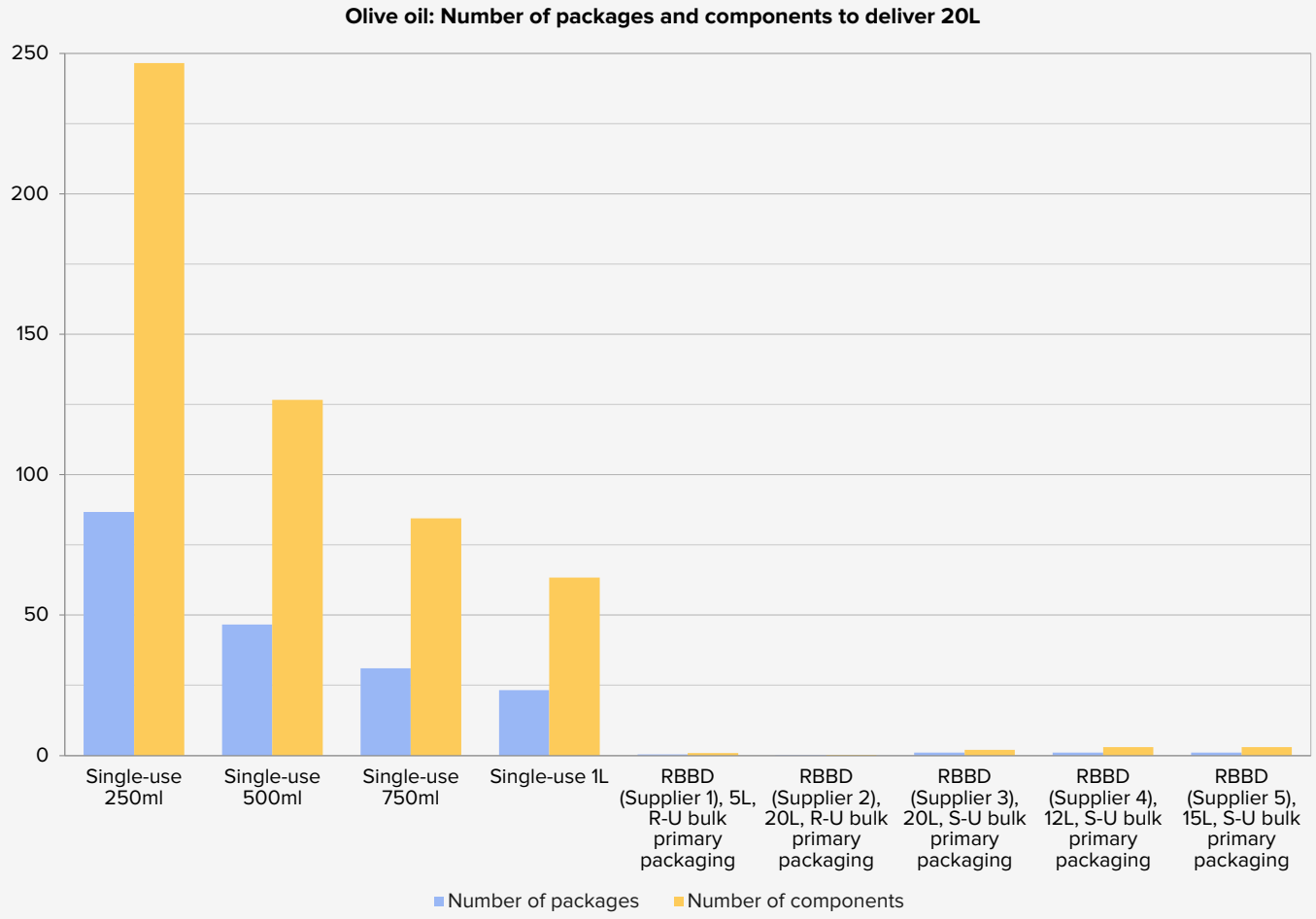


Olive oil: Total packaging by primary, secondary and tertiary to deliver 20L



Olive oil: Packaging materials by weight to deliver 20L





The three graphs show that the RBBD systems for olive oil use significantly less packaging than single-use packaged products, in both total weight, and number of packages and components. For all of the RBBD systems there is no secondary packaging as the bulk primary packaging is the secondary packaging, avoiding a considerable amount of cardboard packaging. Most of the RBBD systems also have no tertiary packaging footprint as the product arrives via courier or is delivered directly by the producer/supplier, in the primary bulk packaging.

The significant packaging avoided in terms of weight partly reflects the difference in the packaging materials used by RBBD systems for olive oil compared to single-use packaged products. Whereas the RBBD systems rely on plastic bulk primary packaging in the supply chain, single-use packaged products primarily rely on glass and cardboard/paper, which is heavier. Nevertheless, even putting aside weight, the numbers of packages and components avoided by the RBBD systems is still significant. This highlights the packaging avoidance impact of not providing new, free single-use containers for customers to fill into in RBBD systems, and instead requiring customer BYO or offering only repurposed jars.

While all of the RBBD systems avoid significant amounts of packaging, a comparison of the different RBBD systems illustrates how the adoption of reusable primary bulk packaging can further extend the packaging avoidance impact.

5.1.6 DISHWASHING LIQUID

We identified and modelled the packaging used for eight differently packaged dishwashing liquid products. The packaging systems included:

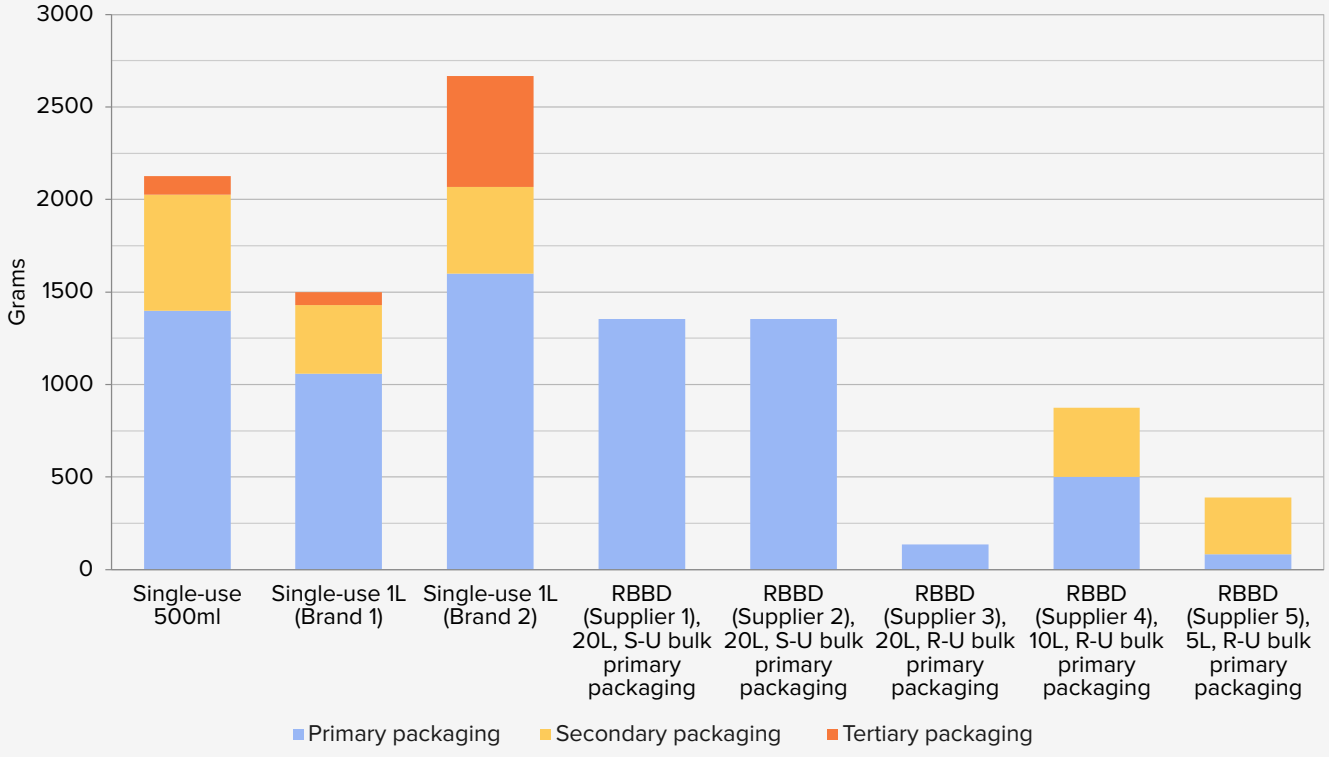
- Three single-use packaged products, all of which used plastic bottles with a plastic lid, packed into secondary cardboard boxes and delivered to retailers on a pallet, which includes the pallet and the plastic shrink wrap.
- Five RBBD systems, all of which rely on customers bringing their own bottles/containers or using upcycled/repurposed bottles/containers or glass jars. Each system is supplied by a different producer/supplier that uses different bulk primary packaging. Two systems use single-use primary bulk packaging, both of which are the same 20L plastic jerry can. Three systems use returnable primary bulk packaging, one of which is a 20L plastic jerry can, one of which is a 10L stainless steel keg, and one of which is a 5L plastic bottle with a pump. Two of the suppliers shipped their bulk primary packaged product in a secondary cardboard box. None of the bulk primary packages were delivered on pallets.

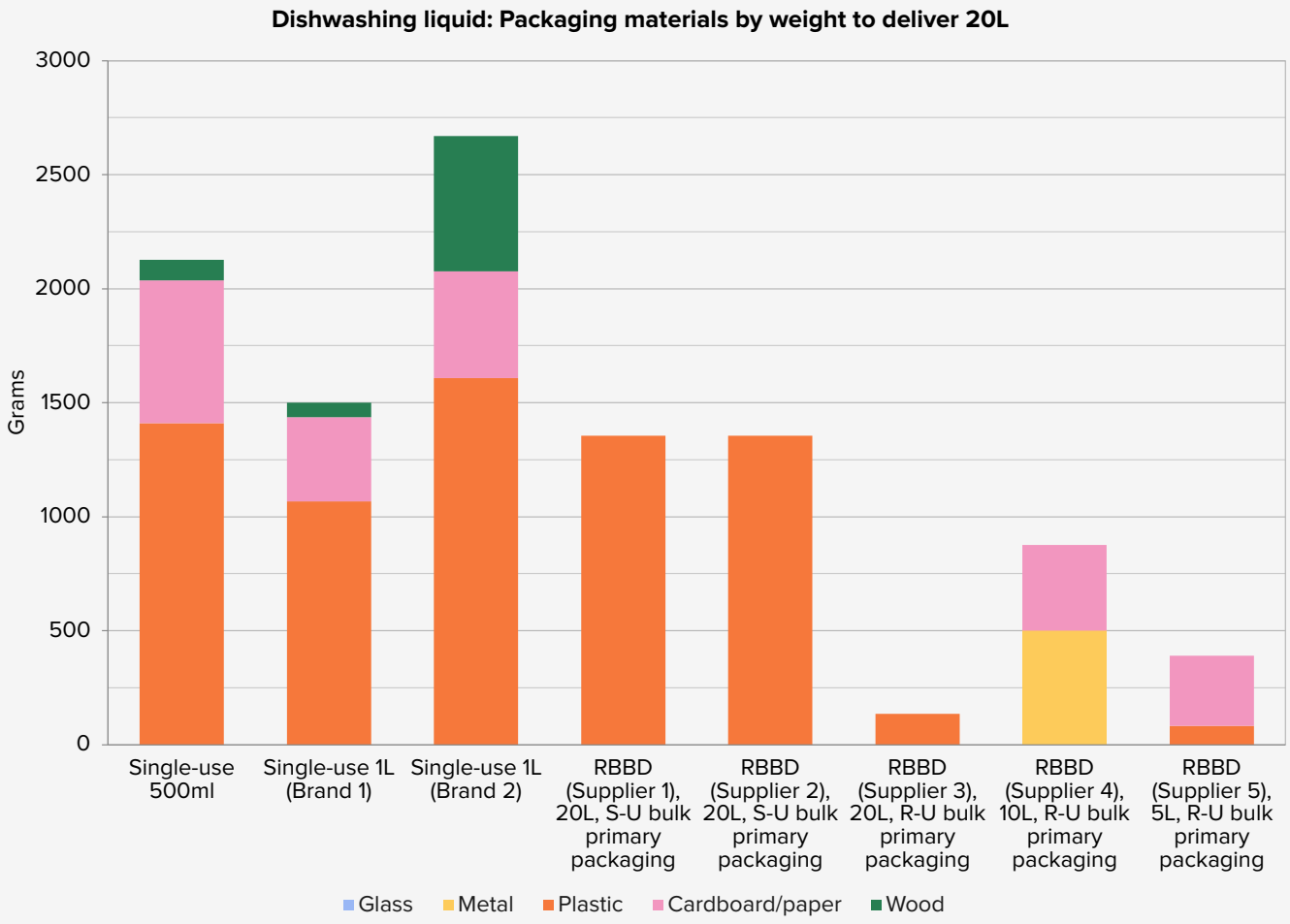
For the reusable packaging systems, we assumed the following return/reuse rates:

- For the consumer refill packaging in the RBBD system, we assumed a 100% return rate because the only free options were for customers to bring their own bottles/containers or use an upcycled/repurposed bottle/container or glass jar.
- For the reusable bulk primary packaging in the RBBD systems, we assumed a 90% return rate (or 10 uses), though this is likely conservative given that supply chain packaging just moving between retailer, distributor and/or producer is likely to have a high return rate.
- The refill quantity customers purchased from RBBD systems was 1L.
- We assumed reuse rates of 10 for reusable pallets based on assumptions in an Australasian lifecycle analysis of beverage packaging (Warmerdam & Vickers, 2021, pp.46-47).

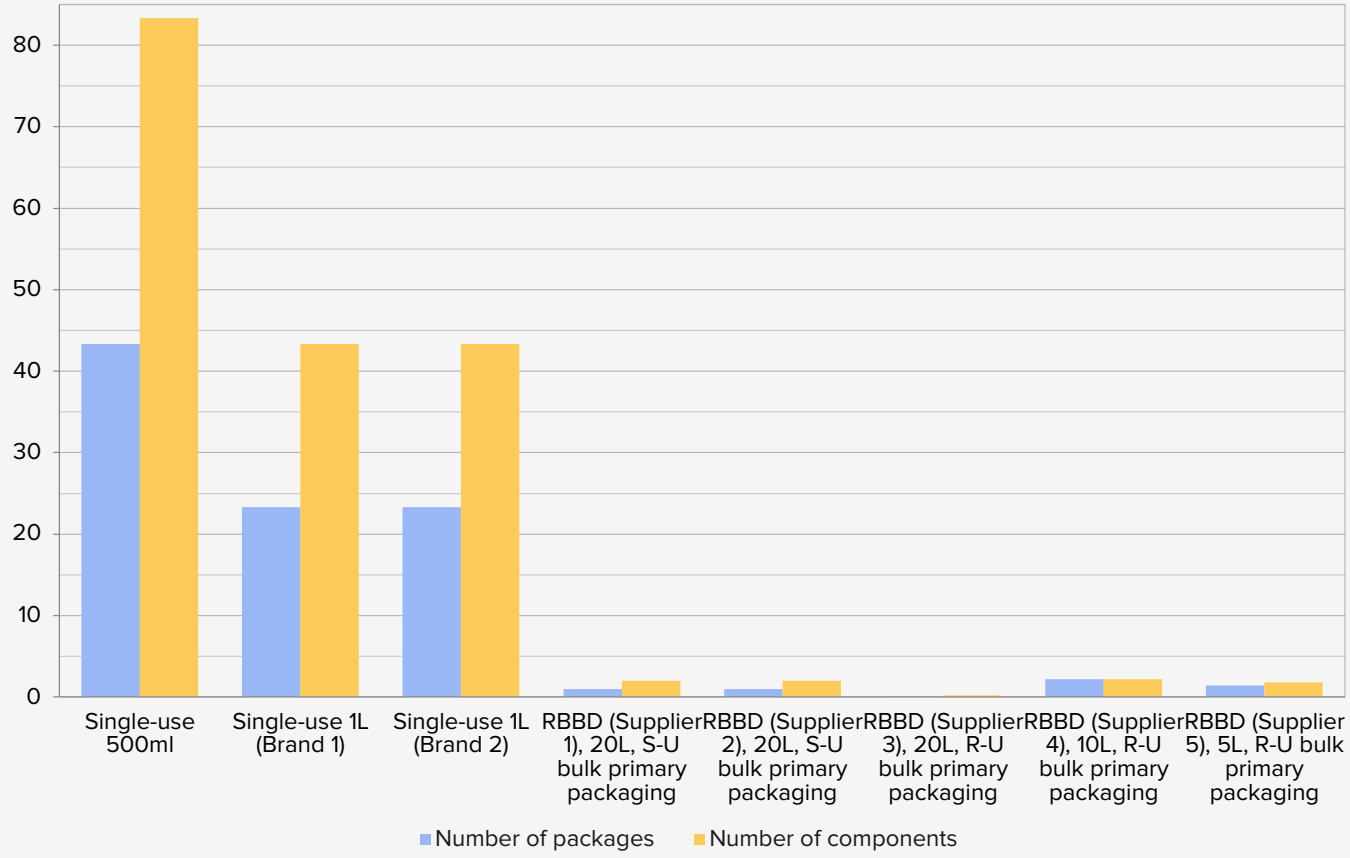
The largest sized bulk primary packaging for dishwashing liquid is 20L. Therefore, we compared the packaging consumption of each system to deliver 20L of dishwashing liquid to a consumer, in order to understand the packaging avoided by the RBBD systems.

Dishwashing liquid: Total packaging by primary, secondary and tertiary to deliver 20L




Dishwashing liquid: Packaging materials by weight to deliver 20L
Grams
3000
2500
2000
1500
1000
500
0
Single-use 500ml
Single-use 1L (Brand 1)
Single-use 1L (Brand 2)
RBBD (Supplier 1), 20L, S-U bulk primary packaging
RBBD (Supplier 2), 20L, S-U bulk primary packaging
RBBD (Supplier 3), 20L, R-U bulk primary packaging
RBBD (Supplier 4), 10L, R-U bulk primary packaging
RBBD (Supplier 5), 5L, R-U bulk primary packaging
Glass
Metal
Plastic
Cardboard/paper
Wood

Dishwashing liquid: Number of packages and components to deliver 20L



The three graphs show that the RBBD systems for dishwashing liquid use significantly less packaging than single-use packaged products, in both total weight, and number of packages and components. As with olive oil, the packaging avoidance impact of retailers not providing free single-use bottles/containers for consumers to refill into in RBBD systems can be seen in the results. The impact of returnable primary bulk packaging in the supply chain of RBBD systems is also significant. For example, despite being much heavier and a smaller capacity, the 10L returnable stainless steel keg shipped out in cardboard boxes still used less packaging by weight than the plastic 20L single-use jerry cans after just 10 uses. Furthermore, the plastic usage of the RBBD system with the single-use plastic jerry cans was greater than the plastic usage of one of the single-use packaged products. In contrast, the RBBD systems that use reusable plastic primary bulk packaging generate a significant plastic avoidance impact compared to single-use after just 10 uses.

5.1.7 WASTE AVOIDED SUMMARY

Our findings show that reuse systems, even poorly performing ones based on our conservative assumptions, generate packaging avoidance impact across the supply chain, and in some cases the impact is significant. However, there is scope to lift performance in the systems we have identified. Specifically, return rates and customer BYO rates are critical to the packaging avoidance impact of reusable packaging systems. We assumed different return and BYO rates due to lack of data on the real-world rates of participants' systems. Higher return rates were assumed when we found evidence of the types of measures likely to shift consumers from single-use to reuse options or to lift reuse rates. These include use of deposits in returnable packaging systems, or not offering (or charging for) single-use packaging for customers to fill into at RBBDs. Naturally, these higher reuse rates (90% and 100%, respectively) result in improved packaging avoidance. Softer measures that might encourage reuse, include incentives to return empty containers (e.g., loyalty cards with rewards), discounts for use of BYO containers at refill stations, or ample in-store signage promoting and encouraging BYO containers. In these cases, a 50% reuse rate is more realistic, and generally still produces a packaging avoidance impact, but there is clear room for improvement.

Our findings also demonstrate that the way that packaging avoidance is measured affects the results. Comparing packaging avoided by weight can underplay a reuse system's performance if the material used is glass or metal and the single-use packaging is plastic. However, if the measure is plastic packaging avoided, the result would be demonstrably successful. Similarly, such a system may underperform for packaging avoidance based on weight, but perform well for packaging avoidance based on number of packaging units and/or components.

The findings also illustrate how different choices of packaging material create different packaging consumption profiles, which have wider public health and environmental consequences. The returnable systems utilise much lower amounts of plastic compared to the single-use packaged products, and thus result in less plastic waste. Returnable systems rely on glass, which is heavier than plastic, but when reused, still results in a lower overall packaging consumption even when measuring this consumption by weight. While returnable plastic is used in the supply chains of some single-use systems and some RBBD systems, the reuse element reduces the overall consumption. This can be compared against the use of non-plastic materials in single-use systems that push up the overall packaging impact rather than reducing it (for example, with olive oil), which further underscores the relevance of reuse as a strategy for sustainably reducing plastic usage in the packaging system.

The results also reinforce that consideration of supply chain packaging is relevant for understanding how well a system avoids packaging, or for identifying areas of focus that can lift a system's performance. For example, we found that reusable packaging systems not only reduce consumer-facing primary packaging, but also secondary packaging, and this adds up in terms of both weight and numbers of packages and components. Furthermore, the ability of this study to compare single-use and returnable bulk primary packaging in RBBD supply chains for liquid products demonstrates that establishing a return system for primary bulk packaging lifts the packaging avoidance impact of a RBBD system. We also found that, where pallets are used, the difference between single-use and reusable pallets can be significant in determining the scale of a RBBD system's packaging avoidance impact. Nevertheless, overall, the findings show that even with single-use packaging in the supply chain, RBBD systems generally still reduce overall packaging consumption, if at least 50% of customers bring their own containers.

Finally, our findings show that, compared to mainstream retailers, smaller grocery retailers and/or their local suppliers are less likely to be part of reusable pallet pools. These retailers are therefore more likely to receive many of their products via deliveries direct from producers, in bulk primary packaging or secondary packaging only, or on single-use pallets. In some cases this results in more supply chain packaging, and in some cases, less. Regardless, we acknowledge that packaging consumption alone is not the only means of determining a packaging system's environmental efficiency, and that there may be environmental burdens associated with delivering smaller quantities of product directly to a retailer via courier or by the producer/supplier. Furthermore, while we have assessed the packaging avoided to move product through the supply chain, we have not compared the environmental burden associated with recycling/disposing of single-use packaging, versus the return journey and preparation for reuse of returnable packaging, nor the recycling/disposing of end-of-life reusable packaging. Therefore, although LCA is an environmental impact tool we have chosen not to focus on for this study, further research could apply an LCA approach to our data in order to increase insights and fill these gaps.

5.2 ENVIRONMENTAL/HEALTH INDICATOR 2: PACKAGING SYSTEMS PROTECT PHYSICAL HEALTH

Any packaging system can present human health or ecotoxicological risks if relevant hygiene or food safety protocols are not followed, if the packaging is easily compromised and enables contamination, or if the packaging materials themselves contain chemicals of concern that can migrate into the product that is used or consumed by people (Lacourt et al, 2024; Seref & Cufaoglu, 2025).

Studies generally highlight plastic as the material most likely to contain known chemicals of concern that can migrate from the packaging into the product contained (Seref & Cufaoglu, 2025). In contrast, glass "stands out" (Seref & Cufaoglu, 2025, p.9) as the safest packaging material option in terms of migration risk. Metal packaging is also considered inert and a reasonably safe choice, though some types can contain and leach heavy metals over time. Paper packaging, often presumed a safe packaging option, can contain both intentionally and non-intentionally added chemicals of concern, especially if there is recycled content, while its lower barrier properties can require use of coatings that sometimes present a chemical safety risk. Regardless of the base material, any packaging type may have coatings, finishings, labels and/or inks that can contain chemicals of concern (Seref & Cufaoglu, 2025; Clean Production Action, 2025).

Factors that can increase the ease and extent of chemical migration from package to product include: duration and temperature at which the product contained in the packaging is stored; if the product is fatty, acidic or hot; recycled content in the packaging; thinner or more porous packaging; and a large contact surface area between product and packaging (Seref & Cufaoglu, 2025). These factors are relevant to single-use and reusable packaging alike. However, the reuse of particular packaging types may heighten some safety risks in some cases. For example, repeated use and washing of plastic materials may result in degradation over time, resulting in microplastic release (Okoffo et al, 2025; Sol et al, 2023; Seref & Cufaoglu, 2025, p.5), and/or greater leaching or migration of chemicals of concern (Seref & Cufaoglu, 2025, pp.2-3).

Consequently, when considering the potential positive or negative impact of a reusable packaging alternative to single-use packaging, studies should consider whether that system replaces a potentially risky single-use packaging system and also whether it generates any public health risks of its own (WEF & Kearney, 2021, p.24; Gordon, 2021, p.54). Relevant considerations include:

- Users' awareness of various hygiene or food and worker safety risks created by the packaging system.
- Evidence of processes or protocols to manage or mitigate food or safety risks, e.g., staff training, cleaning schedules, communication of key product information, and external verification of processes (James Ross Consulting, 2007; Beitzen-Heineke et al, 2017; Coelho et al, 2020; Copello et al, 2021).
- The materials used for packaging, especially primary packaging or any bulk dispenser in direct contact with the product (UNEP, 2022; Bradley & Corsini, 2023, p.133; Kachook, 2022; Gordon, 2021, p.54).
- Underlying motivations for users' packaging choice and design, or evidence of mitigation measures to reduce safety risks, e.g., screening packaging for chemicals of concern, deliberately opting for more inert and impermeable material types, and/or taking into account product characteristics, storage conditions, and functions required of the packaging, in order to reduce chemical migration (UNEP, 2022; Bradley & Corsini, 2023, p.133; Kachook, 2022; Gordon, 2021, p.54; Seref & Cufaoglu, 2025, p.4).

Following our methodology, we explored performance against this indicator through observations, interviews, and analysis of customer survey responses. We were not resourced to test packaging samples for this project, though this is a potentially useful approach for future studies.

5.2.1 OBSERVATIONS ABOUT PACKAGING MATERIALS

When calculating packaging avoidance, we noted the materials and components for every layer of packaging of the samples we observed or collected for each focus product. For the purposes of the physical health indicator, we focused on the primary packaging, which directly touches the product.

For single-use systems, the customer-facing primary packaging was most often plastic for all focus products except for: olive oil, which was usually glass; and oats, which might be packaged in either plastic or paper.

Business-to-consumer returnable packaging systems tended to replace plastic packaging with glass. Our research identified B2C returnable packaging systems for two focus products: milk and/or toothpaste. All these systems (except for one) involved the producer/supplier packaging their product directly into glass when the single-use equivalents would have been plastic.[21] Therefore, for the most part, the B2C returnables facilitated a shift to a material recognised as most safe for packaging. This may be particularly beneficial for milk, as a higher-fat product that would otherwise attract lipophilic chemicals of concern. However, we also noted that while some of these milk producers/suppliers using B2C returnables used a single-use paper label hooked over the neck of the bottle rather than glued on, others had screenprinted labels on their bottles that appeared to fade over time after repeated uses. As noted in the literature, inks and coatings can contain chemicals of concern and these may be leaching into wastewater with each wash. More research into the materials used for screenprinting glass, and whether their degradation presents an ecotoxicological concern, could be useful.

For RBBD systems, we considered the materials for the retailer-provided empty packaging that consumers fill into at refill stations. For non-liquid products, i.e. oats and pumpkin seeds, retailers usually provided free single-use paper or plastic bags. Some retailers offered free, repurposed glass jars, either instead of, or alongside, these single-use options. For milk refill stations, customers were required to purchase, use, and subsequently reuse, bespoke, producer/supplier-provided glass bottles. For toothpaste, olive oil and dishwashing liquid, most retailers did not provide any free empty containers,[22] except those who already provided repurposed glass jars/bottles, which can accommodate both dry and liquid products. Overall, RBBD systems give informed consumers the opportunity to choose the packaging they put product into; this autonomy could be seen as an important aspect of protecting physical health. The model of offering repurposed glass jars reduces packaging usage while also enabling the use of a more inert material. However, where this is not offered, the default option is plastic or paper.

We also considered the material constitution of both the bulk primary packaging producers/suppliers use for sending bulk quantities of product to retailers and the bulk dispensers that retailers often decant bulk packaged product into. Across all examples we observed for our focus products, single-use bulk primary packaging was always made of either paper or plastic or a combination of both (e.g., multi-walled large sacks, plastic bladders inside a box, or thick plastic jerry cans). Returnable primary bulk packaging was almost always plastic (e.g., returnable buckets or jerry cans), as were the retailer bulk dispensers (bulk bins). The exceptions were some retailers decanting olive oil into stainless steel dispensers, and one dishwashing liquid supplier using returnable stainless steel kegs.

The use of plastic or paper for primary bulk packaging and dispensers is often not different to the materials that are used for single-use packaged equivalents (though the polymer and fibre types might differ). However, as RBBD systems rely on large packages and dispensers, the greater quantity of product contained relative to the packaging may reduce overall surface contact area between the packaging and the product. However, in the case of olive oil, both the single-use and returnable bulk primary packaging samples were plastic, replacing the glass usually used for the single-use packaged equivalent, for what is a high-fat product that could attract lipophylic chemicals of concern. This potential for chemical migration may be somewhat mitigated for those retailers that decant the oil from the bulk primary packaging into stainless steel dispensers.

[21] The one exception was a retailer-managed B2C returnable glass bottle system, where the retailer bottled 1L returnable glass bottles of milk decanted from 10L single-use plastic bladders packaged by the producer/supplier.

[22] Customers were expected to either bring their own containers or buy a new bottle.

5.2.2 FINDINGS FROM INTERVIEWS

Our interviews incorporated questions relating to participants' understandings of potential health risks of different packaging systems and any mitigating processes, practices and decisions they had in place. Overall, participants were very aware of hygiene and food safety risks across packaging systems and had thorough protocols in place, approved and audited by external agencies according to food safety laws (e.g., MPI, food safety inspectors). This regulatory regime for food safety effectively manages the hygiene risks of different packaging systems. In contrast, while most participants were aware of the relevance of avoiding single-use plastic packaging from an environmental perspective, very few participants mentioned public health risks associated with packaging materials (both single-use and reusable).

In response to an open-ended question about whether different packaging systems raise any public health risks, concerns, or benefits (perceived or real), most participants cited a public perception that reusable (returnable and RBBD) packaging systems are less hygienic due to greater contamination potential. Our participants who operated these systems mostly disagreed with this perception, noting the need to comply with food safety regulations regardless of the packaging systems used. They highlighted how they are regulated in accordance with the law, visited by food safety inspectors and/or audited by MPI, and required to identify risks and implement suitable processes and protocols for managing them in order to operate. As one participant noted:

> ***We have a relatively standard food control plan. Reusable food packaging isn't really an issue – it doesn't require many changes beyond what we would do for single use packaged products. Things we already do include things like pest control and regular cleaning etc.***

Similarly, another participant noted: "People can perceive refilleries as less hygienic, but if you have the processes in place, it's all good. You have to keep the place clean, that's important."

The various practices participants who operate reusable packaging systems said they implemented to meet legislative requirements (e.g., food safety) while allaying any consumer fears included:

- Batch tracking for RBBD product if product recall is needed;
- Strict and regular in-store hygiene and cleaning measures to reduce cross-contamination risks;
- Regular sampling and testing of washed packaging for microbial contamination for dairy returnable packaging;
- Sanitising packaging between uses (particularly for returnable packaging, but also bulk dispensers in RBBD systems);
- Regular tests and visual inspections of product (particularly in RBBD);
- Storing bulk products in either closed and/or coolstore rooms, or ensuring lids on RBBD containers are kept closed;
- Assisting consumers with cleaning their BYO containers; and
- Only having staff fill customer containers, rather than allowing self-serve, for certain products (e.g., refrigerated, deli items, or toothpaste dispensing).

Both retailer and producer/supplier responses indicated that RBBD systems do create different types of hygiene, food safety, or quality control risks compared to single-use or returnable systems. Managing these risks often involves greater effort and vigilance from retailers and their staff, and demands higher levels of trust from the producer/supplier that the retailer is maintaining those standards. For example, one producer/supplier explained that their dispensing machines "cannot be used by the customers, they must be used by store owners, for both mess and hygiene processes." Another producer/supplier that had previously offered a RBBD system preferred returnables because "letting the consumer do something just creates risk". Another retailer cited the "recurring feedback" they have received about mealy moths or weevils in some bulk products that, while not a health hazard, do create a negative perception for customers.

Two retailers noted the tradeoff between encouraging customers to BYO containers to avoid packaging and the potential that those containers are not properly clean and dry. The latter could compromise or spoil any product put into the container, creating food safety risks for that customer. Unclean containers could also create cross-contamination on shared surfaces, such as taring scales. Both these retailers also offered libraries of free, repurposed jars that had been donated by other customers for people to use instead of single-use bags. Some stores did not sanitise the jars, but used signage communicating this and stating that jars were used at customers' own risk.

For some respondents, our open-ended question led them to discuss wider public health impacts associated with particular packaging systems. For example, one producer/supplier highlighted that the convenience and ease of single-use packaging can promote access to particular products, and this can have significant public health benefits if the product is something that is beneficial when used en masse, such as fresh produce or toothpaste. This

participant noted that the commodification of toothpaste and development of the toothpaste tube by multinational corporations now means "[t]he vast majority of people in the world brush their teeth and support oral health … that's a great achievement, despite the pollution aspect." Some participants also described concerns about packaging systems in terms of physical safety risks posed to workers across the supply chain. These concerns are discussed later in the context of the indicator about new, quality jobs.

Only two participants raised the human health impacts of certain packaging materials or connected the environmental impacts of different packaging systems (e.g., waste and climate change) to human health, specifically. These two participants focused on plastic packaging, explaining their views that it is harder to clean and might harbour bacteria, changes the taste of food, or contains chemicals (BPA was specifically mentioned) that people might be exposed to through ingestion or skin contact. One participant in particular noted:

> ***… our food systems are full of contaminants and things that adversely affect the health of people and planet and that relates to packaging. When I first started managing this store, all our produce in plastic bags was fogging up. In supermarkets this doesn't happen. I asked our supplier about this. He explained that conventional produce bags have anti-fogging agents and these chemical additives can leach. That set me off in terms of packaging. Another example is BPA in cans. This has gotten attention and seen more marketing of BPA-free products, but often BPA is replaced with BPS, which is just as bad, but suppliers go around now saying their cans are free from BPA.***

We asked both retailer and producer/supplier interviewees to explain the reasons for the materials they had chosen for their packaging systems. Avoiding plastic was extremely important to several participants using reusable packaging systems. However, for these participants, motivations were usually framed in terms of reducing environmental impact. For example, one participant explained that they were:

> ***Going out of our way to avoid shrink wrap - I don't like that level of plastic in our society. It's just going to be thrown away, it's not going to be reused. It seems ridiculously wasteful and bad for the environment just because it's cheap and convenient.***

However, avoiding plastic was not always a motivation for interviewees operating reusable packaging systems. In particular, we heard that plastic containers were often chosen for returnable bulk primary packaging (seen in the supply chain of some RBBD systems for olive oil, milk and dishwashing liquid) because they are cheaper and lightweight, which reduces the cost, emissions, and handling complexities of the return trip. Further, retailers with RBBD systems explained that the use of plastic in-store bulk dispensers for most products reflected what was both affordable and available on the Aotearoa New Zealand market, which is extremely limited for products like bulk bins.

These practical considerations were consistent with most participants' explanations of their material choices for single-use and reusable packaging systems, which tended to show that the decision was based on tradeoffs relating to functionality, ensuring product integrity, sustainability, cost-effectiveness, and consumer preferences. Participants described how they chose returnable and RBBD packaging that balanced all these considerations. For example, some participants preferred metal containers (such as stainless steel) for their aesthetic and light-proof properties, especially for bulk dispensers for liquid products. Others chose or preferred glass containers for consumer-sized packaging for aesthetics, affordability, ubiquity (especially relevant when stocking libraries of repurposed jars), and easy cleaning. Some participants described using paper packaging as a compromise due to regulatory constraints and consumer preferences, despite its practical limitations. As already mentioned, others noted that plastic may sometimes be the best option due to its durability, weight, and cost, which was an especially relevant factor for returnable bulk primary packaging. Further, the permeability of paper was a reason why some producers/suppliers using single-use primary bulk packaging chose plastic sacks or paper sacks with an inner plastic lining.

Overall, very few participants mentioned human health considerations in relation to their choice around materials, labelling, or other packaging formats. This suggests this is not front of mind for retailers or producers/suppliers, even those who operate reusable packaging systems to avoid single-use packaging and/or plastic packaging. The potential risks of using plastic for reusable containers or bulk dispensers that are repeatedly washed and refilled (e.g. the possibility that these activities might degrade plastic materials, resulting in release of microplastics and chemicals of concern (Okoffo et al, 2025; Sol et al, 2023; Seref & Cufaoglu, 2025, pp.2-3,5)), was not raised, indicating a general sense that most interviewees viewed reuse as intrinsically beneficial, regardless of material (with the exception of one producer/supplier who used 100% reusable packaging (including bulk primary packaging and secondary packaging) and was adamantly against using plastic at any point in their supply chain). This, in turn, suggests that mitigating measures to reduce risks associated with factors such as chemical migration have not been directly considered when deciding packaging materials and formats.

Nevertheless, despite not necessarily articulating health concerns, it was apparent that most participants who used plastic in either single-use or reusable packaging systems saw this as a compromise rather than considering plastic their ideal material. For example:

> ***"I always said we wouldn't do plastic – but at the end of the day it just came back to the freight cost."***

> ***"I do have the issues with the plastics, what's the lesser of the evils. We go for BPA-free and those things, with our sterilisation not using any nasty chemicals. Somewhere along the way there has to be a nasty element - whether in the manufacturing or the product or the return process, the carbon footprint, there isn't a perfect solution that ticks every single box. It's trying to find the solution that ticks most of the ones that are highest on the priority list. Since we are focusing so much on our product not having the EDCs and the crap in that, I live with the rest of it."***

> ***"I've had to massively grapple with using plastic. When I started this business I said we would never use plastic – we should never use that word "never" - a lot of that has come about through the pandemic and the implications out of that for couriers and viabilities in general. But there has been some evolution with plastics and some of that has been quite rapid. So that does give me more comfort."***

Our interview findings illustrate how participants are balancing and negotiating the different human health impacts of packaging systems. The impacts range from mounting waste streams, to food safety and quality control, to physical safety when handling products, and finally, some (albeit limited) concern about the impacts of chemicals associated with primarily single-use plastic packaging. These negotiations highlight the multifaceted nature of public health considerations for packaging systems. Overall, our participants' priorities lay in those areas associated with legal obligations (food safety), while compromises were often guided by economic practicalities. For those thinking about public health, the focus was usually on ensuring the product's integrity - which might lead to the use of plastic due to its impermeability (c.f. paper), without risk of breakability (glass) or cost (metal) - with potential public health risks regarding chemical migration receiving less attention. These findings suggest that future research could give greater consideration to the potential release of microplastics or chemicals of concern from different packaging materials and systems (both single-use and reuse), with a focus on testing real-world packaging applications in the Aotearoa New Zealand context, to understand the extent of the risk (if any) and potential mitigation measures.

5.2.3 CUSTOMER SURVEY RESPONSES

The results from the customer survey reflected similar concerns about packaging system health impacts. Survey responses emphasised concerns about the impacts of mounting waste (primarily single-use plastic packaging) and the associated impacts on the environment and human health. Survey responses showed broad support for retailers and producers/suppliers who reduce packaging waste, particularly single-use plastic packaging, through reusable packaging systems. However, this support was generally contingent on ensuring reusable packaging systems were hygienic, protected products, and convenient to use. Survey responses described the importance of keeping retail stores clean, as well as complaints about pests contaminating ambient goods in RBBD containers. Concerns about the specific toxicity risks of different packaging materials or the ability to avoid certain packaging from a physical health perspective were not raised in survey responses.

5.3 ENVIRONMENTAL/HEALTH INDICATOR 3: FOOD AND PRODUCT WASTAGE IS AVOIDED

The relationship between food waste prevention and packaging systems is contested, and inquiries into the impact of reusable packaging systems should consider whether they aggravate or ameliorate food waste generation. Studies that have quantified food waste impact when assessing environmental impact of different packaging systems in the grocery sector have generally found that reusable packaging systems are likely more environmentally beneficial across product categories. However, if reuse systems reduce the protection of a product then resulting food wastage could offset this benefit for products with a shorter shelf-life, or that have a higher environmental impact to manufacture compared to the packaging itself (e.g., refrigerated products, especially meat) (UNEP, 2022; Sjolund, 2016). However, overall researchers argue that more studies quantifying the impact are needed, including quantitative research to identify the impact of reusable packaging on food waste generation in consumers' homes, not just the distribution supply chain (John Lewis Partnership, 2020, p.8; Beitzen-Heineke et al, 2017; Kurian, 2020, p.7). Our study was not resourced to undertake a quantitative analysis of food waste generation alongside packaging waste generation, but we included questions about interviewees' perceptions on product wastage in our interviews.

We asked participants whether they thought packaging/packaging system(s) have any impact on food waste. In terms of food waste in retail and supply chain contexts, most participants did not think reusable packaging systems (returnable and RBBD) created more food waste than single-use packaging. Those participants operating reusable packaging systems described their processes for reducing food waste. These included:

- using strategic ordering based on sales rates;
- managing food that is unsold (e.g., due to damage/passing sell by date etc.) by offering unsold items at discounted prices, donating edible food and composting; and
- redistributing unsold items to minimise wastage, for example to food rescue charities or to staff.

Participants noted that with careful management and (often) additional labour, reusable packaging systems did not lead to increased food waste.

Some participants suggested that reusable (RBBD) packaging systems allow customers to purchase exactly what they need, thereby reducing the likelihood of consumer food waste. This reflected similar comments made by interviewees in other research projects (UNEP, 2022, p.57; James Ross Consulting, 2007; John Lewis Partnership, 2020; Beitzen-Heineke et al, 2017). On the other hand, several interviewees noted that the self-serve nature of RBBD systems resulted in product wastage when consumers spilled product. Some retailers also noted that the process of decanting product from the primary bulk packaging to the dispenser resulted in wastage of the product left behind in the original packaging, which was particularly an issue for liquid products.

For returnable packaging, some participants noted that because returnable packaging needs to be washed between uses, it is often designed so that the interior of the package is easy to access (e.g. wide-mouthed jars and bottles). This can have a spinoff benefit for reduced

product wastage because the consumer can more easily extract all of the product without any leftovers (e.g., a jar of toothpaste versus a toothpaste tube). This observation also highlights how reusable packaging systems may change behaviour within households, not just distribution channels. On the other hand, some returnable packaging systems might increase risk of wastage in the supply chain compared to single-use, which is relevant to a system's overall impact given product protection is a key function of packaging (Mahmoudi & Parviziomran, 2020). Our participants who operated B2C returnable packaging were all using glass rather than plastic. A few interviewees discussed the potential for glass packaging to break when transporting packaged product through the supply chain and how this can lead to product wastage.

Overall, our interviewees provided qualitative reflections rather than quantitative insights, with a general view that well-managed stock inventory systems in retail contexts can avoid product waste generation, regardless of the packaging system. However, with the exception of milk, our focus products were largely shelf-stable wholefood products with reduced risk of rapid spoilage, and where the environmental impact of their production relative to the impact of producing their packaging was smaller than for other products that were not considered for this reason. A focused study that quantifies the relationship between packaging systems and food waste in supply chains, customer homes, and businesses is a valid area for future research.

5.4 SOCIOECONOMIC INDICATOR 1: ACCESSIBILITY (COST, EASE, AVAILABILITY/ OPTIONS) OF GROCERIES IS INCREASED

Product packaging can impact the accessibility of groceries. First, the cost of packaging is built into the product price, so if a packaging unit is more expensive or if the system it circulates in costs more to operate, this will increase the cost of the product. Second, packaging is the vehicle used to get a product to a consumer, so consumers have to negotiate the packaging to access the product. If packaging units are difficult to open, heavy or otherwise not ergonomic, or if the packaging system or retail spaces in which they operate are awkward, burdensome, or inconvenient to navigate, this may reduce the accessibility of the associated products. Third, if the packaging system is novel, not operated in mainstream groceries or not used by mainstream brands, then consumers may find those packaging systems, and the products they contain, less available and more limited in range.

According to the literature, the accessibility impact of packaging systems can be assessed in various ways.

Cost can be ascertained by collecting and comparing prices for equivalent products in single-use and reusable packaging. These prices can be collected both within and between retailers (e.g., Beitzen-Heineke, 2017; Salkova & Regnerova, 2020; Minami et al, 2012; Marken & Horisch, 2019, p.171; Brown et al, 2022). Additionally, for each reusable packaged product or reusable packaging system, further factors impacting on cost should be taken into account:

- Any financial incentives for participating, e.g., rewards, discounts or deposits (UNEP, 2022, pp.xi, 60; Kachook, 2022; Marken & Horisch, 2019, p.173; Grimes-Casey et al, 2007; Brown et al, 2022).
- Whether the packaging is mostly used for basic products, or niche or premium products (Brown et al, 2022) because, if the latter, it may be assumed the extra cost for reusable packaging is so significant that only wealthier customers can be presumed to absorb it.
- If the packaging is bespoke or standardised (Brown et al, 2022), as the former tend to be less efficient and therefore more costly to operate.

Ease of use can be ascertained through product observation, retailer site visits, and interviews and surveys, to consider whether individual packaging units are fit for purpose and easy to open, hold, and carry, or if the packaging system imposes particular time or cognitive burdens, or relies on tech or apps. Retail site visits should consider whether packaging systems affect store layout and the physical accessibility of groceries (wheelchair accessibility, needing to bend or reach) (Beitzen-Heineke et al, 2017; Kachook, 2022; Marken & Horisch, 2019, p.171; Lofthouse et al, 2009; Brown et al, 2022).

Availability and options can be ascertained by researching the number and geographic location (e.g., urban, rural, city periphery etc) of products in reusable packaging, retailers selling reusable packaged products, and/or returnable packaging return points (e.g., Salkova & Regnerova, 2020; Moss et al, 2022; Marken & Horisch, p.171; Lofthouse et al, 2009; Brown et al, 2022; Beechener et al, 2020) compared to retailers and producers/suppliers predominantly selling in single-use packaging. It is useful to note if reusable packaging systems are available in low income and marginalised communities as well as affluent communities (Brown et al, 2022). In terms of options, researchers can consider whether reusable packaging systems or the retailers that champion them carry a smaller range of products than single-use packaging and mainstream retailers (James Ross Consulting, 2007; Beitzen-Heineke et al, 2017; Marken & Horisch, 2019, p.171; Lofthouse et al, 2009).

We used desktop research and site and product observations to help garner information on several of the above metrics. Interviews allow producers/suppliers and retailers to provide further information and to demonstrate whether they consider consumer accessibility needs when designing their products and services, and any accommodations (Brown et al, 2022), while surveys can offer insight into consumer experiences (Lofthouse et al, 2009). Accordingly, we included questions in our interviews that related to accessibility and open-ended questions in our customer surveys that enabled consumers to reflect on the convenience, ease, or accessibility of reusable packaging systems.

5.4.1 COST: PRODUCT PRICE COMPARISONS

Figures 1-6 show the results of price comparisons between the different size categories of products in single-use packaging and reusable (returnable and RBBD) packaging for each of the focus products..

Figure 1 presents the price comparisons for milk and shows a relatively small price variation between single-use packaged products, which likely reflects the competitive local market and limited product differentiation. **Figure 1** includes four milk examples in returnable packaging and one in RBBD. One of the returnable examples is organic milk and has a higher price point than any of the milk products sold in single-use packaging. The returnable packaged glass bottles used for milk all carried a fully redeemable deposit, ranging from $1 - $5.

Figure 1: Price comparison for cows milk in single use (2L) vs reusable packaging

Figure 2 presents the price comparisons for toothpaste and shows a wide variation in prices for single-use, particularly in the 'small category' due to niche product differentiations (e.g., organic, specialised whitening formulas, etc.). Products sold in reusable packaging (returnable and RBBD) are more expensive than the median price for products sold in single-use packaging. Products sold in RBBD packaging are cheaper than those sold in returnable packaging,[23] which reflects the lower costs for the producer/supplier of that model compared to a returnable model. A reward system is in place for returnable jars where a customer receives a free toothpaste for every 12 jars returned.

Figure 2: Price comparison for toothpaste in single use vs reusable packaging

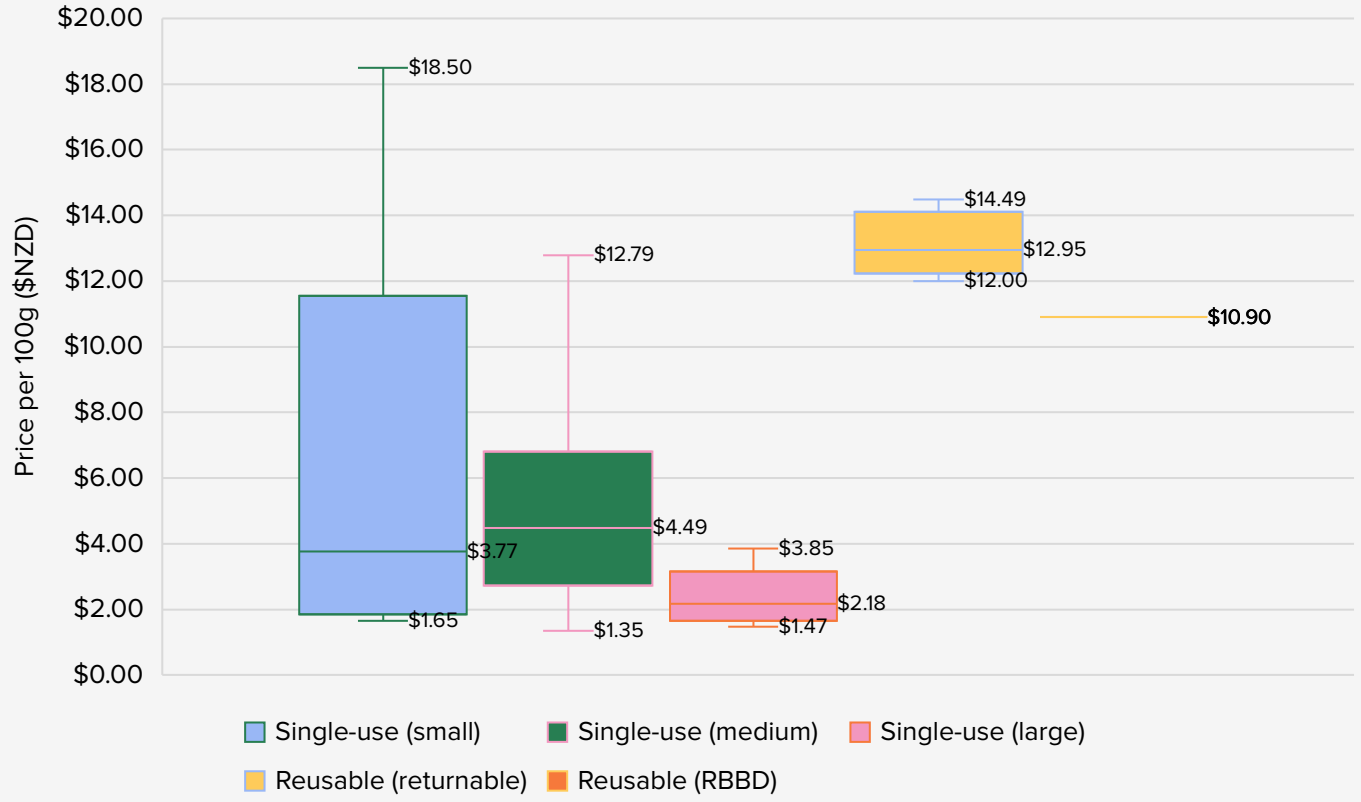


Figure 3 presents the price comparisons for olive oil and shows that small single-use packaged products have the highest variation in price. While olive oil sold via RBBD has the highest median price, one example was comparable to the price of olive oil in the medium single-use packaged example. Overall, the higher cost for olive sold via RBBD relates to the fact that the oil sold in this way is usually a premium product, e.g., either organic or grown in Aotearoa New Zealand.

Figure 4 presents the price comparisons for pumpkin seeds and shows that pumpkin seeds in small single-use packaging has the highest price variation. The median price of pumpkin seeds in RBBD packaging is slightly higher than the median for all three sized categories of single-use examples. Again, this higher price relates to the fact that pumpkin seeds sold in this way are often organic or premium Aotearoa New Zealand-grown product.

[23] One participant producer/supplier that uses reusable packaging (both returnable and RBBD) noted they intentionally price RBBD products cheaper than returnable to reflect the additional reverse logistics costs involved in managing returnable packaging.

Figure 3: Price comparison for olive oil in single use vs reusable packaging

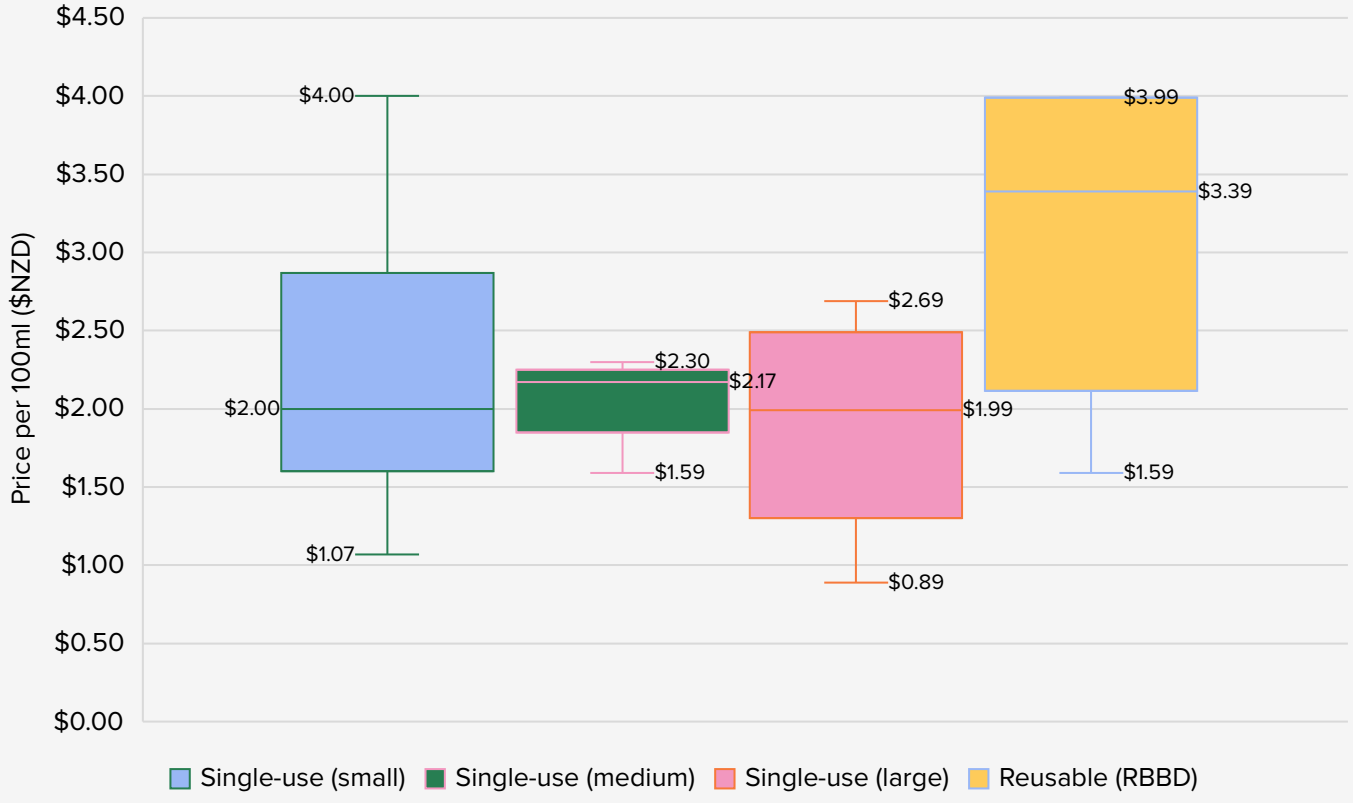


Figure 4: Price comparison for pumpkin seeds in single use vs reusable packaging

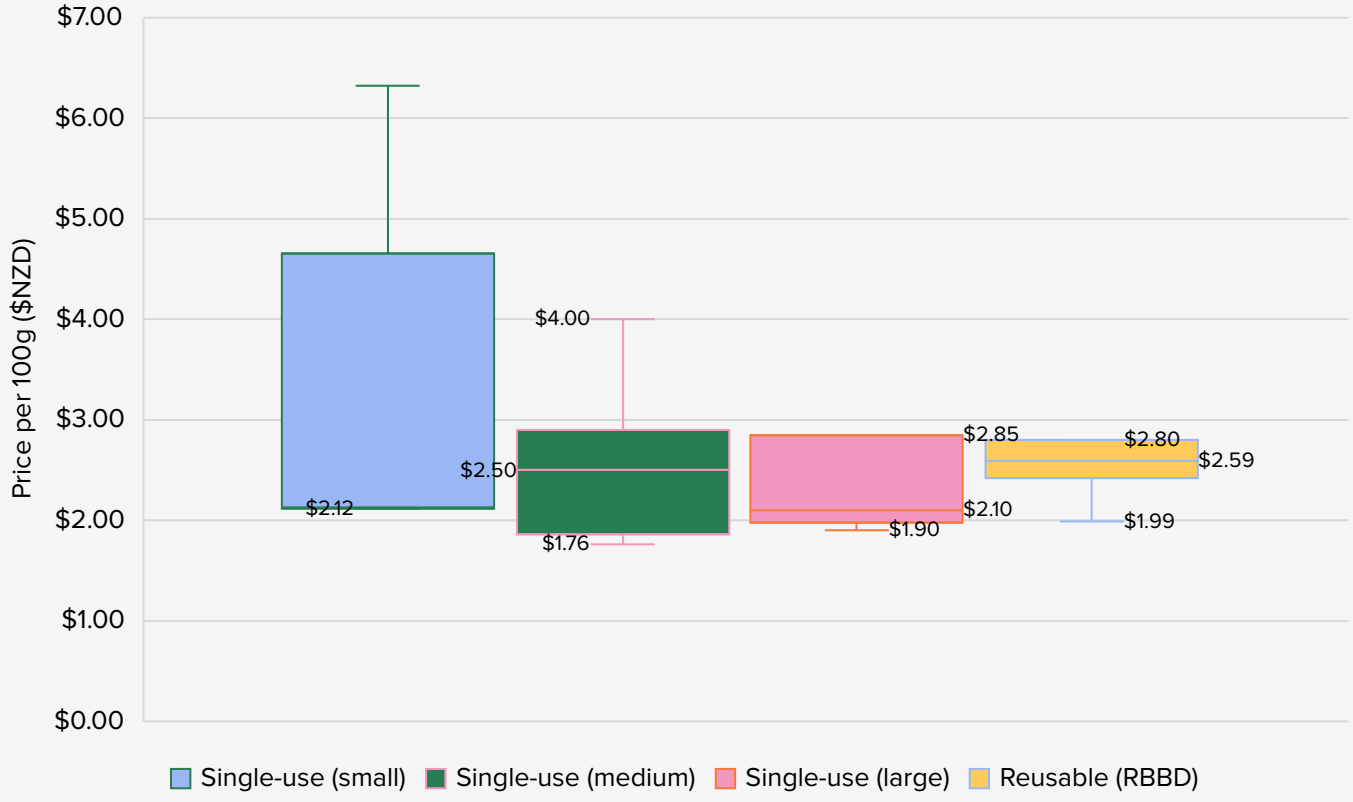


Figure 5: Price comparison for oats in single use vs reusable packaging

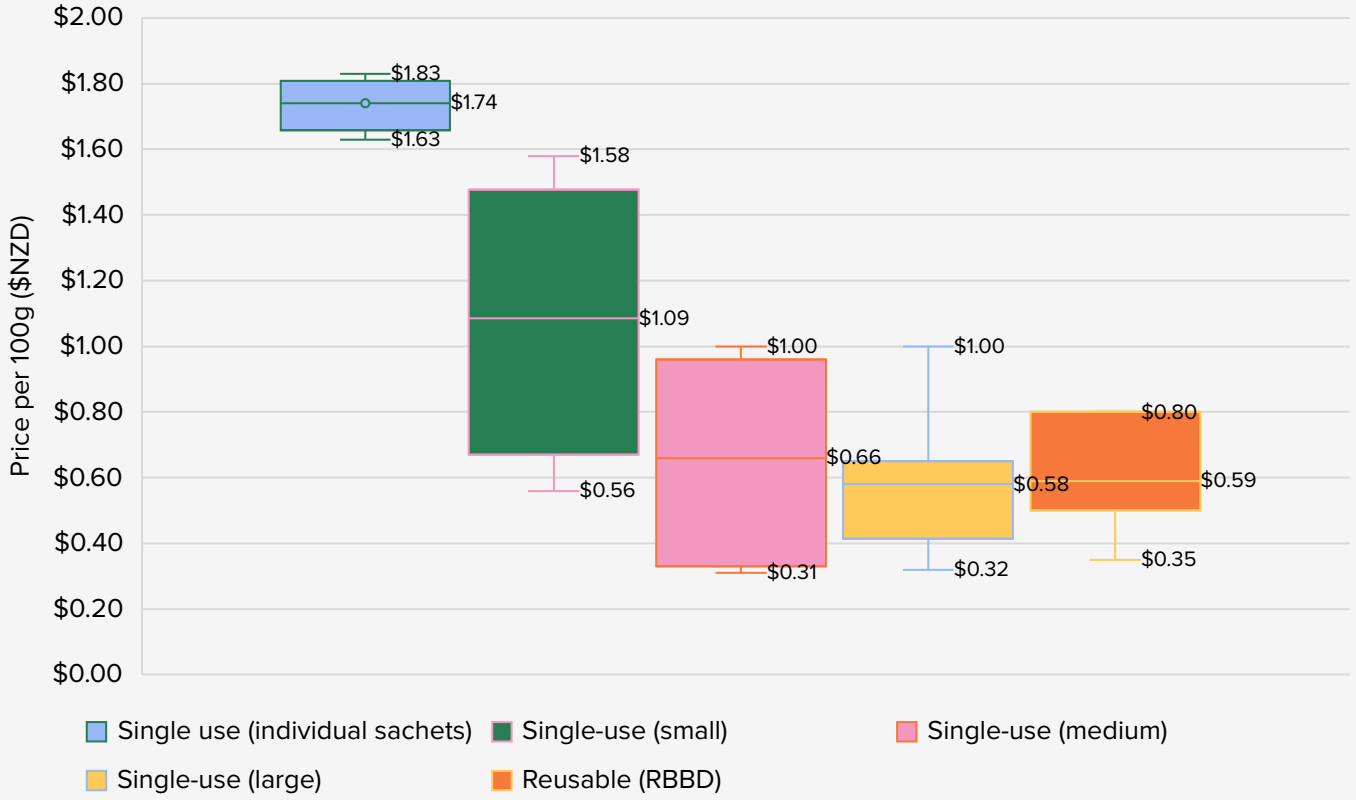


Figure 5 presents the price comparisons for oats and shows that small sachets in single-use packaging are the most expensive. The median price for oats sold via RBBD is lower than the median price for all of the single-use packaging sizes (except single-use (large), which is 1 cent less). The price competitive nature of the oats in RBBD could relate to the fact that oats are the only one of the six focus products where the product sold via RBBD systems and the product sold in single-use packaging are most likely to come from the same producers/suppliers. This like-for-like comparison between the different packaging systems enables clearer visibility of the savings the same producer/supplier can achieve by selling product in bulk quantities rather than incurring additional packaging and handling costs associated with consumer-sized packdowns.

Figure 6 presents the price comparisons for dishwashing liquid and shows that single-use products in the largest size have the cheapest median and overall price. This could be because these products in this category are marketed as 'basic' with a focus on affordability. However, the cheapest example of dishwashing liquid sold via RBBD is cheaper than the single-use small and medium sizes.

Figure 6: Price comparison for dishwashing liquid in single use vs reusable packaging

5.4.2 DISCUSSION OF PRICE COMPARISON FINDINGS

In all cases except oats, the median price of products in reusable packaging (returnable and RBBD) is more expensive than the median price of products in single-use packaging. Amongst single-use packaged products, our results show that the 'small' categories tend to have either higher median prices, and/or a wider range of price. Our packaging avoidance calculations also show these 'small' product package sizings have higher rates of packaging consumption per functional unit, indicating some relationship between price and waste generation within single-use systems. Meanwhile, single-use packaged products in the 'large' categories tend to have either lower median prices and/or a smaller price range. However, accessing this lower price per gram may not be affordable for all people because the upfront price of purchasing a bulk quantity may be prohibitive.

Between reusable packaging systems, RBBD is a cheaper way to offer reusable packaging options than returnable systems. For the two products that have both returnable and RBBD system options (milk and toothpaste), the RBBD option is cheaper. Furthermore, in some cases, the RBBD option can outcompete single-use packaging options on price. For example, for oats, pumpkin seeds, and dishwashing liquid, RBBD systems can be cheaper than single-use packaged products, especially for customers who wish to buy only a small amount of product given the higher per ml or per g price of smaller single-use packaged products.

The higher price for products in B2C returnable packaging compared to RBBD is not surprising given the additional reverse logistics costs associated with these systems. Furthermore, the returnable packaged examples in this study are not standardised systems, but vertically-integrated, meaning the individual manufacturers provide all of the reverse logistics themselves, which increases costs. Furthermore, for milk, all the identified returnable milk bottles carried deposits. Except for one product, these deposits were all almost equivalent to the purchase price of the product. Although redeemable, the delay between paying the upfront cost and then returning the bottle for a deposit could be inaccessible to price-sensitive customers.

The higher prices for reusable packaged products vis-a-vis single-used packaged products is unsurprising for a number of reasons. First, in the absence of a regulated product stewardship scheme, producers/suppliers selling products in single-use packaging do not pay for the costs of managing their discarded product packaging. In Aotearoa New Zealand, recycling and waste disposal is provided for and managed by territorial authorities through rates. The costs of disposal are therefore borne by the wider community. In contrast, producers/suppliers selling products in reusable packaging (especially returnable), internalise the costs of their packaging systems meaning that their packaging does not need to be disposed of in the same way/extent to single-use packaging, and the cost of that system is borne by the producer/supplier and their customers. For our product examples like milk, toothpaste, olive oil, and dishwashing liquid, the infrastructure needed to offer returnable and RBBD packaging is often significant and may include reverse logistics and additional labour time for staff to clean, handle, and transport containers. These requirements increase the product price, even if they lower the costs to the wider community by reducing the volume of packaging going through waste management and potentially to landfill.

The higher price for reusable packaged products may also relate to the fact that products in these packaging systems tend to come from producers/suppliers who are local, small, owner-operated businesses producing premium products, competing against larger mainstream business models, i.e., non-organic, share milking, multinational corporations. They are also more likely to be available in smaller scale, owner-operated retail outlets. As such, reusable packaged products generally do not benefit from the cost-savings associated with economies of scale, nor the distributed infrastructure and logistics systems of the groceries sector, which are based around single-use packaging systems. The smaller businesses that operate them also sit outside the price-setting environments that the supermarket duopoly controls, meaning their prices are slightly higher, even if they reflect the true costs of production, labour, and transportation. As one producer/supplier operating reusable packaging systems noted:

> ***... the bigger you get, you get economies of scale and you make it cheaper. But we pay for the externalities - [big corporation name] doesn't. They don't pay for any of that stuff. When you pay for that and manufacture in NZ, it's more expensive ... But we don't position ourselves as a mainstream cheap brand because we are not and we can't be.***

Reusable packaging is unlikely to be affordable to much of the population if it remains largely siloed to products with a higher price point. This suggests the need for larger and/or more conventional retailers and producers/suppliers to adopt reusable packaging systems to reduce costs and therefore increase accessibility.

5.4.3 PHYSICAL ACCESSIBILITY AND LOCATION OF RETAILERS

Figure 7 illustrates the socioeconomic and accessibility indicators for our selected 44 retailers categorised into three groups:

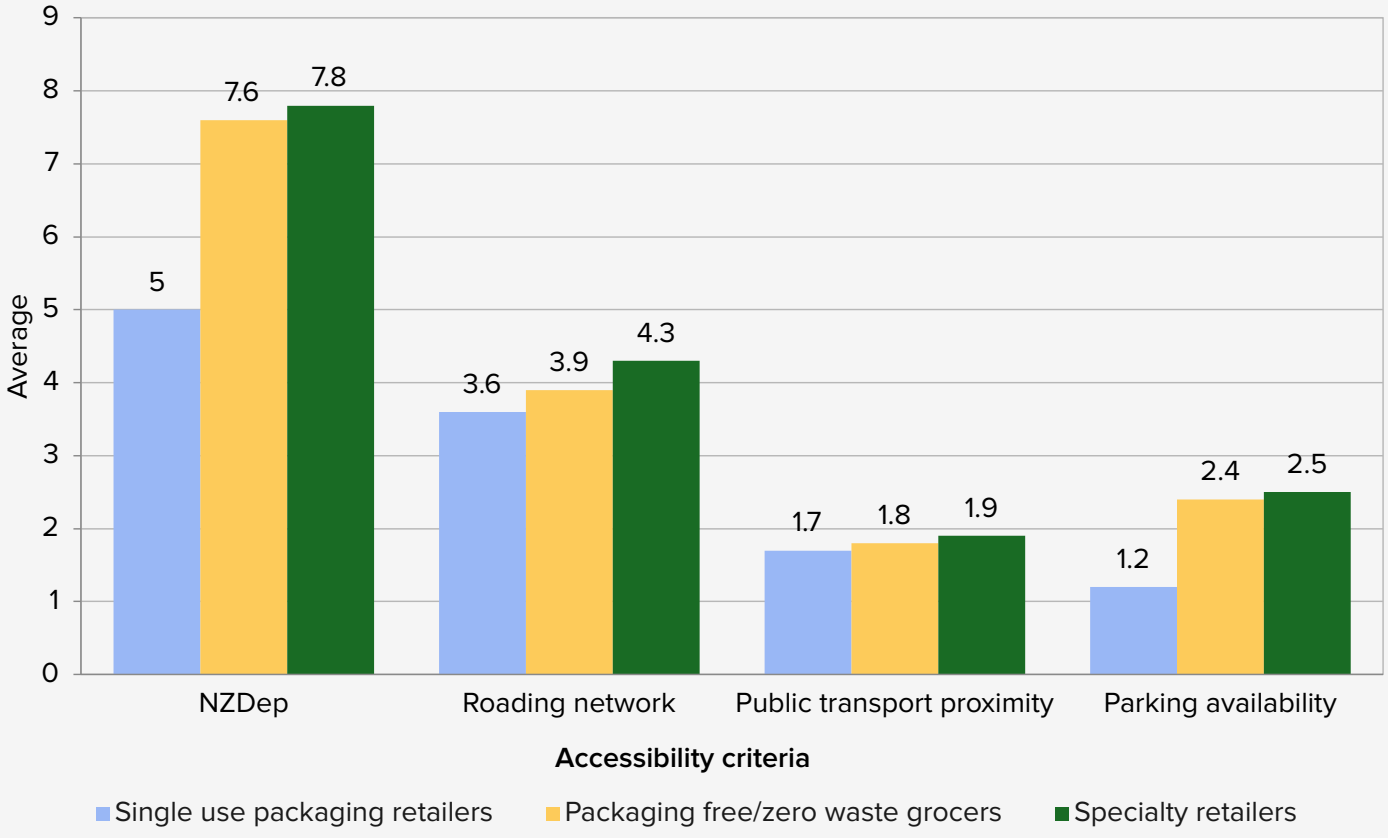
1. Those who predominantly sell single use packaged products (blue)
2. Those who predominantly sell packaging-free/zero waste products (orange)
3. Those who predominantly sell specialty products, with both single use and reusable packaged options (green).

As described in Section 4, we converted descriptive data relating to accessibility into numerical categories to calculate averages and enable comparisons, with a lower score indicating greater accessibility. Figure 7 shows the following high-level trends:

- For the three transport accessibility indicators, single-use retailers score lower than packaging free/zero waste grocers and specialty retailers, suggesting that overall single-use retailers have lower barriers to accessibility.
- Single-use retailers are slightly more likely to be located off larger, more significant roads, rather than secondary (smaller) roads.
- Single-use retailers are slightly more likely to be located close to public transport.
- Single use retailers are much more likely to provide dedicated and larger numbers of car parks.
- Packaging-free/zero waste grocers and specialty retailers are more likely to provide less dedicated parking, or to rely on street or publicly available car parking
- Single-use retailers are more likely to be located in less socioeconomically deprived neighbourhoods. This suggests that for our sample size, retailers who sell products in reusable packaging systems are not necessarily located in affluent suburbs, countering claims that such retailers (and packaging systems) are more accessible, in terms of availability, to the wealthy.

Note: 'NZDep' refers to Stats NZ's index of socioeconomic deprivation. The Y-axis provides a number (average for each retailer group) based on conversion of descriptive data. A higher number on the Y-axis means more barriers to accessibility.

Figure 7: Accessibility measures for three groups of retailers.



Our analysis supports the finding of Kemper et al, (2024) that retailers who sell products in reusable packaging systems are more likely to be geographically less accessible than single-use retailers. Our findings also reflect wider trends relating to urban transport planning, infrastructure, and grocery retail in Aotearoa New Zealand. These include prioritisation of investment in motor vehicle transport and roads over public and/or active transport (Macmillan et al. 2021), and the influence of the highly profitable supermarket duopoly, which uses various methods to reduce competition and innovation (e.g., restrictive land covenants and price setting) (Ministry of Business, Innovation and Employment, 2022; Commerce Commission New Zealand, N.D). These factors have interacted over many years to create a situation whereby retailers who use reusable packaging systems or offer specialty products tend to have smaller floor areas, be located near other smaller independent stores, and unable to provide dedicated infrastructure, such as customer car parks.

While dedicated car parking and reliance on private vehicle transport is ultimately problematic for various human health and environmental reasons, the current arrangement and planning of urban centres in Aotearoa New Zealand means that reusable packaging retailers are less accessible by the main transport infrastructure than single-use packaging retailers. These factors, combined with the limited investment from the supermarket duopoly in reusable packaging systems (other than bulk bins and limited initiatives, such as Foodstuffs removing plastic packaging from produce (see Diprose et al., 2021) or initiating the RePlay returnable packaging trial for deli items in select stores) means that reusable packaging systems are ultimately less accessible, available and convenient for customers. These wider infrastructural factors illustrate the importance of moving beyond individual behaviour change strategies and towards shifting infrastructural investment and associated regulations that shape what people and businesses are able to do.

5.4.4 CUSTOMER SURVEY RESPONSES

The results from the customer survey reflected similar observations outlined above in relation to reusable packaging systems and their products being less accessible than single-use. This also reinforces the findings of Kemper et al (2024) that, not only are zero waste stores and other specialist retailers less accessible, but their more limited range of products mean most are also not able to provide the full grocery shop, therefore requiring more labour and resources from consumers who need to take multiple trips to provision food. Almost half (47%) of respondents in the customer survey noted that grocery stores (e.g., supermarkets) were their main source for groceries. Respondents provided various reasons for this, including; cost (supermarkets were cheaper), convenience (easier to access), product range (supermarkets supplied all of the products they needed), and time (going to a supermarket requires fewer trips). Additionally, some survey respondents also described reusable packaging systems (returnable and RBBD) as more time-consuming and awkward, requiring more labour and advance planning. These findings suggest that even for this sample of people who are broadly supportive of reusable packaging given they shop at zero waste stores, the accessibility barriers for reusable packaging systems still influence their shopping practices and impose an additional time, cost and effort burden.

5.4.5 ACCESSIBILITY: INTERVIEWEE REFLECTIONS

We asked participants whether they had considered accessibility when implementing their packaging systems for their stores or products. Economic accessibility was cited as an important concern. Despite efforts to keep prices competitive, all participants operating reusable packaging systems noted that their inherent cost was a challenge. One producer/supplier noted: "How do you make eco not expensive? That's a real challenge for brands like us. We all need to consider and think about it". Meanwhile, a retail participant said that economic accessibility was their "biggest thing" and had influenced their decision not to stock fully organic products even though this was aligned with their store's ecological values:

> ***... because to me anyone should be able to access [package-free groceries] and organic quite often out-prices the lower socioeconomic group. So, our whole thing is, it's better to refill than it is to be organic... But yeah, pricing is a big one.***

Demonstrating their commitment to economic accessibility, most participants reported efforts to improve the affordability of their reusable packaging goods. For example, some participant retailers deliberately priced their RBBD products as the cheapest options in their stores to incentivise customers to choose these over the single-use alternative. Some also ran promotions that further reduced the cost of RBBD products. For example, one participant retailer offered discounts of 10% during Plastic Free July on products bought via RBBD if customers brought their own containers to fill into. Another participant retailer permanently offers 5% discounts for customers who BYO containers.

For returnable packaging systems, some producers/suppliers opted for trust or reward-based return incentives, rather than deposits.[24] One producer/supplier utilises a loyalty card scheme where customers receive free product if they return a certain number of containers. This not only motivates participation in returns, but results in an 8% price reduction per product unit for consumers who return enough containers to complete a loyalty card (if the cost of the free product is spread over the previous purchases). In other cases, producers/suppliers may rely on trust models, particularly for B2B returnable packaging, where the emphasis is placed on building a relationship rather than relying on monetary incentives. For example, producers/suppliers might cover the freight costs for retailers to return the packaging or add small tokens of appreciation for returning items. In so doing, these producers/suppliers support retailer participation while reducing the costs that might be passed on to consumers.

In relation to physical accessibility, many of our retail participants cited this as a relevant consideration for their stores and packaging selection and design. Participants described attempting to design their store layouts with wider aisles to support mobility within the store. Where this was not possible due to small retail spaces, staff instead provided assistance to customers who needed help navigating the store, including offering to fill containers from bulk bins located in narrow aisles or at inaccessible heights. Some participants also described considering the weight and consistency of product packaging, making efforts to ensure ease of use and avoid containers that are difficult to carry, open, fill or empty. One participant retailer partnered with the Epilepsy Trust to provide discounts to specific customers.

[24] As noted previously, although redeemable, deposits often need to be quite high to be effective in lifting return rates, which is potentially off-putting for price-sensitive customers.

5.5 SOCIOECONOMIC INDICATOR 2: NEW QUALITY JOBS ARE CREATED

We asked participants about the impacts of packaging systems on jobs. This included questions about the number, nature, and quality of jobs and labour tasks associated with different packaging systems, as well as any impacts these tasks might have on recruiting and retaining staff.

5.5.1 NATURE OF TASKS

In terms of the unique, different, or more labour-intensive aspects of reusable packaging systems compared to filling into single-use packages or stocking shelves of single-use packaged products, these can be understood as follows:

- **For RBBD:** regularly cleaning bulk dispensers and scoops between fills or uses; refilling empty containers with product (often from large, heavy bulk packaging) and batch numbering; advising or helping customers about refill processes; cleaning up product spills by customers; more involved processes at the till to weigh and calculate product prices; appropriate storage and warehousing processes for bulk packaging.
- **For returnable packaging:** selecting and designing appropriate returnable packaging materials and tracking systems; collecting, storing and returning empty containers for suppliers/producers; sanitising and inspecting returnable containers prior to refill; advising customers about how returnable packaging works and managing any financial incentives (e.g., rewards or deposits).

Retail participants observed that while the labour tasks for reusable packaging were slightly more than single-use, the nature of the tasks were not substantially different. For example, unloading pallets and restocking shelves, monitoring food safety (checking use-by dates), and cleaning shelves and customer spills. Most of our retail participants did not see RBBD in particular as creating too many additional demands on their staff or resourcing. However, some did note that the additional tasks associated with returnable packaging (e.g., having to be a return point for empty packaging or manage deposit systems) had influenced their decision about whether to stock certain products or not. Furthermore, they felt that all reusable packaging systems generally require a deeper level of staff knowledge, with training implications in the recruitment process.

In terms of job quality, we asked participants whether the unique tasks associated with reusable packaging systems created health and safety risks that differed from single-use packaging. The most common physical safety issue raised was the weight of the bulk packaging for RBBD systems. One retailer acknowledged "bulk is labour intensive and not everyone can do it - you need to be strong and know the difference between products." Mitigations stores implemented involved ensuring staff in charge have the physical strength for the role and that the size and associated packaging is manageable. One producer/supplier using bulk packaging for a RBBD system stated that for their primary bulk packaging:

> *We can go up to 20 litres, but we've just focused on 10 litres. It worries me if they [retail staff] pick up 20 litres by the handle, it's really heavy and if it dropped it would just explode so we left it at 10 litres.*

Additional risks raised in relation to returnable packaging systems were mostly associated with the glass commonly used for the B2C packaging units for these products, which can be hazardous if dropped or chipped. One producer/supplier also noted the risk of burns from the chemicals needed to sanitise the packaging for food safety standards.

However, the nature of the work associated with reusable packaging systems does not seem to undermine the quality or appeal of working for businesses that operate these systems. When asked about whether it was easy or difficult to retain and recruit staff, participants noted either high staff retention or easy recruitment, suggesting these roles are associated with job satisfaction.

> *Easy! We have always got people and always got amazing people that work for us. A lot of the time they start off as 'it's just a job' and then they really get into the whole feeling of what we are all about - we are lucky to have had awesome staff that have been here for years. For them it's also about not using plastic - we all have the same ethos in that respect.*

5.5.2 JOB CREATION IMPACT/LABOUR INTENSITY

Our interviews clearly showed that reusable packaging systems do have a job creation impact. Not only do they create tasks that would not otherwise exist in a single-use packaging system, but these tasks are often more labour intensive, especially returnable packaging systems. However, we were unable to gather enough information to quantify the increase; further research would be useful in this respect. In part, the challenge of quantification related to the fact that the producer/supplier participants who exclusively used reusable packaging systems were mostly vertically-integrated companies, meaning they produced the product and managed their packaging system, and the reusable packaging was usually a key part of their overall product offering, rather than seen as something discrete. These factors made it difficult for participants to cleanly separate out the roles associated with their packaging system or to distinguish them from single-use packaging systems that they did not have experience operating. These difficulties were similar for the two zero waste grocers we spoke with, although their existence and their goal of offering an alternative shopping experience to the supermarket based on reusable packaging effectively meant all roles in these stores were 'new jobs' that otherwise would not exist.

Despite the difficulty of undertaking a comparative quantification, producer/supplier participants who only used reusable packaging told us they had extra staff to run tasks unique to a reusable packaging system. For example, one producer/supplier estimated they had 2 FTE dedicated to washing and inspecting their returned packaging, and 0.5 FTE for the additional administration involved in managing deposits and tracking returns. Another company that did operate its reusable packaging system as a discrete part of the business from the product manufacturing noted that the packaging part of the business employed multiple FTEs and part-time staff to sort, wash, and fill packaging and undertake book-keeping roles relevant to reuse. These cases highlight a clear job creation impact from returnable packaging systems (mostly involving sorting, washing, and filling of packaging).

Also relevant to both retailers and producers/suppliers who were dedicated to reusable packaging systems is that there was often volunteer time associated with aspects of the packaging system. Using volunteer time is one way that these companies manage the internalised costs of reuse without transferring them entirely to the final product price. Additionally, many of these businesses were owner-operated, with owners absorbing some of the extra labour time involved in reuse by completing tasks themselves. These practices suggest that the additional labour requirements of reuse systems may hinder their scalability in for-profit businesses that need to provide revenue to shareholders (in the absence of wider changes to the regulatory system for packaging to internalise the costs of single-use packaging).

The retail participants who operated both single-use and reusable packaging systems could identify the additional staffing requirements compared to single-use packaging. Their responses highlighted the increased labour intensity associated with reuse, although often these tasks were absorbed into the roles of existing staff, rather than representing standalone roles. For example, one retailer explained that although all staff undertook all activities in-store, they had "one main person in-store responsible for the bulk bins", and this management role took up roughly 1–1.5 hours per day. The retailer who managed the retailer-operated returnable glass bottle system for milk said this system was "very labour intensive", but again was an additional role for existing staff, rather than a standalone role, involving about 3 hours a week to sanitise the bottles. Despite the additional roles for RBBD systems, retailers described this offering as an important value-add for their stores that covered its costs.

5.6 SOCIOECONOMIC INDICATOR 3: COMMUNITY WELLBEING AND ENGAGEMENT IS ENHANCED

We asked participants about the wider community wellbeing impacts of different packaging systems. Some participants operating reusable packaging systems noted that reducing plastic waste and encouraging reuse of durable packaging (like glass) was the key community impact. Others went further, describing how their store or product (and associated packaging system) provided consumers with more choices when it comes to taking pro-environmental action. These participants tended to frame the impact of their chosen reusable packaging system as one part of a wider sustainability movement operating in contrast to single-use packaging systems and BAU. They used terms like "waste reduction", "buying local", and "mindful consumption" to describe the reusing and refilling packaging practices they enable.

Several participants emphasised how reducing packaging waste through reusable packaging systems was naturally suited to wider efforts to support local businesses and livelihoods, local supply chains and local food production. Together, these efforts brought positive benefits for the local economy, local food resilience and reduced food miles and emissions. Our observations of the products in returnable and RBBD systems, and the retailers that champion reuse, do seem to verify that these packaging systems often lead to the sourcing of locally produced products. This is especially the case for any system with a B2C or B2B returnable primary packaging element because the empty packaging's return trip is most economically and environmentally efficient when the producer/supplier is close to the retailer (and would be impractical for most imported products). Our retail participants who were committed to offering reusable packaging systems and stretching this impact across the supply chain actively sought out local suppliers with whom it was easier to negotiate reduced packaging or returnable packaging systems. Similarly, producers/suppliers using B2C returnable packaging liked working with smaller stores that championed reusable packaging systems because they were values-aligned and could rely on those stores to encourage customers to return empty packaging. These findings indicate that reusable packaging systems can be a gateway to supporting local food production, and that packaging-free retailers can create opportunities for local producers that might not otherwise be there, and act as an important connection point between customers and the local food system. One producer/supplier that prefers to supply their product to RBBD systems noted:

> ***... supplying NZers with homegrown product is important to me. It's important to me because of low food miles, the more we can produce ourselves, the better we feel we are. There's traceability in what we produce versus the brands that come from overseas ... You can come to our paddock and I can show you happily and openly. Our feedback is that New Zealanders want New Zealand-grown products.***

Our interview participants who operated reusable packaging systems also spoke of the ways they connected to their community and shared their values. Approximately half of our participants described associated sustainability and pro-environmental actions and events they participate in or lead. Examples included: supporting Plastic Free July; educational workshops and sharing information about waste-free living; in-store signage to explain how to refill, reuse, and recycle; engaging with customers on social media to solicit feedback and suggestions for new products; and participating in collaborative initiatives with other organisations (like the Red Cross and local Sustainability Trusts/Environment Hubs). Some participants also described how their enterprise donated a portion of profits to environmental causes, supported local schools and community projects, and engaged with diverse community groups through initiatives like employing non-English speakers and offering educational

tours. Some participants framed these contributions as enabling wider community connectedness and wellbeing. For example:

> ***The biggest one definitely is the sense of community and there's something about it that draws people together – I don't know how or why. Everyone feels responsible for the fact that we are doing something good – for the environment, good for a lot of things, good for the community.***

Those participants who were currently not doing these kinds of actions noted that they wished to expand community outreach in the future when resourcing allowed it.

Participants involved in these wider sustainability actions described trying to strike a balance between advocating for reusable packaging without overwhelming or alienating customers. Some described how they focus on promoting small, manageable changes, rather than large-scale changes or messages that made consumers feel blamed or guilty. For example, one participant retailer stated:

> ***I don't shove it down people's throats. I find sometimes it puts people off. And then you have got the extremes both ways. The more people you can get doing it, the better, versus one person doing it perfectly.***

These actions and examples reflect the findings in Kemper et al. (2024) that retailers and suppliers operating reusable packaging systems often support wider sustainability goals that make consumers feel empowered, hopeful, and connected to others (including producers, retailers, and consumers) taking collective action. Kemper et al (2024) note that these kinds of collective actions can generate positive flow-on impacts in communities that help to avoid the isolating focus on 'individualised behaviour change', which can lead people to feel disempowered and hopeless. As one of our participants noted:

> ***Our customers love that they can return their packaging, it's not just something people think is good and that they should do, they LOVE it. When we survey our customers it's the single biggest thing they love the most. There's something powerful about that. People don't want to just be passive consumers, they don't want to do less bad, they want to do things better and they are prepared to do things differently and make an effort to do better. People will go to extraordinary measures to get us our packaging back … It makes people feel good about themselves …***

5.7 CULTURAL INDICATOR: COLLECTIVE WELLBEING IS IMPROVED

Peryman's parallel Kaupapa Māori study into Māori perspectives on reuse supported the development of a cultural impact indicator for this research, along with interview questions to help ascertain performance against the indicator.

The key questions centred around whether the participant:

- had a cultural advisor to help inform their business and packaging systems;
- had considered cultural practices in designing their packaging systems, such as the relevance of tikanga, halal, kosher;
- had any thoughts on how their business practices supported tino rangatiratanga, kaitiakitanga, and kotahitanga; and
- perceived any relationship between the packaging systems they used and the nature of how communities access the types of products they make and sell.

No participants had a cultural advisor, and most had not considered cultural practices when setting up their packaging systems. Some noted that they had, for instance, considered halal, but this had not led to a change in product or packaging practices. Instead, the identities or experiences of staff or business owners were often the key driver of which (if any) cultural values were seen as relevant to the business and packaging system/s. For example, one retailer said "we generally rely on staff and their interests and connections to specific communities to help inform our approaches." Another participant explained that:

> ***I'm Māori, so I bring my cultural perspective. Our vision is a world where we take responsibility for what we consume and produce and that is another way of saying kaitiakitanga. We don't do what we do because nature's pretty or because we like nature, we do it because it's our responsibility to our tipuna and our mokopuna to protect te ao.***

While most participants had values relating to protecting the environment that they felt comfortable relating to the concept of kaitiakitanga, most found it more difficult to answer in relation to more political or constitutional concepts, such as tino rangatiratanga or sovereignty. No participant directly mentioned Te Tiriti o Waitangi and responsibilities or obligations that might flow from this. However, two participants did point to a responsibility to respect mātauranga and tikanga and/or to support mana whenua, with both providing practical examples of how they were doing this, which indirectly reflected a sense that Te Tiriti had relevance to their business practices.

Only one participant, a retailer, had proactive actions relating to lifting cultural awareness, including running Treaty workshops for staff, and this retailer also had policies in relation to mātauranga Māori and cultural appropriateness as part of their product listing criteria. For example, the policy required suppliers to declare the use of native plant ingredients in their products, and their sourcing and use processes, to ensure these ingredients were being used respectfully and not violating Indigenous intellectual property. This participant also recounted examples where they chose not to stock certain products if the packaging had culturally inappropriate imagery, or Indigenous names or terms that the producer did not have permission to use. However, this example was an outlier, and most of our participants noted that cultural impacts or considerations were not a focus of their business.[25]

In response to whether participants perceived any relationship between packaging systems and the nature of food/production systems more broadly,[26] four participants answered this question by focusing on the adverse human health impacts of single-use plastic packaging. However, another participant reflected that the system in which their product was used had failed Māori; although this was not necessarily connected to packaging systems, the business was seeking to build connections with local iwi in their rohe to support with the delivery of more culturally appropriate approaches.

[25] This is perhaps unsurprising because asking people to reflect on 'culture' is often difficult, especially as people in more dominant cultures tend to perceive questions about 'culture' as only relating to minority ethnic/cultural groups. For example, while hygiene practices and ideas about what is 'safe' or 'acceptable' are culturally constructed and often taken for granted, none of our participants responded to this question by reflecting on their culturally dominant ideas of hygiene or food safety.

[26] In an Aotearoa New Zealand context, this question reflects critiques of current food systems that do not provide kai (food) sovereignty for Indigenous Māori.

5.8 OTHER THEMES

Three additional themes emerged through participant interviews that did not readily reflect our impact categories:

- Data capture and reporting
- Precarity of enterprises that operate reusable packaging systems
- The flow-on impacts of the supermarket duopoly on reusable packaging systems

5.8.1 DATA CAPTURE AND REPORTING

We observed data gaps and inconsistencies regarding whether and how interviewees (as well as other producers and retailers) captured and shared data about their packaging systems. Companies are not required to report on the packaging they put to market. So, this data may not be collected and recorded, and even if it is, it is unlikely to be completed in a standard way, nor made publicly available. Overseas reports into packaging usage in the supermarket sector or by fast-moving consumer goods companies have also noted a similar lack of transparency or consistency around reporting the total plastic used or put to market, how usage and reductions are communicated (e.g., weight vs number of units), and the tracking of progress against targets to reduce packaging or plastics (EIA & Greenpeace, 2021; Urbancic et al, 2020, pp.35-38). Measuring and comparing individual businesses' packaging footprints and efforts to reduce them over time is difficult without consistent expectations or methodologies for collecting and communicating key packaging data.

We also found that participants using reusable packaging systems were not capturing the data needed to understand the real-world impact of their systems. For example, no retailer could tell us accurately the percentage of customers that brought their own containers to RBBD systems. Meanwhile, participant producers/suppliers using returnable packaging struggled to calculate return and use rates. In some cases, this was because, although they might have the raw data needed to make the calculations from their sales and purchases, they did not necessarily have the time to work through this and work out how to calculate reuse rates, specifically. As one producer/supplier told us when we asked what their return rates were:

> ***Really good questions that we still don't have the answers to. We would almost need a consultant to come in and complete this exercise. There is quite a bit of work going through past data ...***

In other cases, those who were monitoring return and reuse rates were using different methods from each other.

In our view, all producers, suppliers, and retailers should be required and supported to keep better data on their packaging systems (whether single-use or reuse) and to report on this. This would support the progress towards a regulated product stewardship scheme for packaging in Aotearoa New Zealand, particularly a scheme focused on outcomes across the waste hierarchy. Furthermore, given both local and central government have supported reuse system development in recent years, ideally this support would be accompanied by guidance on a standardised monitoring and reporting method for communicating system performance. This would provide multiple advantages, including consistent national reporting reducing unnecessary duplication and inaccuracies, enabling comparisons between different reusable packaging systems and models to drive innovation, providing waste avoidance baselines to link to public funding and procurement, and ensuring accountability for receipt of public funds.

5.8.2 PRECARITY OF ENTERPRISES OPERATING REUSABLE PACKAGING SYSTEMS OR STOCKING PRODUCTS IN REUSABLE PACKAGING

The precarity of enterprises that operate reusable packaging systems or that stock products in reusable packaging was a consistent theme that emerged through interviews because of its flow-on effect on the prevalence and viability of reusable packaging systems. Participants attributed this precarity to various factors, e.g.:

- Reusable packaging systems are often operated or supported by small- to medium-sized businesses, which generally have lower survival rates than larger enterprises.[27]
- The ongoing long-tail impacts of COVID-19.
- The impacts of the supermarket duopoly (see below for further discussion).
- The competitive disadvantage of internalising their packaging costs compared to businesses that rely on single-use packaged products.

[27] As noted by the Ministry of Business, Innovation and Employment (2022), who also define a small business as one that has fewer than 20 employees, and a medium-sized business as one with 20–49 employees.

The predominance of small to medium-sized enterprises running and championing reusable packaging systems in Aotearoa New Zealand is reflected internationally. For example, a 2022 global landscape analysis of reuse and refill solutions found 1,196 reuse and refill solutions operating in 119 countries. Only 52 of these solutions were established or mature, with 79.6% (952) being start-ups or small businesses, e.g., packaging-free stores with only one location (Moss et al, 2022).

Reinforcing the precarity of these enterprises, during this research period (2023–2025), a number of retailers championing reusable packaging systems around the country closed, including both of the packaging-free store retail participants for this study. Aside from the loss of a retailer's reusable packaging systems, the closure of a store can also jeopardise the reusable packaging systems of producers/suppliers, given their mutual dependence with packaging-free stores. One producer/supplier who provides product in reusable packaging highlighted this issue with reference to their own experience:

> *... we got a contract to supply [low-waste retailer]. We supplied them for 5 months, we were growing, each month orders were doubling. Then one day we just got told they were closing their stores... it's that volatility. We'd ... borrowed to upscale to get machinery because the volumes went through the roof and we were left with all of that. The poor stores have done it so hard through COVID-19 and still now with the economic situation, it just leaves us really vulnerable if we are relying on that and I don't want our vulnerability to be sitting in their hands ... If we are going to be vulnerable I want to be in control, not be in the hands of someone pulling the plug on their business. I won't go back to actively seeking retailers... there have been dozens and dozens of these shops around the country close ... I don't want to go down with them. I don't need that stress.*

5.8.3 THE FLOW-ON IMPACTS OF THE SUPERMARKET DUOPOLY ON REUSABLE PACKAGING SYSTEMS

As previously noted, in the grocery sector, retailers are gatekeepers between consumers and producers/suppliers, and their ability to choose whether or not to stock products and/or participate in reusable packaging systems greatly influences whether reusable packaging systems exist and succeed. This is an influence that all retailers can exert, including smaller operators, and it can provide a barrier to reusable packaging systems. However, it can also be used to promote or encourage reusable packaging. For example, one participant retailer operating reusable packaging systems described how:

> *We use a range of criteria to help inform whether we stock products, which includes packaging considerations. Our first preference is for products with no packaging, then products with packaging that can be reused, then products with packaging that can be recycled, then only if there are no other affordable alternatives do we stock products with packaging that can't do any of these things. Finally, we also try to provide customers with a variety of packaging options, hence stocking some products in pre-packed single use, but also the paper bags, and reusable glass jars...*

Given retailer influence in what products get stocked and the success or failure of reusable packaging systems, it is relevant to note that the grocery sector in Aotearoa New Zealand is dominated by a duopoly that controls between 85–90% of the market. This duopoly has adverse economic impacts on consumers and food growers/producers/suppliers due to a lack of competition, price-setting, and other predatory/quasi-legal contract practices.[28] The impact of the duopoly has also been linked to adverse impacts on human health, food accessibility (due to high prices), and poor nutrition (due to differential pricing of products).

Studies into the impact of the duopoly in shaping packaging systems are perhaps less studied. However, the duopoly's impact on competition in the sector is likely to reinforce the aforementioned precarity of businesses operating reusable packaging systems. The predatory/quasi-legal practices the duopoly engages in can also create a challenging economic environment for the types of businesses who champion reusable packaging systems. For example, enforcing barriers to entry for new retailers by controlling sites and locations through restrictive covenants and lease agreements, and in supply chains through restrictive contracts, controlling whole supply chains, and cultivating fear amongst suppliers who become afraid to challenge supermarkets.

To better understand the priorities of the major groceries retailers in relation to packaging systems (and thus the types of packaging systems likely to succeed in a sector dominated by these retailers) we examined publicly available information about packaging on their websites. Woolworths' 2023 Sustainability Wrap report acknowledged that, "Packaging is one of our customer's top sustainability concerns" (p.11). However there was limited information offered in the report on packaging.

[28] For example, The Commerce Commission estimates that a normal rate of return for grocery retailing in Aotearoa New Zealand should be around 5.5%. However, for the period between 2015 and 2019, the Commission determined an average return of 12.7% for Woolworths NZ, 13.1% for Foodstuffs North Island and 12.8% for Foodstuffs South Island.

The two packaging initiatives highlighted were phasing out single-use plastic bags to comply with government regulations and the requirement that 1 and 3L milk bottle single-use packaging be made of 30% recycled plastic. The more recent Sustainability report from 2025 similarly states "We know that our customers are concerned about packaging waste, and plastic waste in particular." (p.15). The main initiatives highlighted are focused on increasing recycled content in own brand packaging, and labelling this packaging with the australasian recycling label. One initiative is added to "trial more refillable and reusable packaging options for products in our operations" (p.16), but greater detail about what this could look like is not provided.

By comparison, Foodstuffs North Island 2024 Annual Report website includes a page on 'Packaging',[29] including a separate document outlining 10 packaging principles, with the first principle being "remove and reduce unnecessary packaging".[30] Their Packaging report highlights a partnership with Ecostore, offering RBBD options for shampoo, conditioner, hand and body wash, laundry and dishwashing liquid. In addition, Foodstuffs allows customers to bring their own containers and has expanded bulk bin offerings. The report cites a specific target, "we are working towards 100% reusable, recyclable or compostable retail and private label (Pams, Value and Gilmours) packaging by 2025. This commitment applies to all packaging types. For example, plastic, fibre, glass, and metal." Also, at the time of completing this report, New World launched RePlay, a two-year trial of returnable packaging for deli goods in two of its North Island stores.[31]

The supermarkets' publicly available reporting reveals contrasting approaches. Woolworths appear to primarily focus on regulatory compliance and use of recycled plastic, although have moved to mention an interest in trialling refillable and reusable packaging options. Foodstuffs North Island offers more information on packaging principles and is promoting some reusable packaging, including its new RePlay trial, but these tend to be limited to trials in a small number of stores. The limited research on reusable packaging (or zero waste) research in Aotearoa New Zealand that includes supermarkets notes that even when they support reducing single-use packaging (such as the "food in the nude" initiative for produce), supermarkets still provide single-use packaging options. They tend to frame these decisions as needing to provide customer choice and options (c.f. Diprose et al. 2022).

While there is limited research on the environmental impacts of the supermarket duopoly, critics argue that the two businesses could do much more. For example, Consumer New Zealand argues that despite both supermarkets signing up to various sustainability initiatives (including the Sustainable Development Goals and Packaging Declarations), they could improve their monitoring and reporting of waste (including food and packaging waste), emissions, and stocking of certified sustainable brands and products (Castles, 2019). Similarly, commentary by Biome argues that because of the scale supermarkets operate at, they could significantly reduce waste by extending reusable packaging sections, incentivising reusable packaging options, increasing recycling collection locations and infrastructure, advocating for greater manufacturer responsibility (e.g., lead on their house brands), and work with local suppliers more to reduce transport and packaging requirements (Bailey, 2024). In terms of food and organic waste, Horticulture New Zealand argue that because growers are essentially price-takers from supermarkets and wholesalers in Aotearoa New Zealand, if prices are set too low, growers plough crops back into their land rather than losing money on harvesting and sale. This wastes resources and reduces availability and affordability of fresh, nutritious produce which has flow-on adverse environmental, social, and economic impacts in communities (Horticulture New Zealand, 2022).

Finally, Richardson (2023) argues that the supermarket duopoly plays an important role in profit-driven food production in Aotearoa New Zealand that impacts land-use, environmental degradation, and ultimately socioeconomic inequalities. Richardson describes how supermarket price setting for fruit and vegetables is so low some growers often have to use synthetic inputs to maximise production, and/or exhaust/exploit their land through over-production. Low prices also impact labour conditions and farming succession planning. Because prices are so low, working conditions are often poor, so growers struggle to recruit adequate labour and manage production, and their children often do not want to continue the business. Due to these interacting factors, some growers go out of business, or sell their highly productive horticultural land (which is often close to urban areas) for lifestyle blocks. While some of these processes may seem unconnected to supermarkets, Richardson argues that supermarkets play an important role in the complex food and packaging system in Aotearoa New Zealand that contributes to a range of socioenvironmental problems and risks.

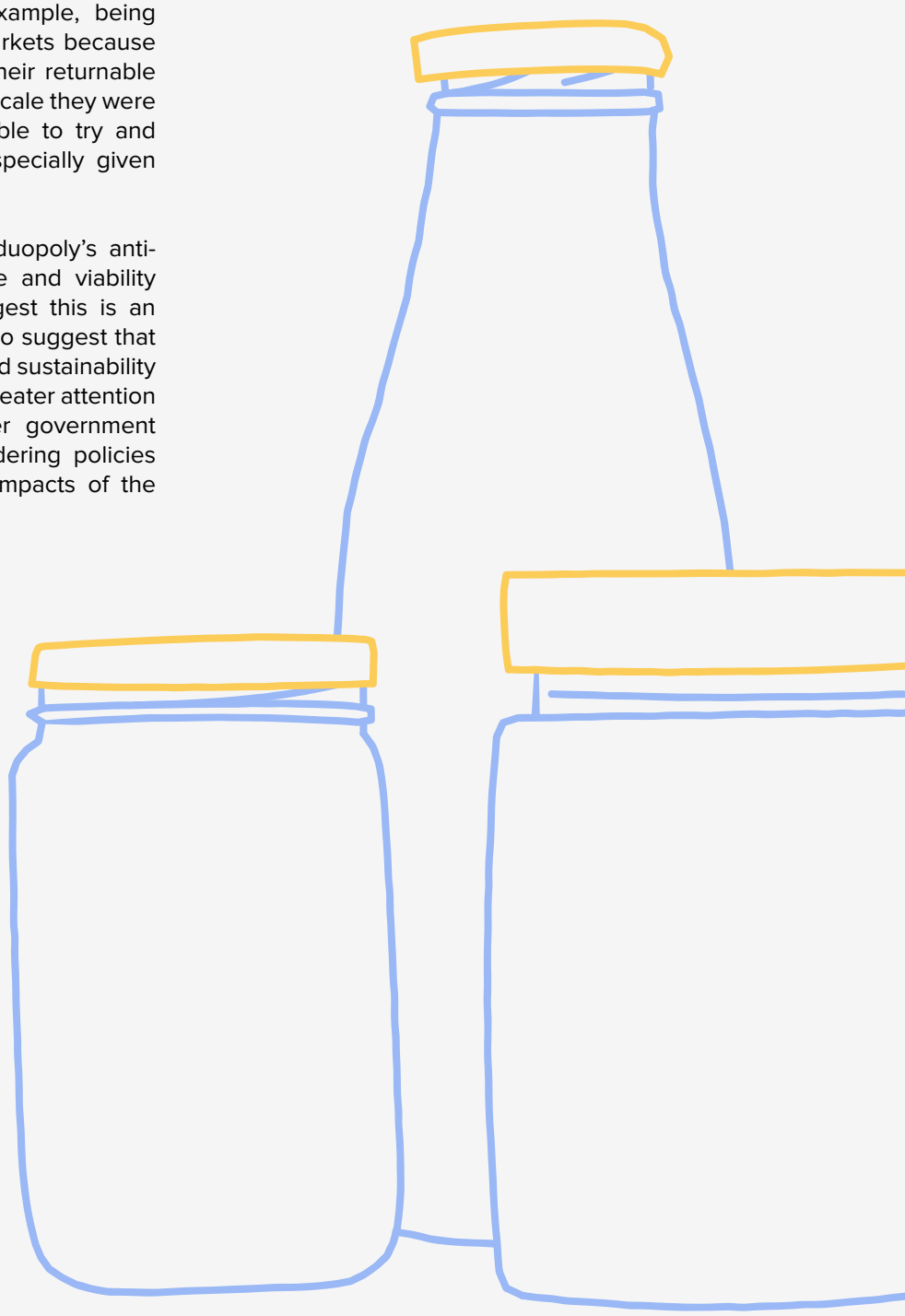
[29] https://annualreports.foodstuffs.co.nz/home/here-for-nz/sustainability/packaging.

[30] 10 Sustainable Packaging Principles accessed here May 2024: https://annualreports.foodstuffs.co.nz/home/here-for-nz/sustainability/packaging.

[31] See https://www.foodstuffs.co.nz/en/news-room/2025/New-World-to-launch-trial-of-returnable-deli-containers.

Concerns about the supermarket duopoly and the wider imperatives for profit-driven food production in Aotearoa New Zealand emerged in different ways through our interviews. For example, some producer/supplier participants were either not interested in, or cautious about, supplying or engaging with supermarkets. One stated, “They are price setters and I don’t think they value local growers. They dominate the price and I don’t want to be dictated to.” Some of the concerns expressed about the supermarket duopoly expressed by producers/suppliers connected directly to packaging. For example, being unable to stock their products in supermarkets because supermarkets were unwilling to support their returnable packaging systems. Others noted that the scale they were operating at made it economically unviable to try and supply their product to supermarkets, especially given their price setting practices.

Given the likely flow-on impacts of the duopoly’s anti-competitive behaviour on the prevalence and viability of reusable packaging systems, we suggest this is an area that warrants further research. We also suggest that packaging system innovation like reuse, and sustainability considerations more generally, are given greater attention by the Grocery Commissioner and other government and advocacy organisations when considering policies and measures to address the negative impacts of the supermarket duopoly.



SECTION 6: CONCLUSION

Grocery items, including food, beverages, cleaning, and personal care products, are key users of single-use packaging. Single-use packaging uses large amounts of raw material resources and over-contributes to waste and plastic pollution, even with high recycling rates. When used for essentials like groceries, single-use packaging brings disposability practices, and exposure to plastics and chemicals of concern, into people's daily lives. In the Aotearoa New Zealand context, the issues of plastic pollution, overpackaging, and the primacy of profit motives that underlie how food and other essential items are made and consumed are also directly connected to colonial and capitalist systems and values.

Reusable packaging systems are a potential alternative that could displace the need for single-use grocery packaging, and help to transform relationships between people and the organisations that produce and distribute essential items, like food. Reusable packaging has thus become a small, but growing area of academic study, non-governmental advocacy, business model experimentation, and policy development.

Long-standing and novel examples of reusable packaging systems both exist across the groceries sector. They include examples of returnable packaging systems and refill by bulk dispenser (RBBD) systems. However, comprehensive studies into their impact across supply chains are still lacking, as are appropriate quantitative and qualitative methods for assessing these impacts. There is a recognised need to interrogate real-world environmental and economic benefits of reusable packaging systems, and their interaction with social and cultural considerations, including accessibility, affordability, collective wellbeing, and public health. Filling these knowledge gaps is critical for assessing the suitability of reusable packaging systems generally, but especially for the packaging of essential items like food and other grocery products.

This research focused on these knowledge gaps, trialing a methodology to measure the impacts and outcomes of reusable packaging systems in Aotearoa New Zealand's grocery sector. The research drew on case studies with different types of grocery retailers in two regions of the country – Waikato and Wellington – and the producers/suppliers in their supply chain for six focus products (fresh milk, toothpaste, pumpkin seeds, oats, olive oil, and dishwashing liquid). The research used seven indicators – relating to environmental/health, socioeconomic, and cultural impacts – against which to compare performance of single-use and reusable packaging systems (**Table 11**).

Indicators were selected based on a literature review and on findings from a parallel kaupapa Māori research project into the relationship between reuse and te ao Māori. This parallel study was critical because most reusable packaging literature comes from overseas, and therefore is not grounded in the knowledge, perspectives and context of Aotearoa, where this study was undertaken. Tāngata Whenua hold tino rangatiratanga in Aotearoa and therefore ensuring research projects carried out here are informed (and ideally, grounded) in Māori perspectives is essential to ensure they are culturally contextualised and uphold our obligations to Te Tiriti o Waitangi, all of which enhances the quality and relevance of the research.

Table 11: Impact indicators for groceries packaging systems

Environmental/health	Packaging is avoided
	Packaging systems protect physical health
	Food waste is avoided
Socioeconomic	Accessibility (cost, ease, availability/options) of groceries is increased
	New, quality jobs are created
	Community wellbeing and engagement is enhanced
Cultural	Collective wellbeing is improved

FINDINGS

ENVIRONMENTAL/HEALTH

In terms of environmental/health impacts, the study found that:

- **Reusable packaging systems almost always reduce packaging use and waste compared to single-use systems.** The extent of this packaging avoidance impact depends on how often consumer-facing packaging units are reused (determined by measuring return rates in returnable packaging systems, or rates of customers bringing their own containers to refill at bulk dispensers). Packaging avoidance is also affected by the supply chain packaging systems used to bring differently packaged products to retail shelves; greater use of reusable packaging in supply chains translates to a greater packaging avoidance impact. Regardless of the packaging avoidance impact, reusable packaging systems almost always reduced plastic usage compared to single-use packaging systems.

- **Producers and retailers do not currently measure and/or report on their packaging consumption.** Consequently, gathering real-world data for the packaging avoidance indicator was laborious or, in the case of supply chain packaging, not always possible, requiring the use of assumptions. We also had to assume reuse rates for most reusable packaging systems because few participants kept accurate data that would enable calculation of actual reuse rates.

- **Any packaging system (whether single-use or reusable) can present human health risks** if relevant hygiene or food safety protocols are not followed; the packaging is easily compromised and enables contamination; or the packaging materials themselves contain chemicals of concern. All producers and retailers were aware of hygiene risks from their packaging systems and the need to comply with food safety protocols, which are regulated and audited by external inspectors. As such, while public concerns about the hygiene of reusable packaging systems are sometimes expressed, these are more perceived than real. In contrast to hygiene considerations, the potential toxicity of different packaging materials was not front-of-mind for most participants, so risk mitigation to reduce presence or migration of chemicals of concern was often not applied when producers and retailers made packaging choices. Despite this, our observations of the packaging used for focus products suggest reusable packaging systems may offer some benefits when it comes to health risks. For example, consumer-facing returnable packaging systems offer an opportunity to shift from packaging materials that may have higher levels of chemicals of concern and potential chemical migration (e.g., plastics or fibre) towards packaging materials that are usually more inert (e.g., glass or metal). While RBBD systems often rely on plastic bulk dispensers and plastic or paper primary bulk packaging, the larger quantity of product contained means less contact between the product and the package or dispenser. However, the act of reusing bulk packaging made of these materials might lead to increased risk of chemical migration from packaging to product over time.

- **Reusable packaging systems do not appear to increase food waste compared to single-use packaged counterparts.** Participants operating reusable packaging systems noted that with careful management and (often) additional labour, reusable packaging systems did not lead to increased food waste. Well-managed stock inventory systems in retail contexts are likely to avoid generation of product waste, regardless of the packaging system.

FINDINGS *CONTINUED*

SOCIOECONOMIC

In terms of socioeconomic impacts, the study found that:

- **Products in reusable packaging systems (especially returnable packaging) are generally more expensive than their single-use packaged counterparts.** Comparing consumer-facing reuse systems, RBBD systems generally offer cheaper prices for equivalent products than returnable systems. Oats in RBBD packaging was the one product that did compete on price with single-use packaged oats. Oats were also the only product where the product in dispensers was generally supplied by the same large suppliers as the majority of single-use packaged brands, meaning the price comparison across packaging systems was more likely to compare like-with-like (other focus products vended via RBBD tended to be supplied by a bespoke supplier on the premium end of the market). This suggests that, where all things are equal, the RBBD model can be a cost-effective means of vending product, potentially making sustainable shopping more affordable (or at least price neutral).

- **Products in reusable packaging systems are less available than single-use packaged products.** Perhaps exacerbated by the supermarket duopoly in Aotearoa New Zealand, retailers that champion reusable packaging systems and stock products in reusable packaging are much less prevalent than mainstream retailers, are in less convenient locations, have fewer parking options, and have more restricted opening hours. The resulting inconvenience makes reusable packaged products less accessible for time-poor individuals and/or marginalised communities who may be burdened by a range of competing priorities.

- **Reusable packaging systems are more labour-intensive than single-use packaged products for both producers and retailers.** Consequently, reusable packaging systems offer potential job creation impacts in the circular economy/green sector. However, this could also increase the costs of reusable packaged products that are passed on to the consumer, particularly when the costs of single-use packaging are not internalised through regulated product stewardship schemes or similar.

- **Reusable packaging systems can help foster community wellbeing and engagement through supporting local businesses, food production, and resilience.** Our participants operating reusable packaging systems described the key community wellbeing outcome as reduced waste and therefore less environmental harm and cost to wider society. They noted that by operating reusable packaging systems they provided customers with greater choice to take pro-environmental action, which can alleviate negative feelings of hopelessness. Approximately half of our participants operating reusable packaging systems supported wider community initiatives (such as waste minimisation campaigns and/or social programmes). Given most reusable packaging systems stock locally made products, their operations also support local businesses and could increase wider community resilience through local food production and shorter supply chains.

CULTURAL

In terms of cultural impacts, the study found that:

- **Cultural considerations are not front of mind for most businesses when they design their packaging systems.** Most of our participants struggled to answer questions about the relevance of cultural considerations to their work, particularly in relation to more political or constitutional concepts, such as sovereignty. For example, no participants directly reflected on the relevance of Te Tiriti o Waitangi, although two participants did point to a responsibility to respect mātauranga and tikanga and/or to support mana whenua, with both providing practical examples of how they were doing this. Overall, where participants were acting on particular cultural considerations (such as choosing whether to stock certain products or implement certain practices) this was usually not due to internal strategic policies or particular investment in this area, but rather reflected the identities or experiences of staff or business owners.

KEY IMPLICATIONS

Overall, the research found that across various indicators, reusable packaging systems can deliver positive impacts compared to single-use packaging systems. The nature and extent of the impact may depend on the type of reusable packaging system. However, data gaps make quantitative analysis across a range of indicators challenging. These findings underscore the need for all suppliers, producers, and retailers to be supported to keep better data on their packaging systems (whether single-use or reuse) and to report on this as part of Aotearoa New Zealand's broader waste minimisation agenda.

Fully realising the positive *potential* of reusable packaging systems is currently constrained. Reusable packaging systems are not yet widespread in the grocery sector (except for pallets for tertiary packaging) and thus lack economies of scale. The systems that do exist are primarily adopted by smaller retailers and producers/suppliers who struggle for viability in a market dominated by a supermarket duopoly. These factors reduce accessibility of reusable packaging systems (in terms of cost and availability), with flow-on effects across all indicators. Mainstreaming and normalising reusable packaging systems and dispersing their benefits will require direct regulatory and resourcing support for reusable packaging systems and the retailers and producers that adopt them. Larger retailers and producers/suppliers will also need to leverage their market power to increase their own uptake of reusable packaging systems.

These findings have implications for producers and retailers of food, beverage, and cleaning and personal care products; the groceries sector generally; and policymakers focused on addressing issues such as packaging waste, competition in the grocery sector, and food insecurity. These issues have heightened relevance in the present context where the supermarket duopoly is under increasing pressure to improve sustainability credentials, including the reducing the packaging waste passed on to consumers, while providing access to essential items in the context of a cost-of-living crisis.

Our study has also highlighted gaps in integrating te ao Māori perspectives, and the essential role of Te Tiriti o Waitangi for everyone in Aotearoa New Zealand, into both reusable packaging research and reusable packaging practices in the grocery sector. This has implications for how future projects and initiatives are approached. The literature on waste colonialism, both locally and internationally, highlights that while a widespread shift towards reusable packaging systems may be one way to displace the use of single-use packaging and disrupt corporate influence over access to groceries and the waste this sector produces, upholding Te Tiriti o Waitangi, mana motuhake, and tino rangatiratanga is critical to more durable structural change and environmental justice in how food and other essential items are provisioned.

RECOMMENDATIONS

- **Improved data capture and reporting:** All producers, suppliers, and retailers should be required and supported to capture and report on key aspects of their packaging systems, including the quantity of packaging put to market (by both weight and units, and expressed with reference to the quantity of product contained), and actual recycling rates (for single-use) and actual reuse rates (for reusable packaging systems).
- **More specialist research is needed to:** quantify food waste impacts of different packaging systems in the supply chain and in consumers' homes; quantify job creation impacts of different packaging systems; and explore human health protection and risks associated with packaging materials in single-use and reusable systems. The latter includes the appropriateness of different packaging material types for certain

RECOMMENDATIONS *CONTINUED*

products and storage conditions, as well as any risks and mitigation measures associated with repeatedly washing and refilling containers and dispensers made of different materials in the context of reuse systems. Lifecycle Assessments that compare real-world single-use and reusable packaging systems (such as those considered in this study) and the producers/suppliers and retailers that operate them could also support ongoing improvements in the environmental efficiency of existing reusable packaging systems. Māori-led research projects and projects co-designed with Māori to ensure Māori expertise and priorities are embedded in future studies of reusable packaging are also critical.

- **Economic and regulatory instruments to support and grow reusable packaging systems to increase their adoption:** Reusable packaging systems in the grocery sector bring a range of social and environmental benefits, but at present, they are mostly operated by small- and medium-sized producers and retailers, making them both niche and precarious. Until single-use packaging systems are required to internalise their wider waste management costs (recycling, disposal and litter), reusable packaging systems will generally find it hard to compete. Economic policy and regulatory measures to help level the playing field between single-use and reuse, and to require the participation of large producers and retailers to increase economies of scale, would lift both the availability and viability of reuse and, in turn, unlock increased positive impact. To this end, ensuring reuse outcomes are part of any regulated product stewardship scheme for packaging is important.

- **Increase the performance of reusable packaging systems:** Existing reusable packaging systems could be further optimised to increase their positive impact. Returnable packaging systems would have increased return rates and lower logistical costs if producers collaborated to share standardised packaging and return logistics, and if larger retailers were willing to stock, and act as return points, for returnable packaging. Refill by bulk dispenser systems would have increased packaging avoidance if single-use packaging was not offered at dispensers, and if retailers and producers/suppliers collaborated to use returnable primary bulk packaging in the supply chain. Expanding retailers' RBBD sections and the product range sold via RBBD could increase the affordability of groceries and the choices available to consumers buying their groceries via this model. Retailers and producers could improve their cultural impact by investing in their understanding of how they can practically and meaningfully uplift and support Tāngata Whenua, Te Tiriti o Waitangi, tikanga Māori and tino rangatiratanga in their work.

- **Measures to assess and mitigate the impact of the supermarket duopoly should include sustainability (and packaging) considerations:** The supermarket duopoly in Aotearoa New Zealand is recognised to reduce competition in the grocery sector, negatively impacting the price of groceries and suppliers' ability to access the retail market or dictate terms of sale for their products. While advocacy organisations and public agencies, such as the Commerce Commission and its Grocery Commissioner, are investigating and/or promoting measures to alleviate these concerns, our research suggests the duopoly also has a negative impact on the viability of sustainable packaging innovation like reuse in the grocery sector. Measures to assess and mitigate this impact are justified, given that overpackaging, plastic usage and waste are consistently highlighted as issues of concern for New Zealanders, on which they would like to see businesses take greater action.

- **Increase public communication about alternative grocery packaging systems and retailers, and their potential positive impacts:** In light of the concern New Zealanders express about overpackaging and plastic pollution, the dissatisfaction with the current grocery sector in terms of meeting community needs for accessible and affordable groceries, and the precarity of alternative retailers that may be more values-aligned, we suggest more investment is needed to communicate about potential alternatives to the supermarket grocery model and single-use packaged products. This would be ancillary to (not in lieu of) economic and regulatory measures to create more favourable conditions for viable and affordable alternatives. This could involve supporting retailers and producers/suppliers that champion reusable packaging systems to communicate effectively about the positive impacts of these systems in a way that connects with the public's concerns, and placing greater emphasis on reuse, rather than recycling, in public information campaigns about packaging waste minimisation.

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FROM THE PEACOCK

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APPENDIX 1: MEASUREMENT TOOLS/METRICS NOTED IN THE LITERATURE REVIEW FOR ASSESSING VARIOUS INDICATORS

INDICATOR: SINGLE-USE PACKAGING, WASTE DISPOSAL AND PLASTIC POLLUTION/ LITTER IS AVOIDED/ REPLACED/ REDUCED

MEASUREMENT TOOLS/METRICS:

- **Measure and compare packaging consumption of reusable and single-use packaging systems in relation to specific products in a retail context.** Packaging consumption can be measured by weight (James Ross Consulting, 2007; Kurian, 2020; Beechener et al, 2020), number of sales units (Peeters et al, 2023), number of components, or a mixture (e.g., Greenpeace, 2020; Salkova & Regnerova, 2020, pp.5-6; Minami et al, 2010; Gordon, 2021; Copello et al, 2022), and further distinguished by material type (Minami et al, 2010; John Lewis Partnership, 2020; Greenpeace, 2020; Salkova & Regnerova, 2020; Dolci et al 2016; Copello et al, 2022). Comparisons may made within a single store (Minami et al, 2010; John Lewis Partnership, 2020), between a packaging-free store and a conventional retailer (Salkova & Regnerova, 2020; Kurian, 2020), or focused on comparing single-use packaging consumption against hypothetical reusable packaging systems for particular products (Greenpeace UK, 2020; James Ross Consulting, 2007; Dolci et al, 2016). Comparisons may focus only on the packaging passed on to the consumer within each system (Greenpeace, 2020; Salkova & Regnerova, 2020; James Ross Consulting, 2007), or include the supply chain packaging to bring product to store for the different consumer-facing packaging systems (John Lewis Partnership, 2020; Dolci et al, 2016; Minami et al, 2010):
  - Quantify the single-use packaging used to deliver standardised unit(s) of target product categories using:
    - A small, randomised sample of self-acquired on-shelf single-use packaging (Salkova & Regnerova, 2020; James Ross Consulting, 2007; Copello et al, 2022, p.17) or the average of a large sample (Dolci et al, 2016).
    - The average of empty packaging weights from packaging manufacturer websites or other publicly-available sources (Kurian, 2020; Copello et al, 2022, p.17)
    - Detailed data shared by willing retailers (e.g., John Lewis Partnership, 2020; Greenpeace, 2020), or self-reported data from retailers captured via questionnaires (GP & EIA)
    - Divide the secondary and tertiary packaging used to deliver loads of primary packages by the quantity of primary packaging carried by that secondary and tertiary packaging (Dolci et al, 2016, pp.450-451)
  - Quantify the packaging used to deliver equivalent product via a reusable alternative:
    - For returnable packaging, first calculate or assume return and reuse rates (e.g., UNEP, 2022, p.58; Kachook, 2022, p.44; Consumers Beyond Waste, 2022; Coelho et al, 2020, Peeters et al, 2023). The PR3 Resolve Standard sets an equation for calculating return and reuse rates, which requires specific data from the operator of the system (whether that is the producer, retailer or a third-party). Where this data is not collected or easily ascertainable, studies will assume return and reuse rates (e.g., Kurian, 2020; Dolci et al, 2016; Peeters et al, 2023).
    - For refill systems, quantify:
      - the bulk packaging from which dispensers are filled and the containers provided to customers to use for refill (e.g., UNEP, 2022, p.57; Dolci et al, 2016; Minami et al, 2010; John Lewis Partnership, 2020; Salkova & Regnerova, 2020; Kurian, 2020; James Ross Consulting, 2007, p.30). NB bulk packaging is behind-the-

scenes and cannot be determined by simple in-store observations. Studies have either not considered supply chain packaging (Salkova & Regnerova, 2020), used data shared by the stores who are part of the study (John Lewis Partnership, 2020; Kurian, 2020), or determined this through interviews with retailers and suppliers (James Ross Consulting, 2007; Kurian, 2020). Dolci et al (2016) considered both real and hypothetical bulk packaging sizes in their analysis, but did not set out how the real sizes were identified.
    - the % of customers bringing their own containers, generally determined by survey or interview-based approaches (e.g., UNEP, 2022, p.57; John Lewis Partnership, 2020; James Ross Consulting, 2007), or otherwise assumed.
- A shortcut measure is to compare the total amount of packaging material reaching the consumer for each packaging system (Tsiliyannis, 2005)
- Producer/retailer self-reporting packaging avoided estimates (Beechener et al, 2020)
- Measure if reuse is replacing/capturing share of single-use packaging
    - Compare the share of total product volume or product units that is in single-use versus reusable packaging (Consumers Beyond Waste, 2022; Coelho et al, 2020), or the % of product line/packaging that has been or will be converted from single-use packaging to reusable packaging (Kachook, 2022; Changing Markets Foundation, 2022).
- Compare end-of-life scenario for packaging, e.g., how much waste is generated, is the packaging recyclable, what are the recycling and litter rates? (Bradley & Corsini, 2023, p.133; WEF & Kearney, 2021, p.24; Kachook, 2022, p.44; Coelho et al, 2020; Tsiliyannis, 2005; Copello et al, 2022, p.26)
- Additional metrics for individual stores or producers:
    - % of repeat customers using reuse/refill systems (Kachook, 2022; Marken & Horisch, 2019, p.173)
    - % of sales in reusable packaging (Kachook, 2022). NB this is deprioritised by Consumers Beyond Waste, 2022.
    - Evidence of measures to shift consumers from single-use to reuse options, and lift reuse rates:
        - in-store signage and/or clear labelling on containers, communicating and promoting possibility of reuse and refill (Kachook, 2022; Marken & Horisch, 2019, p.173; Copello et al, 2021)
        - online and offline advertisement, including social media and newspaper articles, of reusable packaging system options (Marken & Horisch, 2019, p.173)
        - use of financial incentives for effective participation, e.g., deposit returns systems, discounts, rewards (Kachook, 2022; UNEP, 2022; Global Plastics Policy Centre, 2023; John Lewis Partnership, 2020; Coelho et al, 2020; Marken & Horisch, 2019, p.173; Copello et al, 2021; Röjning & Petersson, 2020)
        - offering or retailing reusable containers at bulk dispensers (Marken & Horisch, 2019, p.173)
        - a marketing strategy that engages customers on an emotional, cognitive and motivational level (Röjning & Petersson, 2020)

INDICATOR: GREENHOUSE GAS EMISSIONS ARE REDUCED AND NATURAL RESOURCES ARE CONSERVED

MEASUREMENT TOOLS/METRICS:

- Lifecycle analysis (e.g., UNEP, 2022; Sjolund, 2016; Dolci et al, 2016; Greenwood et al, 2021; Copello et al, 2021)
- Calculate the emissions that would have otherwise occurred to produce the avoided packaging (Beechener et al, 2020)
- Multiply the weight of single-use packaging materials with conversion factors to calculate energy carriers, global warming, eutrophication, land use and water consumption (Copello et al, 2022, p.19)
- A shortcut measure is to compare the total amount of packaging material reaching the consumer for each packaging system (Tsiliyannis, 2005)
- Calculating/ensuring real-world reuse rates of packaging, e.g., high return rates for returnable packaging and customer BYO containers for refill by bulk dispenser systems (Kachook, 2022; UNEP, 2022; Global Plastics Policy Centre, 2023; Bradley & Corsini, 2023; Grimes-Casey et al, 2007; Coelho et al, 2020)
- Evidence of measures to lift reuse rates, including in-store signage and/or clear labelling on containers, communicating and promoting possibility of reuse and refill (Kachook, 2022), or the use of financial incentives for

effective participation, e.g., deposit returns systems, discounts, rewards (Kachook, 2022; UNEP, 2022; Global Plastics Policy Centre, 2023; Coelho et al, 2020)
- Consideration given to material selection, such as durability and weight for all packaging in reuse systems (returnable containers, refill bulk packaging, containers consumers fill into), and the distance travelled by returnable packaging/ products across the supply chain and between uses (Kachook 2022; UNEP, 2022; Bradley & Corsini, 2023; Global Plastics Policy Centre, 2023; Blumhardt, 2022a; Dolci et al, 2016; Kurian, 2020; Sjolund, 2016; Coelho et al, 2020; Greenwood et al, 2021; Copello et al, 2021)
- Consideration given to water usage throughout a container's lifecycle, including sorting and cleaning processes for returnable packaging or bulk dispensers (Bradley & Corsini, 2023, p.133; WEF & Kearney, 2021, p.24; UNEP, 2022; Scharpenberg et al., 2021; Gordon, 2021)
- Evidence that reusable packaging systems leads to reduced transport distances, e.g., greater stocking of local suppliers with shorter supply chains, local washing etc. (Beitzen-Heineke et al, 2017; Copello et al, 2021; Brazao et al, 2021; Brown et al, 2022)

INDICATOR: FOOD/PRODUCT WASTE AVOIDED

MEASUREMENT TOOLS/METRICS:

- Does reusable or single-use packaging better protect products through the supply chain? (Mahmoudi & Parviziomran, 2020)
- Does packaging system allow for customer portion control? (e.g., UNEP, 2022, p.57; James Ross Consulting, 2007; John Lewis Partnership, 2020; Beitzen-Heineke et al, 2017)
- Does the food contained in the packaging have a high, low or intermediate Packaging Relative Environmental Impact (PREI)? (e.g., UNEP, 2022, pp.44-46; Sjolund, 2016)
- Are there food rescue or donation programmes to divert perishing foods? (Beitzen-Heineke et al 2017)
- Quantitative research needed to identify the impact of refill models on food waste in consumers' homes (John Lewis Partnership, 2020, p.8; Beitzen-Heineke et al, 2017; Kurian, 2020, p.7)

INDICATOR: MORE AFFORDABLE AND ACCESSIBLE GROCERIES

MEASUREMENT TOOLS/METRICS:

- Financial impact of reusable packaging systems for consumers
  - Price comparison between the same product in single-use packaging and reusable packaging systems (either within one retailer or across different retailers) to understand if reusable packaging systems affect price of groceries (e.g., Beitzen-Heineke, 2017; Salkova & Regnerova, 2020; Minami et al, 2012; Marken & Horisch, 2019, p.171; Brown et al, 2022)
  - Evidence of rewards or discounts for buying or participating in reusable packaging systems (e.g., UNEP, 2022, pp.xi, 60; Kachook, 2022; Marken & Horisch, 2019, p.173)
  - Deposits for returnable packaging are not too high (Kachook, 2022; Grimes-Casey et al, 2007; Brown et al, 2022)
  - Is reusable packaging mostly used for basic products, or niche or premium products? (Brown et al, 2022)
- Availability/convenience of reusable packaged groceries
  - Number and geographic location (e.g., urban, rural, city periphery etc) of products in reusable packaging, retailers selling reusable packaged products and/or returnable packaging return points (e.g., Salkova & Regnerova, 2020; Moss et al, 2022; Marken & Horisch, p.171; Lofthouse et al, 2009; Brown et al, 2022; Beechener et al, 2020) cf to retailers and producers predominantly in single-use.

    - Are reusable packaging systems available in low income and marginalised communities as well as affluent communities? (Brown et al, 2022)
  - Are consumers aware of packaging-free options in their local area (Salkova & Regnerova, 2020; Moss et al, 2022; Marken & Horisch, 2019, p.171)?
  - Are reusable packaging systems standardised to ensure wide access, ease of use and affordability (Brown et al, 2022)?
- Non-financial accessibility impact (practicality) of reusable packaging systems
  - Are reusable packaging units and systems quick and easy to use, or burdensome in terms of physicality or imposing a time/cognitive burden on consumers, either in-store (e.g., needing to carry or refill into own containers) or at home (e.g., containers difficult to open, or cooking skills or lifestyle changes required) (Beitzen-Heineke et al, 2017; Kachook, 2022; Marken & Horisch, 2019, p.171; Lofthouse et al, 2009; Brown et al, 2022, pp.26-27)
  - Are retailers with reusable packaging systems wheelchair accessible? (Brown et al, 2022)
  - Do reusable packaging systems restrict choice due to size range for each product, or availability of recognised multinational brands (James Ross Consulting, 2007; Beitzen-Heineke et al, 2017; Marken & Horisch, 2019, p.171; Lofthouse et al, 2009)?
  - Does the reuse system rely on tech or apps? (Kachook, 2022; Brown et al, 2022)
- Demographics of customers of reusable packaged products/retailers selling reusable packaged products (e.g., Beechener et al, 2020), cf to customers of products/retailers using predominantly single-use
- Are businesses using reusable packaging systems actively considering consumer accessibility needs in the design of their products and services? (Brown et al, 2022)

INDICATOR: NEW EMPLOYMENT OPPORTUNITIES

MEASUREMENT TOOLS/METRICS:

- Quantify number of jobs created to operate reusable packaging systems (WEF & Kearney, 2021, p.24; Brazao et al, 2021, p.35; Brown et al, 2022; Beechener et al, 2020)
- Quality of jobs in reusable packaging system operation, e.g., do employees express job satisfaction, adequate wages and working conditions, a feeling of safety and security, development of new valued skills and on-the-job training? (Brown et al, 2022, pp.20-23)
- Nature of jobs in reusable packaging system operation, e.g., full-time, part-time, volunteer (Beechener et al, 2020)
- In the transition to reuse, are jobs lost in single-use packaging systems carefully managed so workers have fair outcome (Brown et al, 2022)?
- Do reusable packaging systems create accessible jobs or job opportunities for people who otherwise face difficulties entering the job market (Brown et al, 2022, p.23)?
- Are new jobs created locally or through SMEs? (Brown et al, 2022, p.28)

INDICATOR: AUGMENTED CONSUMER/COMMUNITY WELLBEING, EXPERIENCE AND CONNECTION WITH THE GROCERIES/FOOD SYSTEM

MEASUREMENT TOOLS/METRICS:

- Evidence that reuse systems drive long-term consumer engagement and wider benefits for consumers, such as lifestyle advantages (Kachook, 2022):
  - Choice and product diversity, e.g., the size of range for each product, availability of recognised/multinational brands and/or local, ethical trade and culturally appropriate suppliers (James Ross Consulting, 2007; Beitzen-Heineke et al, 2017; Brown et al, 2022, p.28)
  - More interactive and autonomous shopping experience, e.g., rituals of return, bringing own containers, ability to self-select product and thus dictate price, quantity and product mix (Röjning & Petersson, 2020)
  - Trust and connection: do customers know and trust retail staff, store owners and/or product suppliers (Diprose et al, 2021; Beitzen-Heineke, 2017)?
  - Do reusable packaging systems make consumers feel ethically better, able to live their values, reduce their waste (Lofthouse et al, 2009; Brown et al, 2022)
  - Augmented user experience (e.g., higher quality containers and no disposable packaging) (Brazao et al, 2021, p.12, Brown et al, 2022)
- Are reusable packaging systems culturally appropriate? (Bradley & Corsini, 2023, p.136)
- Is the packaging system's promotional aspects able to 'attract-change-retain' customers to zero waste lifestyles? (Röjning & Petersson, 2020)

INDICATOR: HUMAN HEALTH IS PROTECTED

MEASUREMENT TOOLS/METRICS:

- Does the system generate any public health risks or replace potentially risky alternatives? (WEF & Kearney, 2021, p.24; Gordon, 2021, p.54), e.g., evidence of:
  - Consideration of the materials used for packaging units and whether these pose toxicity concerns generally, or in relation to the specific product type or storage conditions, e.g., potential chemicals of concern and risk of migration into the packaging contents (UNEP, 2022; Bradley & Corsini, 2023, p.133; Kachook, 2022; Gordon, 2021, p.54; Seref & Cufaoglu, 2025, p.4)
  - The packaging having been screened using any material health tools (e.g., GreenScreen, SciveraLens etc) (Kachook, 2022)
  - Is there a difference in ergonomics between handling reusable and single-use packaging for workers in the supply chain, e.g., packaging weight, hand grips (Mahmoudi & Parviziomran, 2020)?
  - Processes to ensure hygiene and food safety in the packaging system (James Ross Consulting, 2007; Beitzen-Heineke et al, 2017; Coelho et al, 2020; Copello et al, 2021). For example:
    - The packaging communicates key product information, such as nutritional information and use by date (James Ross Consulting, 2007)
    - Staff are trained to operate the system in accordance with food safety principles, including proper cleaning and logistics, and measures to mitigate risk of cross-contamination or retailer/consumer contact with food (Beitzen-Heineke, 2017; Copello et al, 2021; Coelho et al, 2020)
- Does the reusable packaging system promote positive public health outcomes, for example:
  - Healthy nutrition (Beitzen-Heineke et al, 2017)
    - e.g., no processed or frozen food (Beitzen-Heineke et al, 2017)
    - increased customer knowledge about nutrition, balanced diets and food handling (Beitzen-Heineke et al, 2017)
- Does the reusable packaging system reduce the use of single-use packaging that might otherwise be transported off-shore for recycling to lower income countries? (Brown et all, 2022)

INDICATOR: PROFITABILITY OR FINANCIAL VIABILITY OF REUSABLE PACKAGING MODELS

MEASUREMENT TOOLS/METRICS:

- Return on investment and accumulated costs: are the costs to set-up and run the reusable packaging system outweighed by the cost-savings of not using single-use packaging, or by any revenue brought in by the system (Kachook, 2022; WEF & Kearney, 2021; Upstream, n.d.a; Upstream, n.d.b.; Gordon, 2021; Brazao et al, 2021; Peeters et al, 2023; Mahmoudi & Parviziomran, 2020)?
  - Cost calculation can include:
    - Set-up costs: packaging units, retail displays, washing equipment (Kachook, 2022, p.46; Gordon, 2021; Peeters et al, 2023, p.38; Mahmoudi & Parviziomran, 2020)
    - Ongoing costs: employee training, collection costs, inspection costs, washing/cleaning costs, redistribution & fleet replacement, cleaning of bulk dispensers (Kachook, p.46; Gordon, 2021; Brazao et al, 2021; Peeters et al, 2023, p.38; Mahmoudi & Parviziomran, 2020)
  - Factors that may offset costs/increase efficiency include:
    - amount of product contained in each unit and the daily volume sold, as well as cycle time and delivery distance for each unit (Mollenkopf, 2005)
    - high reuse and return rates (Brazao et al, 2021, p.36; Peeters et al, 2023, p.14; Cobb, 2016), ideally higher than 95%, but certainly no fewer than 4 uses (Peeters et al, 2023, pp.14-15)
    - Short retention/cycle time, e.g., maximum 30 days (Peeters et al, 2023; Cobb, 2016)
    - Shorter transportation distances/decentralised infrastructure (Brazao et al, 2021, p.36; Peeters et al, 2023, p.39)
    - scale (Brazao et al, 2021, p.36; Peeters et al, 2023, p.39)
    - standardisation of packaging units or the system across different producers and products (Brazao et al, 2021; Copello et al, 2021, p.12; Brown et al, 2022; Peeters et al, 2023; Mahmoudi & Parviziomran, 2020)
    - an independent reuse system provider that owns the containers, charges a pay-per-use fee for the packaging and manages packaging system operations and logistics (Peeters et al, 2023; Mahmoudi & Parviziomran, 2020)
- Do sales and stock demonstrate viability of the reuse model for producers or retailers?
  - % of sales in reusable packaging (Kachook, 2022; Beechener et al, 2020)
  - % of product line in reusable packaging (Kachook, 2022)
  - Changes in annual turnover of packaging-free stores/packaging free goods sales over time (Beechener et al, 2020)
- Does the system show growth potential, i.e. ability to deliver sustained value generation over the long term? (WEF & Kearney, 2021, p.24)
  - For example, are reusable packaging systems/retailers increasing or contracting in number? What is the opening rate of packaging-free stores (Beechener et al, 2020)?
- Do packaging choices bring positive or negative outcomes for a business' public image, reputation or legitimacy, and/or enhance consumer loyalty? (Grimes-Casey et al, 2007; Gordon, 2021, pp.65-66; Coelho et al, 2020; Brazao et al, 2021, p.12; Brown et al, 2022; Louis ET AL, 2021)
- Are reusable packaging system operators reliant on volunteers? (Beechener et al, 2020)

INDICATOR: ACCESSIBILITY FOR SUPPLIERS, LOCAL PRODUCERS, SMES AND SOCIAL ENTERPRISES

MEASUREMENT TOOLS/METRICS:

- Can all stakeholders afford to make, deliver or participate in the system (WEF & Kearney, 2021, p.24)
- Does pursuit of reusable packaging systems support procurement of products from local suppliers? (Beitzen-Heineke et al, 2017; Blumhardt, 2022a; Brown et al, 2022)
- Are reusable packaging systems accessible to SMEs and social enterprises, for example, standardised/pooled and affordable systems? (Brown et al, 2022)
- For retailers, identify the source of products in reusable packaging to calculate distance travelled (Beechener et al 2020) cf with products in single-use packaging

INDICATOR: OPERATIONAL EASE OF ADOPTION BY PRODUCERS/RETAILERS

MEASUREMENT TOOLS/METRICS:

- What is the extent of internal operational changes required to run reusable packaging systems?
  - Staff training (Kachook, 2022)
  - Changes to distribution, warehousing or retail workflow (Kachook, 2022)
  - Changes to payment and other tech (Kachook, 2022; Brazao et al, 2021, p.37)
- Does a third-party reuse system provider exist or do producers run vertically-integrated systems (Mahmoudi & Parviziomran, 2020)?

Some organisations, such as UP Scorecard, Plastic IQ, and the Netherlands Institute for Sustainable Packaging, have created calculators with an in-built range of metrics (including those outlined above) to support users to choose packaging, including reusable packaging options.