PLASTICS NZ
NEW ZEALAND'S INDUSTRY ASSOCIATION

EXPANDED POLYSTYRENE PACKAGING PRODUCT STEWARDSHIP:

Opportunities and Challenges.

A REPORT FOR THE MINISTRY FOR THE ENVIRONMENT.

EPS PACKAGING PRODUCT STEWARDSHIP WORKING GROUP –
FACILITATED BY PLASTICS NEW ZEALAND INC.

July 2024

About Plastics NZ

Plastics New Zealand (Plastics NZ), the industry association, has been representing the New Zealand plastics sector for 80 years. Our membership includes a range of companies from plastics processors, raw material and machinery suppliers to tool makers, designers, recyclers, brand-owners and retailers.

Plastics NZ's role covers a range of activities including working with Government and other stakeholders on issues impacting the industry, providing technical expertise on plastics, facilitation of best practice programmes and providing opportunities for education and upskilling of the industry. The organisation also provides leadership in relation to environmental initiatives such as transitioning to a circular plastics economy in Aotearoa.

This project has been completed as part of our circular economy initiative Advancing the New Plastics Economy in Aotearoa New Zealand. This initiative is supported by the Waste Minimisation Fund, which is administered by the Ministry for the Environment. The Ministry for the Environment does not necessarily endorse or support the content of the publication in any way.

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Glossary

B2B (Business-to-Business): Refers to transactions and operations between businesses, such as between a manufacturer and a wholesaler.

B2C (Business-to-Consumer): Refers to transactions and operations between a business and individual consumers.

Consumer Goods: Products purchased for use and consumption, including whiteware, appliances, furniture, electronics, art, and so on. In this report, consumer goods could be sold to consumers for personal use, or businesses for example for office fit outs.

Contamination: The presence of non-recyclable materials or substances which hinders the recycling process, lowers the quality of recycled products, and increases costs. Examples of contamination to the EPS recycling stream include food residues, tapes, adhesives, wet material, incorrect sorting, and hazardous materials.

Conversion: The process of transforming EPS through methods such as pyrolysis and gasification, which break down the material into simpler chemical compounds for recycling or energy recovery.

Chemical Decomposition: A recycling process using chemicals to dissolve EPS. Also known as dissolution.

Circular Economy: An economic system aimed at eliminating waste and the continual use of resources.

Depolymerisation: A process that breaks down polymers, such as EPS, into their monomer components for recycling.

Eco-modulation: A fee structure that incentivizes the design of more recyclable products by adjusting fees based on the cost of processing.

Expanded Polyethylene (EPE): A lightweight, flexible foam made from polyethylene, often used for protective packaging, cushioning, and insulation.

Expanded Polystyrene (EPS): A lightweight, foam-like plastic material made from polystyrene beads containing a blowing agent and treated with steam.

Extruded Polystyrene (XPS): A rigid foam insulation material made from polystyrene that is extruded into sheets, known for its high compressive strength and moisture resistance.

Medical Goods: In this report, medical goods describes equipment, medications, biologicals, and supplies used for human and other animal health. 'Biologicals' include cell and tissue-based products such as organs, blood, semen, and embryos of human and other animal origin, as well as other biological products like vaccines.

Polystyrene: A versatile plastic polymer used in a wide range of applications, from disposable containers and utensils to insulation and packaging materials.

Recyclers: Entities that collect, sort, and aggregate recyclable materials for processing, usually delivering them to reprocessors or manufacturers for reuse.

Recycled: Refers to materials or products that have been reprocessed and reused after their initial use, often in a new form or application.

Product Stewardship: The responsibility of manufacturers for the entire lifecycle of their products, particularly in terms of environmental impact and recycling.

Repolymerisation: The process of converting monomers, obtained through depolymerisation, back into polymers.

Reprocessors: Facilities or companies that process collected plastic waste and transform it into new products or materials, often by melting, re-forming, or chemical conversion.

Research and Development (R&D): The process of creating and refining products, services, or technologies through systematic investigation and innovation.

Seafood Goods: Includes all fish and shellfish produce. Seafood goods are transported live, processed, chilled, and frozen.

Virgin Grade: Material that has not been previously used or processed, often derived directly from natural resources like petroleum.

1. Preface

This report has been prepared by Plastics New Zealand Incorporated (Plastics NZ) in consultation with a wide group of stakeholders across government, retail, manufacturing and plastics. We are grateful to the Ministry for the Environment (MfE) for allowing Plastics NZ to lead this working group in relation to product stewardship for Expanded Polystyrene (EPS) Packaging.

Under its circular economy programme, Advancing the New Plastics Economy in Aotearoa, Plastics NZ ran working groups focused on activating national solutions for specific plastic waste streams. To ensure alignment with national priorities, the focus areas for these working groups are determined in conjunction with MfE. Plastics NZ recommended EPS as a priority target, with a focus on product stewardship. It was considered that this would enable the effective recycling of EPS nationally, occurring in practice and at scale, with all stakeholders across the system involved, rather than just those reprocessing it onshore.

In late 2021, MfE and Plastics NZ agreed to move forward with an EPS working group with a two-phase approach. In line with starting at the top of the waste hierarchy, the initial focus for the working group was to identify where EPS could be eliminated from consumer protective packaging (excluding cold chain and B2B applications). The group produced a findings report [1] which used a traffic light system to show where EPS can be removed and where it will be required for the foreseeable future. Phase two would then focus on product stewardship for the EPS that cannot feasibly be removed from the system.

The EPS Product Stewardship Working Group (PSWG) was formed in September 2023. This report is the culmination of the Group's work, capturing the challenges, opportunities and recommendations regarding product stewardship for EPS.

[1] Plastics NZ EPS Working Group, 29 June 2022, Phaseout of Business-to-Consumer ES Protective Packaging, a report for the Ministry for the Environment (copy on request).

2. Working Group Participants

This report was developed in partnership with a wide group of stakeholders across the brand/manufacturing and plastics industries. We gratefully acknowledge the efforts of our hard-working participants who have given significant amounts of their time to this project.

2.1 Governance Group

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Katy Constance –
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Te Whatu Ora

Te Rua Wallace,
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*Participants retired from the working group at different stages throughout the project due to changes in their availability/roles.
**Picture unavailable.

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B2C

- Stephen Armstrong - General Manager, CDB Group
- John Flower - National Technical Manager, Sharp
- Tyrone Human - National Logistics Manager, Fisher and Paykel
- Andrew McDougall - Technical Leader, Fisher and Paykel
- Sharon Mimilo - Sustainability and Services Support Lead, Bunnings
- Reena Subramaniam - Regulatory Affairs Manager, Electrolux
- Robert Wooley - Technical Manager, Consumer Electronics Suppliers Association (CESA)
- Garth Wyllie - Executive Officer, Consumer Electronics Association of New Zealand (CEANZ)

B2B

- James Blamey - Technical Support, Safety and Compliance Manager, Sony
- Vera Chehade - National Quality and Sustainability Engineer, Electrolux
- Emma Coote - Sustainability Advisor, Office Max
- Vitali Furt - Business Manager, TCL Hunt
- Josh Kuah - Product Manager, Fujitsu
- Ryan Philip - Sustainability Lead, Daikin
- Ugur Sertan - National Product & Product Training Manager, Daikin
- Wayne Tolver-Banks - Manager Health, Safety & Environment, Mitsubishi Electric

Higher Risk of Contamination

- Emma Harding* - Waste Minimisation Manager, Foodstuffs
- Mohammed Khan - Site Manager, Moana New Zealand
- Erwin Melendrez - Packaging Development Manager, Sanford
- Mandy Miller - Product & Packaging Development Manager, Sanford
- Shelley Ormiston* - Sustainability Advisor, Te Whatu Ora, Waitemata
- Helen Polley* - Sustainability Manager, Te Whatu Ora, Counties Manukau
- Ella Sheehy - Sustainability Coordinator, Moana New Zealand
- Jules Smith - Waste Minimisation & Circular Economy Coordinator, Te Whatu Ora, Northland
- Jacob Van Loghem - Health and Safety Coordinator, Labtests

Recovery and Reprocessing

- Sandy Bannerman - General Manager, Barnes Plastic
- Cameron Brooks - Project Manager, Expol
- John Forbes - Managing Director, JJ Recycling
- Vitalii Furt - Business manager, TCL Hunt
- Spring Humphreys - Product Recovery Division, EnviroNZ
- Paul Lightowlers - General manager, Hope Moulded Polystyrene
- Hugh MacEwan - SI Recycling Manager, Waste Management
- Hamish McMurdo - General Manager, Recycle South
- Michael Van Der Merwe - General Manager, Abilities Group
- Nadine Wakim - Senior Waste Planning Advisor, Auckland Council

3. Executive Summary

Figure 1: Crumbled EPS

Expanded Polystyrene (EPS) is currently considered a ‘problematic plastic’ in Aotearoa New Zealand. It is not recoverable through kerbside recycling and has limited drop-off services for recovery and reprocessing. It crumbles easily resulting in a high impact when littered or leaked to the environment. It also takes up a large amount of space in landfills due to its bulky nature. The New Zealand government is keen to take action on EPS and other hard-to-recycle plastics.

EPS packaging is vital to a number of supply chains. Although it is highly recyclable [2], it can be problematic if not managed properly at end-of-life. Product stewardship can be used to support material recovery and reprocessing, and the Product Stewardship Working Group (PSWG) was set up to explore the specific opportunities and challenges to product stewardship for EPS packaging.

Figure 2: EPS waste collection

Figure 3: EPS packaging

The PSWG was facilitated by Plastics New Zealand and made up of stakeholders from across a range of sectors including consumers goods, seafood, medical, plastics, waste management, and local government. This spread helped to ensure that the opportunities and challenges considered were informed by a range of perspectives.

With EPS falling in scope of mandated Plastic Packaging Product Stewardship (PPPS), the PSWG also collaborated with the team working on the PPPS co-design, led by The Packaging Forum, to ensure alignment. Analysis of options for overall scheme management was left to the PPPS. The PSWG focused on analysing the EPS specific challenges and opportunities to material recovery and reprocessing through product stewardship.

Throughout 2023, regular working group meetings were held. The Governance Group convened to determine the direction of the group, review sub-group findings, and steer progress. A material flow analysis gave insight to where EPS is found within New Zealand. Sub-groups were formed off the back of this to investigate opportunities and challenges across the areas identified. These groups shared insights from their own practices and reviewed findings gathered through desk research to explore current and future state options. Through this analysis, it was determined that Product Stewardship must make use of a range of recovery and reprocessing options to manage EPS used across a diverse range of application and locations, as well as according to access to funding and technology.

This report highlights the PSWG’s key findings and recommendations. The report is intended to inform the Ministry for the Environment, Industry Stakeholders and the PPPS Project Team to provide insights into the requirements needed to successfully manage EPS packaging through a product stewardship scheme.

[2] UNEP Plastic Pollution Science (UNEP/PP/INC.4/INF/1) 16 April 2024
https://wedocs.unep.org/bitstream/handle/20.500.11822/45368/PlasticPollutionScience.pdf

This report does not include:

- Full data analysis: due to the lack of available data, 'educated guesstimates' have been used in some cases. The data in this report should be taken as a guide only.
- Scheme Governance and Management options, including; Cost benefit analysis of various scheme options; Definitions regarding liable parties; Specifics around scheme management and material ownership

These were not in scope of the PSWG as they are in scope of the PPPS.

3.1 Key Findings

- There is ~5,304 tonnes of EPS packaging used within New Zealand per annum. Despite the challenges, ~1230 tonnes of EPS packaging are recovered for reprocessing per annum (~23% rate). There is ~4074 tonnes of material lost to landfill and the environment.

- Some recovered EPS packaging and products are reprocessed into new construction products onshore. The rest is compressed, exported, and reprocessed into rigid polystyrene products overseas.

- It is challenging to collect EPS as it is bulky, crumbly, and lightweight. Collection points fill quickly, material that is not enclosed is likely to be blown around, and the material crumbles at all handling points risking environmental pollution.

- Transporting uncompressed EPS is inefficient as the material has a low weight to volume ratio. Trucks fill up their volume capacity well before their weight capacity resulting in greater costs and emissions per kg compared to denser materials.

- Collection and transport is least efficient in rural areas/areas without local EPS recyclers or reprocessors. EPS can be compressed for more efficient collection and transport, however, compressed material cannot be reprocessed onshore at present.

- A variety of collection methods are currently available, with further opportunities possible. Different methods should be utilised to effectively recover material from different regional areas/site locations.

- Contamination can be minimised through design for recyclability, enclosed collection points, and good signage can reduce contamination, however, sorting before reprocessing is the only way to manage contamination entirely.

- Current onshore recycling capacity is limited. Offshore recyclers have capacity to take more material. More data is required to determine the feasibility of developing additional onshore recycling infrastructure.

- A number of opportunities exist for a product stewardship scheme to effectively increase EPS packaging recovery and recycling rates in Aotearoa.

- An industry led scheme set up in advance of the PPPS would help to ensure that effective material recovery systems are in place. Further analsysis of scheme options is required for this.

3.2 Recommendations

The PSWG puts forward the following recommendations to enhance the successful implementation of product stewardship for EPS packaging.

1 **Utilise a range of recovery and reprocessing options**

To account for variances across sectors, explore and implement a range of EPS recovery and reprocessing options.

2 **Employ robust data reporting systems**

Implement data reporting for volumes place on market, collected, and reprocessed (on and offshore). This will be mandatory under PPPS.

3 **Implement reasonable recovery/reprocessing targets**

Regional & onshore and offshore targets should be split. Targets should be regularly reviewed and adjusted.

4 **Map transportation and infrastructure required**

Identify the resources required for efficient recovery & reprocessing, rioritising onshore options.

5 **Stagger scheme implementation across regions**

Start in urban areas/areas with local manufacturers first whilst developing plans for harder to reach communities.

6 **Provide users/producers with 'waste hierarchy' guidance**

Outline where EPS should be phased out and, where it is needed, guidelines for reuse and design for recyclability.

7 **Structure fees to incentivise design for recyclability**

Adjust fees based on the cost of processing/recycling more contaminated EPS. Eco-modulation across product verticals could also incentivise certain packaging designs.

8 **Create a strong communications plan**

Clear messaging should be provided highlighting how to engage with the scheme, including material drop off/collection options and acceptable material standards.

9 **Plan strategies to boost engagement**

'Gamification', rewards, and positive messaging regarding impact made systems should be used to drive engagement.

10 **Support Research and Development (R&D)**

Include allowance for R&D into circular opportunities such as reuse systems, and recovery/reprocessing technologies

11 **Ensure proper handling at recovery points.**

Mitigate pollution and contamination at recovery points by providing training and consistent signage.

12 **Support opportunities to mitigate environmental harm.**

Include allowance to develop or support initiatives that mitigate or remediate EPS environmental pollution.

13 **Take steps to support alignment with Australia**

Maintain communication with Australian partners to support scheme efficiencies and Trans-Tasman trade.

14 **Conduct further analysis into options for an industry led scheme**

An industry-led scheme would establish recycling pathways preemptively of the PPPS scheme, and manage materials beyond its scope.

3.3 Next Steps

Scheme Options Analysis:

Conduct analysis of scheme options to determine opportunity for implementation of an industry led scheme ahead of the PPPS.

PPPS Review:

Government consideration of the PPPS co-design to be carried out. Anticipation of regulations to enact scheme.

Working Group Continuation:

Plastics NZ plans to continue working group to support members interests through scheme development and allow for trials.

3.4 Conclusion

The recovery and reprocessing of EPS packaging can be successfully increased to well above the current estimated rate of 23% through the implementation of a product stewardship scheme. Under government mandate, a large portion of EPS packaging is under the scope of the PPPS. The findings and recommendations in this report will help provide guidance to the scheme management organisation in regard to the successful management of EPS within the scheme.

The EPS packaging covered in this report is broader than the scope of the PPPS in that it includes medical and B2B packaging. To ensure cost-effectiveness and completeness of an end-of-life solution, it is recommended that the EPS scheme be set up to align with the PPPS, but in such a way that out-of-scope EPS can be included in the recovery network. This could include construction EPS over the longer term.

Steps can be taken by industry in advance of mandated product stewardship to set up recovery and reprocessing systems. This would help to ensure that systems are effective and reduces fees payable for use of EPS through a mandated scheme.

4. Introduction

Expanded Polystyrene (EPS) packaging serves as a vital component in modern supply chains. However, the lack of a formal, nationwide recovery system and reprocessing infrastructure results in the loss of material to landfill and the environment (including through illegal dumping and material crumbling when handled). The negative consequences of this include loss of valuable resources from the economy, wasted space in landfills, and environmental pollution.

Figure 4: Examples of EPS packaging

Product stewardship presents an opportunity to address these issues by requiring producers and users of EPS Packaging to manage the material throughout its entire lifecycle. Successful product stewardship would ensure nationwide material recovery in practice and at scale, reuse, and reprocessing opportunities. The PSWG has worked to identify the gaps, obstacles and opportunities in Aotearoa to implement a successful EPS stewardship scheme.

Figure 5: Examples of the impact of bulky and crumbly EPS

4.1 Background

The New Zealand government is keen to take action on EPS and hard-to-recycle plastic packaging more broadly. A number of announcements and consultations relating to EPS have occurred over the last few years as indicated in the timeline below. The work of the PSWG has been carried out in alignment with these, as also shown below:

2019	(December): The Prime Minister announced a plan to move away from single use packaging and beverage containers made from polystyrene at the launch of the *Rethinking Plastics* Report [3].
2020	(July): Associate Minister for the Environment gazettes a *Declaration of Priority Products* Notice [4] including 'plastic packaging', mandating product stewardship under the Waste Minimisation Act 2008. (August): MfE releases consultation *Reducing the impact of plastic on our environment* [5] that includes a proposal to ban all EPS packaging.

[3] Rethinking plastics in Aotearoa New Zealand | Office of the Prime Minister's Chief Science Advisor
[4] Declaration of Priority Products Notice 2020 - 2020-go3343 - New Zealand Gazette
[5] Reducing the impact of plastic on our environment - moving away from hard-to-recycle and single-use items | Ministry for the Environment

2021

(July): MfE & the Minister for the Environment advise Cabinet that a ban on EPS protective and cold-chain packaging is not feasible and that further work is required [6].

(October-November): MfE and Plastics NZ agree to move forward with an EPS working group with a two-phase approach. The initial phase to focus on identification of areas where EPS should be phased out. The second on product stewardship for necessary EPS.

(December): Plastics NZ establishes the EPS Working Group (EPSWG) to focus on identifying where EPS could be phased out of Business to Consumer (B2C) protective packaging, without adverse environmental consequences. The narrow scope of work was due to the short time frame the EPSWG provided to inform the Minister for the Environment (initially 4 months).

2022

(June): Government announces decisions on *phasing out hard-to-recycle and single-use plastics* [7]. While some EPS (or XPS) packaging is included, it is acknowledged that the public consultation demonstrated further work is needed on EPS used to transport cold items or protect large items.

(June): EPS Working Group's Report *Phaseout of Business-to-Consumer EPS Protective Packaging: a report for the Ministry for the Environment* [1] released. This showed where EPS could be immediately phased out, where further R&D might identify feasible alternatives, and where removal of EPS was not feasible. Recommendations were made for both phaseouts and proceeding with product stewardship for EPS.

(September): MfE releases *Guidance on plastic products banned from October 2022* [8] which includes exemption for cold-chain and protective packaging EPS. MfE also notes that it is working with sector experts to identify possible solutions.

(September): The Minister for the Environment announces that the Plastics Packaging Product Stewardship (PPPS) Scheme co-design would be led by the Packaging Forum partnered with the NZ Food & Grocery Council (NZFGC) [9].

(September): Plastics NZ begins work for the EPS Product Stewardship Working Group (PSWG) with the establishment of the Governance Group. Planning includes opening of communications with the PPPS to ensure the EPS work aligns with the overriding plastic packaging product stewardship design.

2024

(August): Expected release date of the PSWG report to the Minister for the Environment, MfE and industry stakeholders.

[6] Regulatory Impact Statement: Phasing out specific hard-to-recycle plastics and single-use plastics items | Ministry for the Environment & Minister for the Environment
[7]Government takes action on problem plastics | Beehive.govt.nz
[8]Guidance on plastic products banned from October 2022 | Ministry for the Environment
[9] Government backs initiatives to cut environmental impact of plastic waste | Beehive.govt.nz

5. Material Flows

A material flow analysis was conducted to provide insights on the movement, use, and post use pathways of EPS within Aotearoa.

Three key sectors reliant on EPS packaging were identified:

Consumer Goods	Seafood Goods	Medical Goods
Large, fragile, and sensitive goods produced for use by general public.	All fish and shellfish, whether live, processed, fresh, or frozen.	Equipment, medications, biologicals and supplies for human/animal health.
EPS needed to package heavy, fragile, or sensitive to damage items.	EPS needed to package heat and/or vibration sensitive items.	EPS needed to package heavy, fragile, and/or damage/heat sensitive items.

It was highlighted that EPS packaging within each sector takes diverse paths before and after its use.

Touchpoints through use include:

- Manufacturing sites
- Primary industry sites
- Warehouses
- Retail outlets
- Medical centres
- End users

Post use pathways include:

- Reuse.
- Onshore recycling.
- Offshore recycling.
- Landfill disposal.
- Offshore incineration (some medical waste).
- Environmental leakage.

The PSWG Governance Group recognised that the material flows and post use options varied between sectors. The decision was made to establish subgroups to further investigate the current state of EPS packaging within NZ.

The subgroups established were:

- Consumer Goods Packaging* – B2B and B2C
- Packaging with Higher Risk of Contamination – Medical and Primary Goods
- Recovery and Reprocessing – Manufacturers, Recyclers, and Reprocessors

**The 'Consumer Goods Packaging' working group was initially two groups: B2B and B2C. However, initial discussions found that material in each group flowed through similar touchpoints and had similar outcomes. The decision was made to merge these groups.*

An initial material flow map was developed by Plastics NZ, to provide each subgroup with a starting point for analysing the specific material flows for their sector. This also shows the out-of-scope construction EPS flows for completeness. This map can be found in Appendix A.

5.1 Consumer Goods

Figure 6: Examples of consumer goods that require EPS packaging.

'Consumer Goods' includes products such as small appliances, furniture, whiteware, art, and electronics. Although some smaller, more durable consumer goods can be effectively packaged in alternative materials (e.g. moulded fibre), replacing EPS is not feasible on certain products.

The *Phaseout of Business-to-Consumer EPS Protective Packaging* report [1] found that alternative materials could not adequately protect heavy, fragile, or sensitive items. Without EPS, items like heavy furniture, fragile electronics, or sensitive products such as microwaves and items containing refrigerants would be likely to become damaged during transit. This would result in significant environmental harm from lost resources and energy, increased waste, and health risks from damage to certain products.

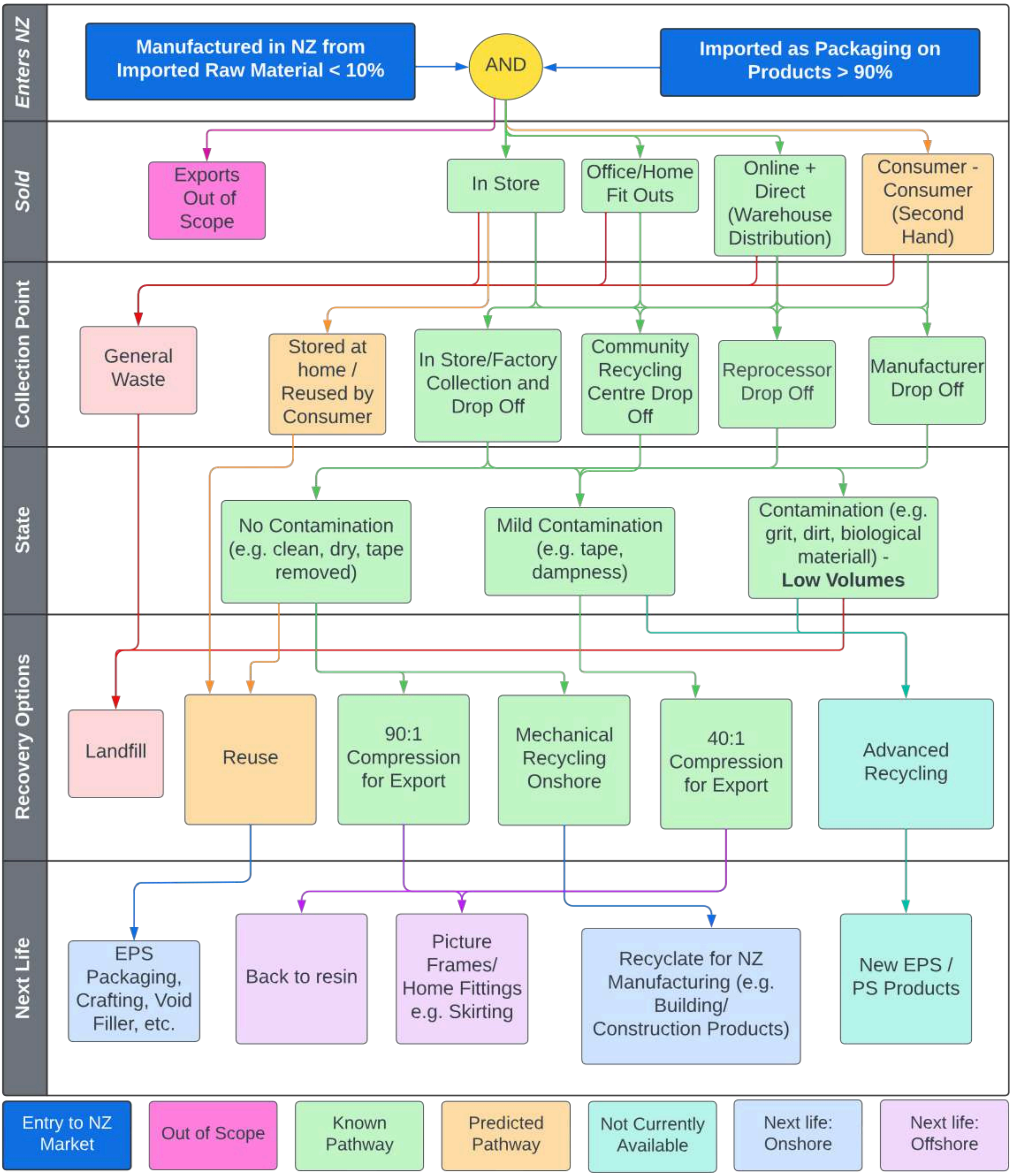
It was noted that using larger volumes of alternative materials may result in adequate protection in some instances. However the increased material use, weight, and packaging size would result in negative environmental outcomes. In particular, a higher carbon footprint.

A traffic light system was produced highlighting the consumer goods products identified as requiring EPS packaging - this can be found in Appendix B.

In addition, the relatively small New Zealand market has limited influence over packaging on imported product. A ban would likely result in loss of access to certain products, rather than a change in packaging material.

Material flow review findings:

- The primary source of material entering the market is imported products.
- It is found in both B2B and B2C settings such as individual purchases and home/office fit outs.
- It can be recovered through retailer take back, commercial waste collection, community recycling centre drop off, and manufacturer/reprocessor drop off.
- There is an unknown, but estimated low, level of informal reuse.
- Tapes, labels, and adhesives are the main contaminants.
- It can be recycled both on and offshore.
- It is likely that large volumes of material currently end up in landfill.



**Loss to environment at all handling points*

Figure 7: Consumer Goods EPS Packaging

5.2 Seafood Goods

Figure 8: Examples of seafood goods that require EPS packaging.

'Seafood Goods' includes all fish and shellfish produce*. Seafood goods are transported live, processed, chilled, and frozen. New Zealand's seafood industry generates $5.2 billion in economic output annually [10]. EPS packaging enables the industry to maintain the quality and safety of seafood during transportation and storage by providing effective protection from heat and damage. It also protects live produce from harm from vibration.

Removing EPS packaging from seafood goods would result in negative externalities including product loss and animal harm.

Ongoing R&D seeks to identify alternatives to EPS packaging in the Seafood sector. This includes exploring durable, reusable options as well as single use alternatives. However, discussions with stakeholders highlighted the following challenges to removing or replacing EPS packaging:

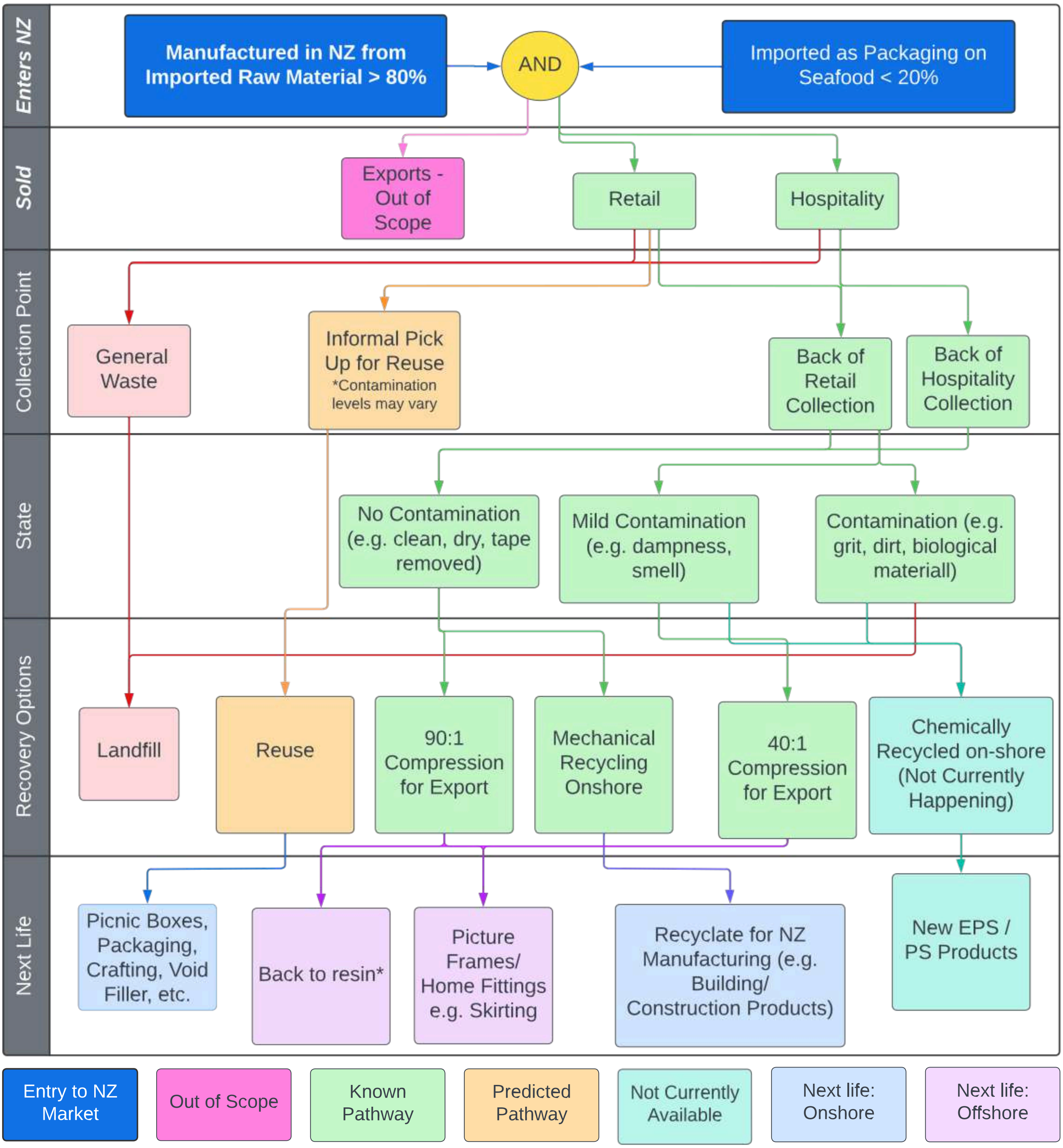
- 80-90% of New Zealand Seafood is exported. Reusable systems are not currently feasible for exports.
- Using different packaging for onshore and offshore sales would require products for local use and export to become separate inventory items, requiring intensive planning and resourcing.
- Many of the single use alternatives to EPS, such as wool lined packaging, do not offer sufficient protection from damage/vibration, or the insulation needed to maintain freshness in different climates/over long time periods.

Material flow review findings:

- Material mostly enters the NZ market as packaging manufactured in NZ.
- An estimated 90% of EPS packaging on seafood produce is exported.
- Contamination from biological material is a risk during packaging, unloading, and transit. This restricts reprocessing options. Tapes, labels, and adhesives are further contaminants.
- Liners are sometimes used to protect against biological material contamination. However, they: increase packaging cost, weight, and waste; do not always prevent contamination during packaging/unloading; can be damaged during use; and cannot be used on live produce.
- There is an unknown, but estimated low, level of informal reuse, e.g. through supermarkets.
- Material is primarily B2B and can be collected from back of grocery/hospitality. Some material may end up with consumers and travel through 'Consumer Goods' collection points.
- It is likely that most of this material currently ends up in landfill.

*Animal products such as livestock semen/embryos have been included in medical goods.
Other animal products may also be packed in EPS - it is likely that these are smaller categories of goods with similar opportunities and challenges to Seafood.

[10] Commercial Fishing Economic Contribution Final Report 2022



**Loss to environment at all handling points*

Figure 9: Seafood Goods EPS Packaging

5.3 Medical Goods

Figure 10: Examples of medical goods that require EPS packaging.

The term ‘Medical Goods’ in this report describes equipment, medications, biologicals, and supplies used for human and other animal health. ‘Biologicals’ include cell and tissue-based products such as organs, blood, semen, and embryos of human and other animal origin, as well as other biological products like vaccines.

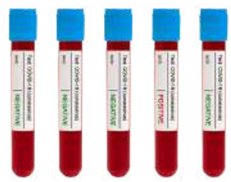
Some medical equipment requires EPS packaging as it is heavy, fragile, and/or sensitive to damage. Medications and biologicals may also require EPS to protect against heat and/or vibration.

As with seafood, alternatives to EPS packaging (including reusable systems) have been explored for Medical goods. Challenges to these include:

- It may be challenging to ensure that reusable systems are as clean/sterile as required for medical use.
- Reusable systems are not feasible at present for exported goods (such as animal semen/embryos exported as breeding stock).
- Many of the single use alternatives to EPS, such as wool lined packaging, do not offer sufficient protection from damage or heat in different climates/over long periods.

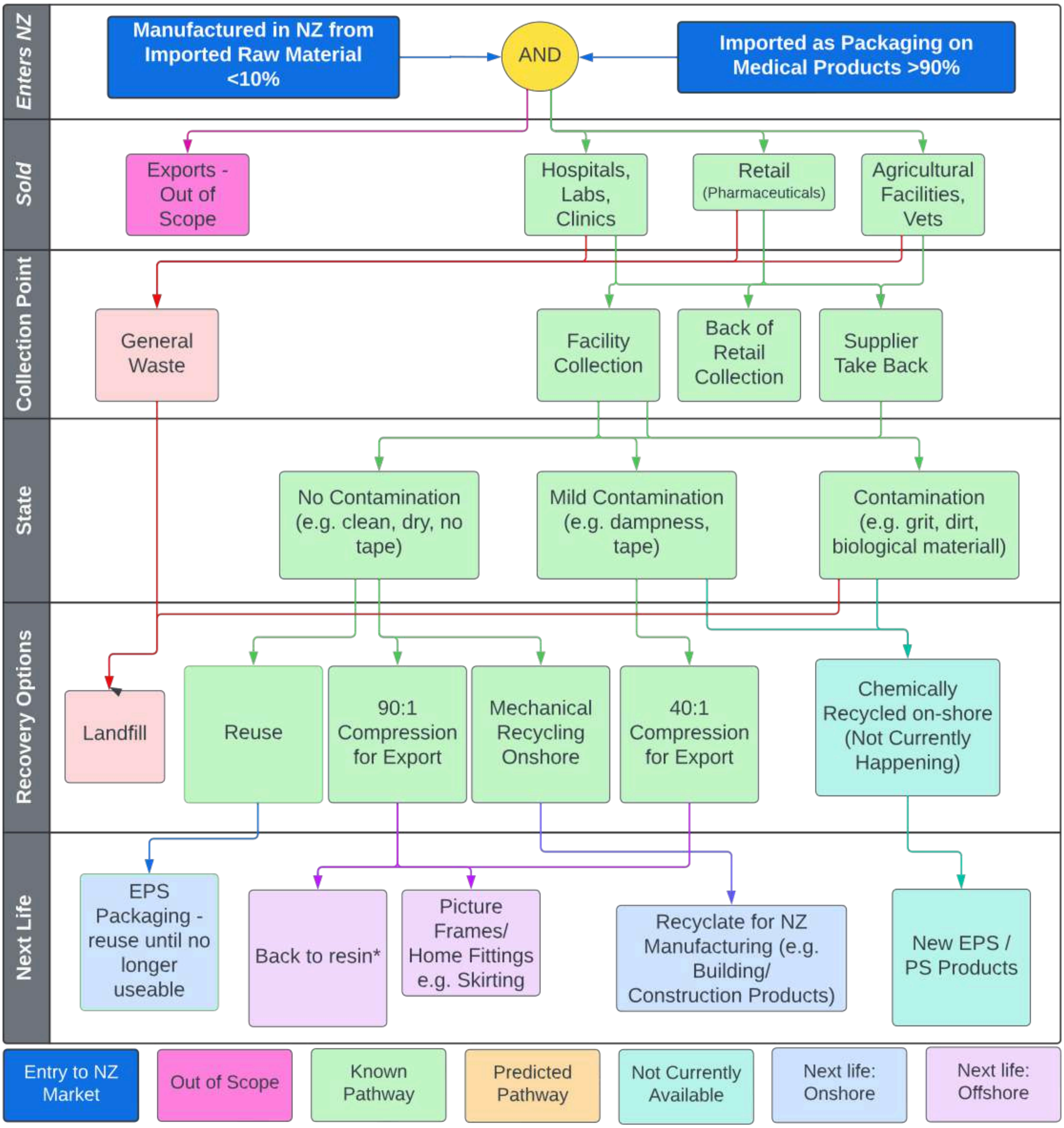
Material flow review findings:

- Material enters New Zealand as packaging on imported product and packaging produced by manufacturers within New Zealand.



- It is used to transport materials within the country and as packaging on exports.
- Contamination levels vary from labels/tapes/adhesives to biological material contamination. EPS that enters certain labs is immediately considered too contaminated for recycling.

- Some systems of reuse are in place; EPS packaging on some medical supplies is collected and reused by suppliers; Some labs keep EPS packaging for internal reuse.
- Some hospitals have collected EPS packaging for compression and offshore recycling. This has been limited by inconsistent collections.
- Material is used B2B and can be collected from back of medical facilities including hospitals, labs, pharmacies, and veterinary clinics.
- It is likely that a large volume of this material ends up in landfill at present. A small amount is exported with other hospital waste for offshore incineration.



**Loss to environment at all handling points*

Figure 11: Medical Goods EPS Packaging

5.4 Overall Findings

Material Use:

EPS is used in B2B and B2C settings to protect products against damage from impact, vibration, and/or temperature change.

Entry Points:

Most EPS packaging on consumer goods and medical goods is imported to New Zealand on products. Most EPS packaging on seafood goods is manufactured in New Zealand. Around 90% of this is exported.

Contamination Levels:

Post use sorting and treatment requirements vary in line with different risks of contamination between sectors. Tapes, labels, and adhesives are the main contaminants in the consumer goods sector. The medical and seafood sectors have a greater risk of contamination from biological material and odour. There may be regulated disposal requirements due to the risks of products or usage environments.

Collection Systems:

Current collection systems are limited. A small amount of (typically informal) reuse occurs. There is some take-back of Consumer Goods packaging through in-store, manufacturer, reprocessor, and community recycling centre drop-off. Waste contracts support some B2B material recovery for reprocessing. This has been inconsistent for some businesses.

Reprocessing Options:

EPS packaging is currently recycled onshore (into new construction product) and offshore (into new polystyrene products).

Challenges:

Despite being 100% recyclable, lots of EPS packaging is not recycled. This is due to the lack of adequate collection and sorting systems in New Zealand at present.

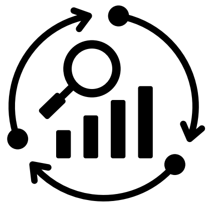
Recommendation 1: A range of recovery and reprocessing models and technologies will need to be investigated and employed to support improved recovery and recycling for EPS packaging used across different sectors. This to allow for variances in contamination levels and local infrastructure.

6. Volumes

Data is needed to design and run a product stewardship scheme effectively. Understanding the volume, diversity, and regional spread of material placed on market helps to determine what infrastructure is required and how to allocate resources. Throughout the running of a scheme, data is needed to monitor scheme performance and provide accurate reporting.

The PSWG sought data to answer the following questions:

- How much EPS packaging is placed on market in Aotearoa?
- How much EPS packaging is recycled within New Zealand?
- How much EPS packaging is exported for recycling offshore?



This would help to identify:

- The amount of material not being recovered.
- The additional capacity needed to support a product stewardship scheme.

6.1 Plastic Packaging Product Stewardship Scheme

As part of the Plastic Packaging Product Stewardship (PPPS) design process, the PPPS project team commissioned research from Valpak on material flows and volumes for plastic packaging within New Zealand. The EPS Product Stewardship working group reviewed the research report to understand whether the volume of EPS Packaging had been identified.

The PPPS data showed a total estimate of 6,490 tonnes [11] of polystyrene packaging placed on market in NZ per annum and 120 tonnes of EPS (grocery sector). The polystyrene data was not split between rigid and expanded polystyrene. The EPS data showed only grocery sector data. It was therefore not possible to identify the total volume of EPS Packaging placed on market from this report.

As rigid polystyrene is heavier than EPS, the group anticipated that 6,490 tonnes is too low for rigid polystyrene and EPS combined. This feedback was passed back to the PPPS team. The sub-groups commenced attempting to identify data in other ways.

Figure 12: Rigid and EPS Packaging

Rigid Polystyrene

Expanded Polystyrene

[11] J. Skidmore, et al. (2023) 'Research to Support the Co-design of a Plastic Packaging Product Stewardship Scheme for New Zealand' pg. 22

6.2 EPS Packaging Manufactured & Recycled in NZ

The 'Recovery and Reprocessing' subgroup focused on identifying volumes of EPS produced, sold, and recovered for recycling in New Zealand. Stakeholders shared observations from their own practice, reviewed existing estimates, and made calculations based on reasonable estimated and known data. A breakdown of this work can be found in Appendix C. A summary of the findings is shown below:

504 tonnes of NZ manufactured EPS packaging is placed on market per annum.

450 tonnes of EPS packaging is recycled onshore per annum.

~780 tonnes of EPS packaging is compressed and exported for recycling per annum.

A total of **~1,230 tonnes** of EPS packaging is recovered for recycling (on and offshore) per annum.

6.3 EPS Packaging Imported into NZ

Data showing the volume of imported EPS packaging was difficult to gather. Companies were either not gathering or not reporting publicly on data at present.

The group hoped to estimate the volume of imported EPS packaging through taking the following steps:

- Generate a list of key products known to require EPS packaging.
- Estimate the average volume of EPS packaging used for each product type.
- Identify the total volume of units imported per annum for each product type.

The traffic light system from the 2022 'Phaseout of Business-to-Consumer EPS Protective Packaging' report highlights products that are likely to require EPS packaging for the mid-long term (Appendix B). This information was used as the list of key products known to require EPS packaging. Some additional products were highlighted by stakeholders in the Medical and Seafood sectors. The Consumer Goods and Higher Risk of Contamination sub-groups then estimated the average volume of EPS packaging on each of these product.

Finally, 16-digit Harmonised System (HS) codes were identified for each product. These codes are used to access import and export data. Unfortunately, import data gathered from Statistics NZ, Customs, and the UN Comtrade Database showed a mixture of units, tonnages, and values imported. It was not possible to extrapolate between sets of data as none of the sets was complete. It became apparent that data on the volume of units imported was not available.

The decision was made to estimate the volume of imported EPS packaging through known and predicted data.

Desk research and cross sector discussions within the subgroups indicated the information below. A detailed analysis of this work can be found in Appendix C. The Australian market provided a key foundation for this work as the Australia Packaging Covenant Organisation (APCO) has some existing estimates regarding the volume of EPS packaging used in Australia. Our thanks to APCO for their assistance in this area.

Australia's imported EPS bead, EPS packaging production, and population are all approximately five times greater than New Zealand's. It is assumed that Australian EPS packaging imports are also around five times greater than New Zealand's.

2023 EPS Packaging data from APCO estimated imports of ~10,867 tonnes. However, this data excludes many applications that require EPS (e.g. air conditioning units, seafood, medical products, furniture, art, computing).

A 2018 report from an APCO working group estimated imports of ~24,000 tonnes of EPS packaging per annum. This report is no longer on the APCO website, however, the figure seemed more reasonable to stakeholders during discussions based on the products not covered in the later data.

Based on the 2018 data, if Australian EPS packaging imports are around 5 times greater than New Zealand's, the estimated EPS packaging imports to NZ will be ~4,800 tonnes.

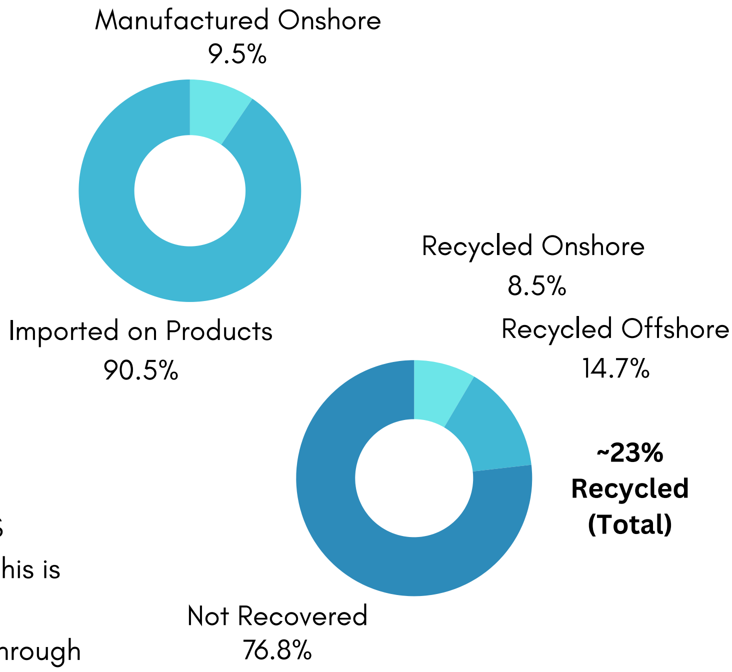
This is low confidence data. APCO are conducting further research into the volume of EPS packaging in Australia. An error margin of at least +/- 30% should be applied.

6.4 Recovery Gap

Despite the lack of reliable import data, a significant gap has been identified between the volume of EPS packaging placed on market in New Zealand, and the volume recovered.

- ~5,304 tonnes of EPS packaging are placed on market in NZ per annum (~504 manufactured on shore, ~4800 imported on products).
- ~1,230 tonnes of EPS packaging recovered for recycling per annum.
- ~4,074 tonnes of EPS packaging used is not recovered for recycling in NZ per annum.
- Based on the PSWG's estimated data, EPS packaging has a recycling rate of ~23%. This is relatively high compared to some other materials, and can be further developed through product stewardship.

Figure 13: Estimated split of EPS manufactured and recycled on and offshore



6.5 Addressing the Data Gap

To gain more accurate info and close the data gap, additional work is required. Without this, system design, monitoring, and reporting for a stewardship scheme would be problematic.

The PSWG highlighted that the following data needs to be reported to the scheme:

- Quantity of EPS packaging placed on market (total, regional split, and sector split)
- Quantities recovered (total, by region, and by format (compressed, and not compressed))
- Quantities recycled (total, onshore, and exported for recycling)

Companies exporting to Europe are required to report on packaging data and the systems used to support this could be explored and developed. Packaging data sheets (documents providing information about packaging use, materials, and specifications) and digital technologies (such as blockchain technology) could be used to support this data collection. Steps need to be taken to ensure that commercially sensitive information is protected and not made publicly available.

Data reporting could be mandated or voluntary. However, mandated reporting would ensure the most market fairness and accuracy. In addition, any regulations stipulated by the PPPS will need to encompass EPS packaging reporting.

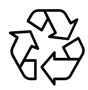
Recommendation 2: Data reporting for volumes placed on market, collected, and reprocessed (on and offshore) will need to be implemented through a scheme. Ideally this will be mandatory under the broader PPPS regulations.

7. Recovery Locations

While discussing material flows and volumes, the PSWG considered how the ease of recovering EPS packaging varies by region.

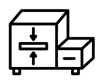
Onshore recycling requires uncompacted EPS, making it costly for material recovery at locations far from reprocessing facilities. Currently, Expol offers an EPS take-back option at some Mitre10, ITM, and Hyperdrive stores, but only near their manufacturing sites.

Some Community Recycling Centres (CRCs) & Waste Transfer Stations (WTSs) accept EPS. However, most CRCs lack compactors. EPS must be transported as packaging to reprocessors for recycling or recyclers for compaction and export. Transporting non-compacted EPS is costly, so CRCs far from reprocessors/recyclers may not collect EPS or may send it to landfill.

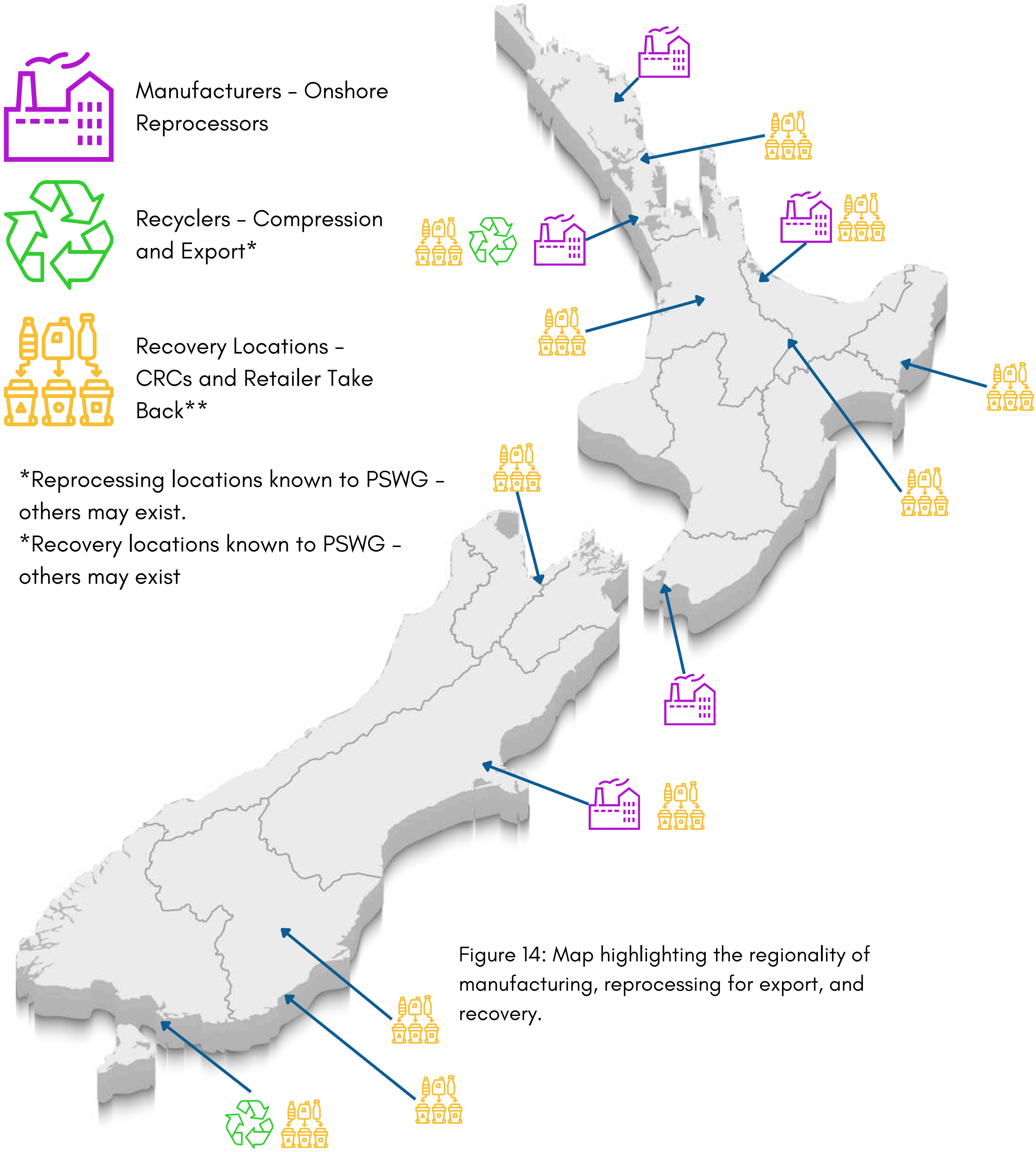


Recyclers also offer EPS drop-off for compaction and export. A fee is charged for this service.

Some businesses have compactors for their own packaging (whether B2B or take back of packaging from deliveries). This is generally in in urban areas with larger volumes.



Waste contracts have supported collection of B2B packaging to be compressed and exported, but this is not cost-effective for regional areas. Collections in some regions have been inconsistent or stopped.



*Reprocessing locations known to PSWG - others may exist.
*Recovery locations known to PSWG - others may exist

Figure 14: Map highlighting the regionality of manufacturing, reprocessing for export, and recovery.

Recommendation 3: Reasonable recovery & reprocessing targets should be set. These should be reviewed and adjusted as the scheme progresses. Targets should be split for regional recovery, onshore reprocessing, and overall reprocessing rates.

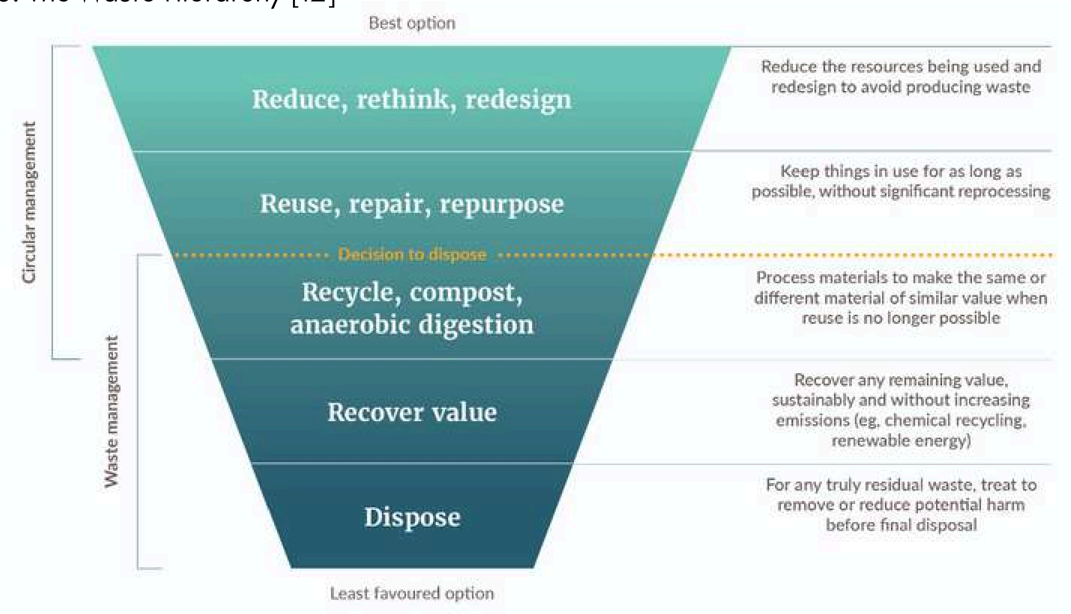
Recommendation 4: Transportation & infrastructure requirements should be mapped. Planning and investment should be focused on maxmising onshore reprocessing and remaining material exported for environmentally sound reprocessing offshore.

Recommendation 5: Scheme implementation should be staggered. Commence collection and reprocessing in urban areas/areas with local reprocessors first whilst developing a plan for harder to reach communities.

8. Opportunities for Managing EPS

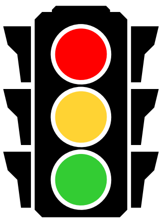
A product stewardship scheme will need a clear plan for managing post use EPS packaging. The waste hierarchy, shown in Figure 6 provides a framework for evaluating material management options, prioritising those that reduce the volume of material in use and retain material value. By applying the waste hierarchy to EPS packaging, our working groups assessed the current and future state options for managing EPS packaging

Figure 15: The Waste Hierarchy [12]



8.1 Reduce

Opportunities for designing out EPS packaging were examined by Plastics New Zealand's first working group focused on EPS packaging. This produced a report 'Phaseout of Business-to-Consumer EPS Protective Packaging' [1] which helped inform the Minister for the Environment and MfE. It was found that viable alternatives to EPS packaging exist for some products, but not for others. A traffic light system was produced to show:



Where suitable alternatives are unlikely to be available for the foreseeable.

Where suitable alternatives may be available soon.

Where EPS can safely be replaced with alternatives.

The report highlighted that alternatives to EPS can be used to package smaller products. Moulded fibre (pulp), honeycomb cardboard, cardboard, air cushions and bubble wrap are commonly found

[12] https://www.wastenothing.co.nz/our-zero-waste-journey/waste-hierarchy/

packaging alternatives that can be recycled post use. Other biobased options, such as mycelium (fungi), were also identified. These are less frequently used due to higher costs and production time. It was noted that a switch to expanded polyethylene (EPE) or expanded polypropylene (EPP) is not advisable as they are not recyclable in our system at present.

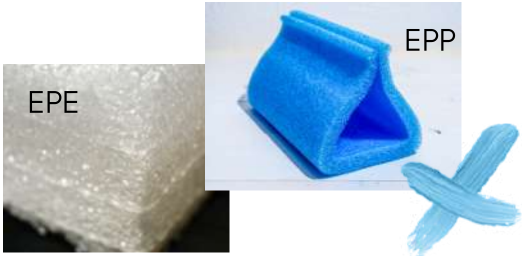


Figure 16: Feasible alternatives to EPS on certain applications include cardboard, bubble wrap, and air cushions.

Whilst R&D into alternatives continues, the report highlighted that certain products are likely to require EPS for the foreseeable. For products that are heavier, fragile, sensitive to damage, or that need to be temperature-controlled, the alternatives do not pass the extensive transport, safety, and regulatory testing required. In some cases, the protection level needed can be achieved by using an increased amount of packaging, growing the packaged size of the product. This has adverse economic and environmental costs due to the reduced shipping efficiency and increased trips (climate impacts). Removing EPS from these goods would likely result in significant increase in product damage and loss, loss of market access to international brands, and increased carbon footprint caused by a greater volume of packaging.

Recommendation 6: Design guidance should be provided to EPS producers and users outlining where EPS should be phased out, the negative externalities of alternatives on certain products, and guidelines for reuse and design for recyclability.

8.2 Rethink/Redesign

Packaging redesign could include switching to alternative materials. See 'reduce' for guidance around this. When designing packaging, steps can be taken to increase its recyclability. Products can be recycled most easily when they are recovered as clean, dry, single polymer streams of material. Contamination occurs when materials are mixed or dirty.

When designing EPS packaging, the following steps can be taken to avoid post use contamination:

- Avoid inseparable packaging components, e.g. connected wood, foil or liners.
- Avoid adhesives and inks that impact recycling process or impact the value of the recycled material.
- Avoid tape and labels. Where necessary, these should be coloured and 'easy peel' to support removal.
- If the material will be used in an application where there is a high risk of contamination (e.g. for seafood), include steps to protect the EPS. Separable (loose) liners/barriers can help to ensure that the material stays clean.

In addition, design for resource efficiency can help to minimise the amount of material used while ensuring functional efficacy and product protection.

Figure 17: Scale of contamination level from clean to non-recyclable.

Design for Recycling guidance, similar to the Re:Plastics document [13], would be valuable for liable producers in a stewardship scheme. A recyclability assessment tool could aldo ensure packaging design is optimised to fit both its functional requirements, and to maximise recovery at its end of life.

Fees could differ between sectors to meet the costs of varying post-use sorting and treatment requirements (e.g. more thorough sorting in the seafood sector to ensure no contamination).

Ecomodulation, where scheme fees are modified to drive producer behaviours, could also be utilised to incentivise, or disincentivise, certain aspects of packaging design. As EPS use is complex, it is recommended that this is tied to applications and product verticals, rather than materiality specifically. Eco-modulation would be problematic in a plastics-only stewardship scheme as it would encourage liable parties to move to alternatives with adverse environmental impacts, such as increased carbon footprint.

Recommendation 7: Fees should be structured to incentivise appropriate design and use. This could include adjusting fees based on the cost of processing/recycling more contaminated EPS and using eco-modulation across product verticals to incentivise certain packaging designs.

8.3 Reuse

Prior to recovering material for recycling, there is an opportunity to reuse material. Material reuse can be formal or informal.

Formal reuse: material reused for same purpose through structured mechanisms established by organisations/businesses. Examples [14] include:

- Return from site/home: Reusable packaging is collected by a pick up service for cleaning and reuse (e.g. reusable cold-shipping box for meal-kit or grocery deliveries)
- B2B Reuse system: Reusable transport packaging utilised within distribution system (e.g. medical supply boxes used, recovered and reused repeatedly in medical goods distribution)

Informal reuse: material reused, often in an alternative application (or 'repurposing'), outside of a formalised system. Examples include:

- Consumers reusing packaging from purchases.
- Supermarkets giving away boxes to consumers in store.
- Businesses reusing packaging internally.
- B2B material sharing for reuse.
- Consumers sharing material for reuse, such as through social media platforms.

[13] https://www.replastics.nz/
[14] 2019, https://www.ellenmacarthurfoundation.org/reuse-rethinking-packaging

8.3.1 Current State:

Some formal reuse systems have been identified in New Zealand B2B supply chains. Some EPS bins used for local production and delivery of seafood, pharmaceuticals, biologics, and veterinary supplies are reusable and fit into circular logistics pathways. One such example was identified within the medical sector. Stakeholders from Te Whatu Ora Tāmaki Makaurau and Te Tai Tokerau noted that Onelink, supplier of pharmaceutical products, takes back EPS packaging for reuse on future orders.

Conversations within the working groups also provided colloquial evidence of informal reuse:

- Medical sector stakeholders noted that labs typically reuse their EPS vial holders until 'no longer useable' after which they are disposed of to landfill.
- It was stated that a supermarket in Nelson had such high public collection of EPS packaging that very little was sent to landfill. It is likely that this material was repurposed.
- A consumer goods stakeholder shared that they were aware of retailers keeping EPS boxes for local sushi shops to reuse.

As informal reuse is not monitored, it is not possible to identify how much material is reused through these channels.

EPS is often reused as packaging, however, conversations within the working groups highlighted that consumer 'reuse' of EPS often repurposes the material in alternative applications. Repurposing is not reuse as intended by the waste hierarchy and can result in negative externalities. Examples include:

- Picnic/fishing boxes
- Arts and crafts
- Gardening supplies
- Void filler
- Luggage

Figure 18: EPS is sometimes reused for picnic boxes (below) and arts and craft (right).

8.3.2 Challenges

Although high on the waste hierarchy, several challenges impact EPS packaging reuse. The most significant of these are:

- Hygiene: most EPS packaging from supermarkets is from seafood packaging. There is a higher risk of contamination from biological material on these boxes. Whilst formal systems can take steps to ensure they are cleaned or lined appropriately, informal reuse poses a hygiene risk.
- Accountability: Informal reuse systems lack monitoring, leading to low accountability. Discussions within the working groups highlighted that much reused material ultimately ends up in landfill.
- Contamination and Damage: Reusing EPS increases the risk of contamination and damage. Contaminated EPS cannot be reprocessed in Aotearoa and likely ends up in landfill. Damaged EPS is hard to handle, easily blown away, and poses an environmental risk, especially when reused outdoors or for non-packaging purposes.

Anecdotal evidence has highlighted that much reuse of EPS within Aotearoa results in negative end of life outcomes. Material is either reused until it is contaminated and sent to landfill, or damaged and leaked to the environment. Steps should be taken to ensure that any reuse of EPS is within a formal system where its use, reuse, and recovery is properly managed.

8.3.3 Opportunities

- Formalising informal reuse between/within businesses can help to ensure that EPS packaging is reused for the same purpose, over a certain number of times (or length of use), and managed appropriately at end of life. This would help to extend the product's lifespan, reduce the need for new packaging to be produced, and minimise waste to landfill.
- Clear guidelines regarding how to return material and acceptable standards of material would support businesses with formal reuse systems in determining when to end reuse ahead of material becoming too contaminated for recycling. This would ensure positive end of life outcomes for reused material.
- Product stewardship would help to minimise informal reuse as it would provide both businesses and consumers with an easy to access, more appropriate option for managing material. Providing clear guidelines regarding how to return material, acceptable standards of material, and the benefits of engaging with product stewardship would help to promote recovery over informal reuse.
- 'Gamification' could be used to promote material recovery rather than informal reuse. For example, points could be awarded to consumers for the return of clean, dry, tape free EPS through the product stewardship scheme. An app could be used to highlight to the consumer the impacts of their efforts based on the points they earn. Awareness of the impacts made can help consumers to hold themselves accountable for reusing and recovering material responsibly.

Recommendation 8: Clear guidelines should be provided highlighting how to engage with the Product Stewardship Scheme. This should include information regarding drop off/pick up options and acceptable material standards.

Recommendation 9: Additional strategies should be used to boost correct engagement with the scheme. 'Gamification' and rewards would help to incentivise material recovery of clean, dry, non-contaminated EPS packaging.

8.3.4 Rethink/Redesign for Reuse

A global scan highlighted that there could be scope to improve packaging reuse by replacing EPS with a more durable alternative for some B2B deliveries. Icelandic business 'Saeplast' [15] produce insulative PE boxes that are designed to be reused for deliveries of chilled produce (e.g. seafood) over a period of around 15 years.

Drawbacks to systems such as this include increased economic and environmental costs associated with using heavier packaging and cleaning processes. A life cycle analysis (LCA) would be needed to determine whether reuseable alternatives such as these would be more sustainable.

Another challenge identified is that, within New Zealand, many companies primarily export products. Durable reuse systems are not feasible on exports at present as systems are not in place to recover or ensure the reuse of exported packaging. Furthermore, companies that sell to both onshore and offshore markets would need to double their SKUs to provide alternative packaging for local and offshore sales. This is not impossible but would require substantial effort.

[15] https://europe.saeplast.com/en/sustainability-matters-recycling

A product stewardship scheme should allocate a portion of funds to investigating opportunities to advance circularity. This could include feasibility testing for implementing durable reuse systems.

Recommendation 10: Funding for research and development to advance EPS circularity should be allocated through the scheme. This could include feasibility testing for implementing durable reuse systems.

8.4 Recycle

8.4.1 Current State

EPS packaging within New Zealand can be recycled in two ways at present:

- Onshore Recycling
- Offshore Recycling*

Onshore Recycling:

- New Zealand based EPS manufacturers reprocess post use EPS into new product.
- Material recycled onshore mostly goes into construction products that have a % of recycled content.
- A smaller amount of 100% recycled content products are produced onshore, e.g. beanbag fill and drainage products.

Offshore Recycling:

- EPS packaging can be compressed and exported to be reprocessed into new polystyrene products offshore.
- Material recycled offshore goes into products with 100% recycled content.
- These products can be recycled again at their end of life.

*A detailed account of the onshore and offshore recycling processes can be found in the 'Opportunities - Reprocessing' section, page 32.

No nationwide, coordinated system of recovery exists. Material is currently recovered through the following systems:

- Expol currently run an EPS take back scheme to recover material for recycling. Post consumer EPS is collected in cages at participating retailers/CRCs. Expol collect the recovered material to be recycled into new products. When Expol's capacity to reprocess the recovered material is met, the remainder is compressed and exported for recycling offshore.
- Some other EPS manufacturers accept drop offs of post use EPS packaging for recycling into new products or compression and export.
- Several larger retailers have their own compressors to manage EPS packaging from their sites. Some also take back EPS packaging from deliveries for compression and export.
- Waste contracts support further B2B EPS recovery for compression and export.
- Some CRCs and WTSs accept EPS drop offs. This is typically delivered to recyclers for compression and export.

*See recovery locations on page 21.

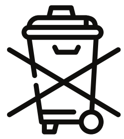
8.4.2 Challenges to Recycling

EPS is technically 100% recyclable. However, we see a gap between the volume of EPS packaging used in NZ and the volume recycled. There are many challenges that impact EPS recovery and recycling rates – the key challenges identified by the PSWG were: Collection, Contamination, and End Markets.

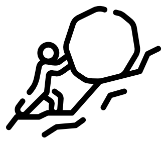
<u>Collection Systems:</u>

The lightweight, bulky, and crumbly nature of EPS makes it difficult to collect and transport due to the following issues:

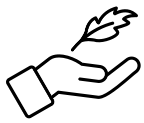
- EPS is not accepted through kerbside recycling as it takes up too much space, blows away easily, and crumbles to mix with other materials, negatively impacting material sorting.



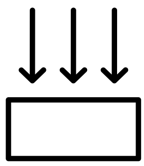
- Finding suitable recovery locations is challenging. A contained space, freedom from contamination, and protection against weather are all required. The collection format must meet specific site requirements.



- The lightweight nature of EPS makes it an efficient packaging material. However, it is inefficient to transport EPS for recycling as it takes a lot of space to move low weights of material.



- Compression can help to increase efficiency. However, compressed material cannot be recycled onshore at present. All EPS packaging destined for onshore recycling must be transported in its bulky format. In addition, compressors are large, expensive, and require time and energy to run. Whilst big retailers can make use of these, it is not feasible for smaller facilities.



- New Zealand's population is spread across a broad geographic area. In urban areas, there is sufficient material in close enough proximity to recyclers to make recovery feasible. Rural locations, such as the West Coast of the South Island, generate relatively low volumes of material and are far away from recyclers and reprocessors. The economic and environmental impacts of recovery are high for these locations.

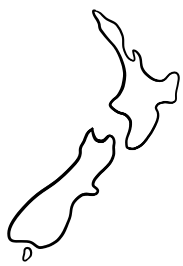


Figure 19: The bulky and crumbly nature of EPS make it difficult to contain and can lead to pollution.

Contamination:

Whether reprocessing on or offshore, EPS must be recovered as a single, clean stream of material. Contamination impacts EPS packaging recycling due to the following issues:

- Adhesives, tapes, and labels are often 'designed in' to packaging. These items clog up recycling machinery and impact the quality of recycled material. They are all contaminants that must be removed before EPS is recycled.

- Dirt, dampness, odour, and biological materials can contaminate EPS packaging through use. These contaminants can impact the recycling process, damage machinery, and impact the quality of recycled content. EPS must be well sorted to ensure that material with too much contamination is cleaned (where possible) or removed.

- Similar looking materials such as expanded polyethylene (EPE), expanded polypropylene (EPP), and extruded polystyrene (XPS) are also contaminants that must be removed before reprocessing. Although XPS is also a polystyrene, it cannot be compressed alongside EPS.

Figure 20: Top to Bottom; tape; biological material; residues; XPS; EPP; and EPE are all contaminants.

End Markets

Secure end markets are needed to ensure that material recovery is sustainable. Most recycled content EPS products produced onshore do not contain 100% recycled content. Consequently, onshore recycling capacity is limited. Local manufacturers would prefer to reprocess their own material first before tackling imported product. New Zealand is therefore reliant on offshore recycling for managing EPS packaging.

8.4.3 Recovery Opportunities

While EPS can be challenging to collect, a range of options can be used to meet the needs of specific collection locations and applications. Selection of the most appropriate methods of storing, handling, and transporting material needs to be done on a case-by-case basis.

Figure 21: Collection Cage

Cages:

EPS collected through the Expol take back scheme is gathered in large cages. These cages are surrounded by boards with visual aids highlighting which material should be placed inside. They are colour coded in line with the Standardised Colours of Rubbish and Recycling Bins [16]. This supports reduced contamination.

The cages have wheels making them easy to move. This is important for in store take back where space is limited, and the most appropriate collection location may change from day to day.

Using bags inside these cages supports containment of any crumbled EPS bead. The cages are best suited for use in enclosed areas with regular material collection. This ensures that material is not contaminated, or is not leaked to the environment via the open top.

Bins:

Te Whatu Ora Capital and Coast reported collecting EPS packaging in large bins with closeable lids. As the holding docks where the material is gathered can be draughty, the lids are important to secure material. Good volumes of EPS can be collected in these bins.

Signage on the bins, staff training, and rewards could help to ensure that only correct items are added to the bins and lids are shut between use. Bulky bins such as these are best suited to locations with larger areas assigned for waste collection.

Figure 22: Enclosed Bin

Figure 23: Mattress Bag

Bags:

In the UK, department store 'John Lewis' commenced a scheme to take back EPS packaging from whiteware deliveries. They collected the material in old mattress bags to make sure it would not crumble and leak during transit. This was a good option for them as it made use of another of their waste streams.

Material may need to be broken up in order to fit into bags. This should only be done indoors (e.g. within the delivery building or in the back of trucks) to ensure that any crumbled EPS can be quickly contained and properly disposed of.

EPS can also be collected and stored in bulk bags. These bags can be sourced second hand, making use of a post-industrial, difficult to recycle waste stream. They are compact to store away when empty, so multiple bags can be kept on-hand for use when needed. This makes them useful for small or busy sites where EPS volumes vary. They are also easy to collect as forklifts can be used for loading on to trucks.

Figure 24: Bulk bag

Collection in bulk bags is best suited to locations that already have access to a supply of bulk bags as a waste stream. To avoid material leaking out or contaminants leaking in, bulk bags should be used indoors or in conjunction with a system to secure the bags (e.g. Velcro straps).

[16] https://www.wasteminz.org.nz/files/Behaviour%20Change/Bin%20and%20lid%20colours%202022-2.pdf

Figure 25: Hot melt compactor

EPS Compressors:

Compression is an effective way to improve the efficiency of EPS storage and transportation.

Hot melt compressors crush EPS into pieces which are then melted and formed into hard bricks. This process reaches a compression ratio of up to 90:1.

Cold press compactors also crush EPS before pressing the material into tight blocks.

However, they do it without melting of the polystyrene meaning a lower density is achieved in the final brick. These machines reach a compression ratio of up to 50:1.

Figure 26: Cold press compactor

In addition to saving space and minimising the risk of environmental leakage, compressed material is more efficient to transport. This makes shipping overseas more feasible and allows us to access international reprocessing options.

Cardboard compactor:

Cardboard compactors have been used used in New Zealand to compress EPS for transport to recyclers. Cardboard compactors work by using a hydraulic press to compress large volumes of material into dense, tightly-bound bales for easier storage, transport, and recycling. This reduces the space required and improves overall efficiency in waste management.

Figure 27: Cardboard compactor

Cardboard compactors do not compress EPS as effectively as hot melt or cold compress machines, but they do help to make transport to recyclers more efficient and recyclers are able to further compact the material ahead of export. Cardboard compactors are cheaper to purchase than hot melt and cold compress machines, and many businesses using EPS packaging will already have them. They are commonly found in supermarkets, hospitals, and large retailers.

EPS compressed through a cardboard compacter may be able to be recycled into new products onshore, but feasibility testing is needed to ensure the beads are not too damaged through this process.

Figure 28: Mobile compactor

Mobile Compression:

Companies such as Foam Muncher in Australia have introduced technology that chops and compresses EPS inside a mobile operation. EPS is fed into the trucks on a conveyor belt where it is dropped into a grinder and then a compactor.

This technology enables smaller companies to benefit from more efficient transportation without having to buy compactors themselves. It would also support rural and remote areas in engaging with material collection.

Currently, this technology is not utilised in New Zealand, although anecdotally there is some interest from waste companies. Further analysis and cost/benefit analysis is required for individual companies to determine commercial feasibility. While potentially viable, set up of such a collection method would require funding support or secure contracts. An application could be made to the Waste Minimisation Fund. A product stewardship scheme should also set aside funding for R&D into new technologies such as these.

Static Compression Stations

In the USA, Foam Cycle [17] provide a collection and compression service for EPS. EPS is dropped off into an enclosed bin which is located next to a static compression unit enclosed in a container. The staff managing the material drop off locations are able to compress the material on site before it is shipped to recyclers, resulting in more efficient transport.

Figure 29: Local compression station.

This system would be well suited to material collected through CRCs or in parking lots close to big box retailers. The material would have to be shipped offshore for reprocessing and staff would need to be employed and trained to manage the collection stations.

Chemical Decomposition on Truck

Another company attempting to increase the efficiency of transporting EPS are WIT Holdings [18] in Hong Kong. Their 'Ultimo Technology' uses chemicals to dissolve EPS, claiming that it can process over 50kg of EPS in an hour. The dissolved solution is then delivered to a plant where it is filtered, extracting any additives and producing raw rPS. They state that the rPS output has a purity of 99.8%.

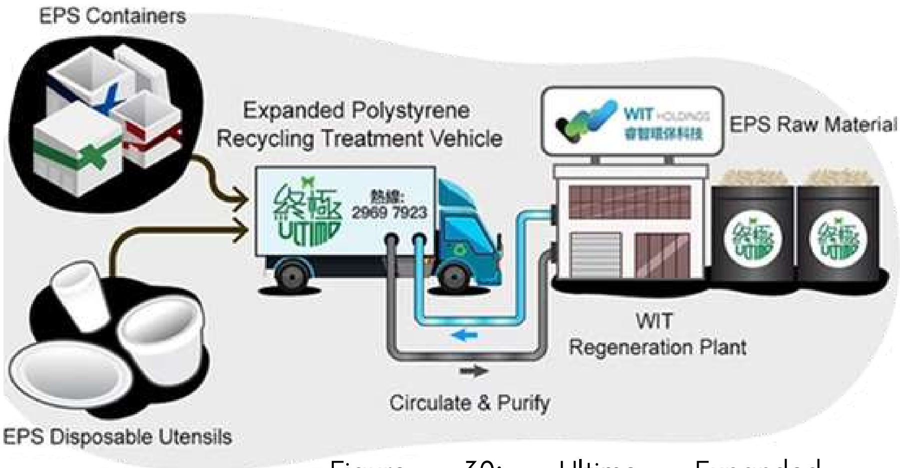


Figure 30: Ultimo Expanded Polystyrene Recycling Treatment Cycle

A benefit from this process is that contamination is not an issue. The company claim that labels and tapes can remain intact. This would save costs from sorting and removing contaminants from collected EPS.

The website shows examples of the technology in action. Figure 30, for example, shows the residual tapes left over from the dissolution of fish boxes at a market in Cheung Hang. However, it is unclear if the technology is commercial at present.


Figure 31: Residual waste from fish box dissolution

[17] https://www.foamcycle.com/
[18] https://www.witholdings.info/

There is also no information regarding the nature and safety of the solvents being used to dissolve the EPS. This raises a number of questions which need further investigation to ensure viability and no unintended consequences:

- Is the solvent considered hazardous, or a dangerous good, and what health and safety implications are there in terms of material handling and use in a moving vehicle?
- How are additives, such as flame retardants, dealt with and what impact do they have on the process or the final recovered materials?
- What equipment is required to filter the polystyrene molecules from the solvent?
- How are the recovered polystyrene molecules reformed into a usable material (e.g. pellets) for plastics conversion operations? Is repolymerisation required?

8.4.4 Mechanical Recycling Opportunities

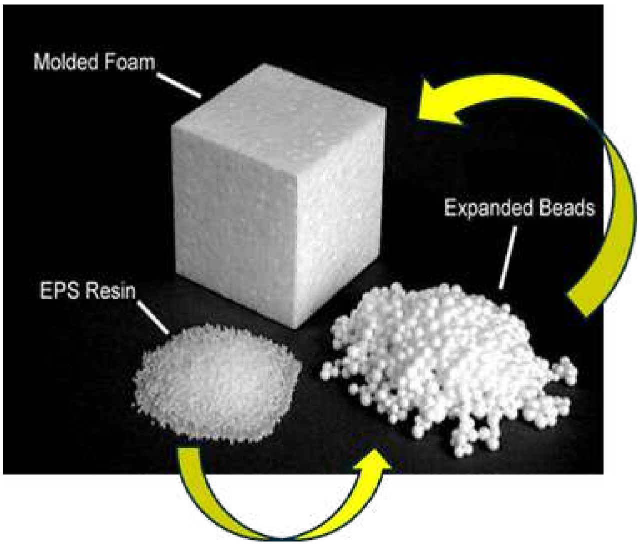


Figure 32: EPS Manufacturing Process

Onshore Mechanilcal Recycling

EPS manufacturers in New Zealand can recycle EPS through their production process, which had two stages:

- EPS resin is treated with steam to create pre-expanded beads.
- The pre-expanded beads are then placed within a mould and treated with more steam until fully expanded into a moulded foam.

Post use EPS foam can be broken up and added to the second stage of production along with virgin pre-expanded bead. The virgin bead expands around the post-use material to form products with a percentage of recycled content.

A small portion of EPS recycled onshore can be used in 100% recycled content products (such as bean bag fill and EPS drainage products). Most EPS recycled onshore is incorporated into products with a percentage of recycled contant mixed with virgin bead. As such onshore recycling capacity is limited and manufacturers compress and export excess material.

As EPS recycled onshore replaces new expanded bead, the closed cell structure of the beads cannot be damaged and it not possible to compress EPS using a hot melt or cold compact compressor beforehand. EPS is transported to reprocessors in its bulky format, making onshore recycling best suited to material collected close to manufacturers. Working group conversations suggested that a cardboard compactor may be suitable for reducing the volume of EPS without damaging the beads. This could help to improve transport efficiency.

Figure 33: Pre-expanded Bead

Contaminants cannot be present in this recycling process. Manual labour must be used to sort and clean material for reprocessing, this impacts cost efficiency and detracts from manufacturers main business. This reprocessing option is therefore best suited for material used in clean, dry applications.

Offshore Mechanical Recycling

EPS can be exported and recycled offshore.

First, the EPS is compressed to make it more efficient to transport. The compressed EPS is then shipped offshore to a reprocessing facility to be repelletised.

The recycled polystyrene (rPS) pellets are then shipped to facilities where they are used to produce new products at up to 100% recycled content.

Figure 34: Offshore Recycling Process through Intco [19]

Figure 35: 100% recycled content PS products [20]

New Zealand is reliant on this export market as capacity to reprocess EPS onshore is limited. While this means that material must be shipped long distances, sometimes through multiple countries, to be reutilised, it is preferential to the recovered material ending up in landfill and the resources being lost to the economy.

At present there are good international markets for polystyrene. With the global focus on a circular plastics economy and future tools to drive this change (such as the global plastics treaty), we expect this demand to remain sustainable. Transport packaging (cold chain and protective packaging) is now considered by UNEP to be recyclable as per their brief to the global treaty participants [2].

Under the Basel Convention, polystyrene is one of the plastic wastes that can be shipped without Prior Informed Consent (PIC) providing it is destined for 'recycling in an environmentally sound manner and almost free from contamination and other types of wastes' [21]. Third-party verification of the reprocessing facility is not necessarily occurring in practice. Monitoring and auditing of receiving offshore facilities by the scheme, is therefore recommended to ensure no unintentional harm.

[19] https://www.intcorecycling.com/eps-foam-recycling-solutions.html
[20] https://www.intcorecycling.com/Reuse-Waste-EPS-Foam.html
[21] https://www.basel.int/Portals/4/download.aspx?d=UNEP-CHW-IMPL-CONVTEXT.English.pdf, Annex II

Circular Mechanical Recycling

Desk research also highlighted a possible option for EPS to EPS mechanical recycling [22].

Useon, a polymer extrusion equipment and process technology provider, claim that they are able to support EPS-to-EPS recycling through foaming extrusion technology.

Figure 36: Useon's EPS to EPS Extruder.

The process is laid out as follows:

- Compressed and crushed EPS waste is fed into a twin-screw extruder.
- Hexane foaming agent is injected into the material though the extrusion process.
- The material is cooled for underwater pelletizing.
- The pellets produced are similar to brand new EPS raw materials and contain foaming agents.
- The recycled EPS pellets containing foaming agents can be used like EPS new materials.

Useon claim that many of the performance characteristics of the recycled EPS pellets are even better than those of EPS new materials.

More information is required to determine whether this technology would be a feasible solution within New Zealand. Discussions with New Zealand based manufacturers highlighted that this is a relatively new technology that is likely to advance.

8.4.5 Advanced Recycling

Chemical Conversion

Conversion processes, such as gasification, hydrothermal liquefaction and pyrolysis, turn used plastic into virgin quality raw material feedstocks (gas, oil, or naptha) using heat or catalytic processes. The gas/oil output can then replace extracted fossil feedstocks as fuel and in the production of new polymers [23].

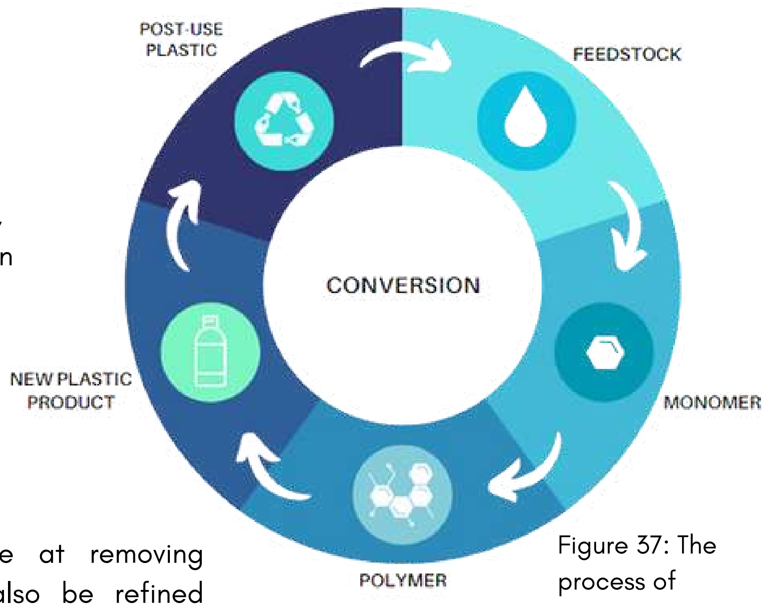


Figure 37: The process of conversion

Conversion processes can be effective at removing contaminants. The end products can also be refined further to remove any remaining impurities. As an example, biologically contaminated EPS from the seafood and medical sectors could be safely reprocessed through conversion, providing safe handling methods for collection and transport were set up.

[22] https://www.useon.com/eps-recycling/#:~:text=The%20EPS%2Dto%2DEPS%20recycling,material%20during%20the%20extrusion%20process.
[23] https://cefic.org/a-solution-provider-for-sustainability/chemical-recycling-making-plastics-circular/chemical-recycling-via-conversion-to-feedstock/waste

However, the process to turn the gas/oil produced back into plastics (repolymerisation) is costly and energy intensive. While typically producing a lower carbon footprint than for virgin resources, advanced recycling is more intensive than mechanical recycling. It is therefore the secondary option, unless there are specific reasons for its use such as requiring virgin-quality materials for food or medical grade applications, or removal of additives.

While conversion technologies provide the opportunity to create new plastics, the gas/oil produced may also be used as fuel, a form of 'waste to energy'. This is not circular as it extends the use of the molecules by only one extra use.

This technology does not exist commercially in New Zealand at present. However, hydrothermal liquefaction [24] and pyrolysis [25] technologies are being set up in Australia. With a refinery and cracker in Melbourne, the output materials are able to be turned back into plastics and other chemical feedstocks through existing systems. The main focus for these systems is recovery and reprocessing of the polyolefins (polyethylene and polypropylene) at present as they provide the highest quality output for the lowest cost with current technologies. Tuning would be required to run polystyrene, likely in its own facility. It is felt that this is unlikely in Australasia in the near future due to the relatively low tonnages of materials in market, and the impact this would have on economic viability.

Figure 38: Licella's Hydrothermal Liquefactation Plant - New South Wales.

Export of compressed EPS further afield would likely be required to utilise these recycling options.

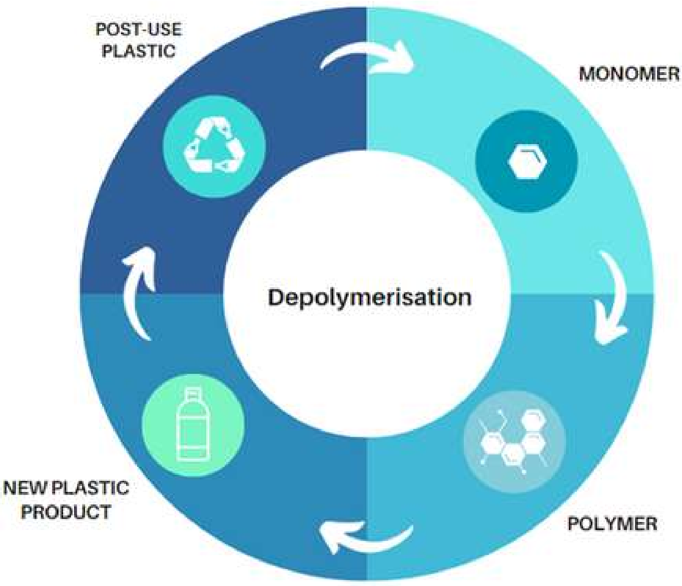


Figure 39: The process of Depolymerisation

Depolymerisation

Depolymerisation (also known as chemolysis or solvolysis) uses chemicals, solvents, and heat to break used plastics back down to monomers. These can then be used again in the raw materials production process as secondary feedstocks.

As with conversion, a benefit of the depolymerisation process is its ability to take contaminated waste streams and turn them into virgin quality products. However, as the plastics processed are returned to monomers, repolymerisation would be required to produce a circular system.

This technology is not available in New Zealand and is limited at present for EPS globally.

[24] Licella Feasibility Study
[25] https://www.vivaenergy.com.au/media/news/2024/viva-energy-and-cleanaway-team-up-to-address-hard-to-recycle-plastic-waste

Dissolution

Dissolution uses heat and solvents to dissolve plastics into a solution of the polymers and additives they were made from. The additives are separated from the polymers, and the polymers are recovered from the solution. The polymer molecules (e.g. polystyrene) remain whole, and can then be used to produce new plastic products.

As the polymer chains are unbroken, - no additional energy needs to be used to repolymerise the output. As with conversion and depolymerisation, the process can tackle contaminated EPS streams and turn them back into virgin like recycled polystyrene. It is worth noting that the output is polystyrene bead, not expanded polystyrene bead. The output could only be used to produce non-expanded polystyrene products.

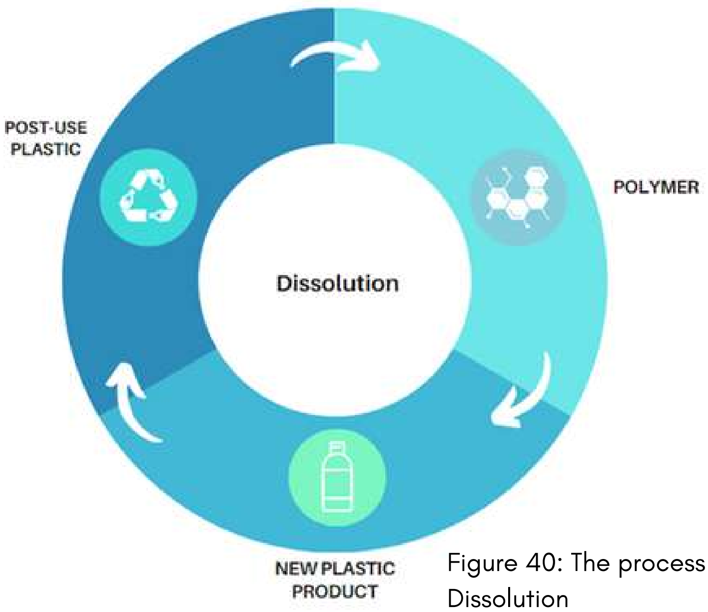


Figure 40: The process of Dissolution

The outputs of this process are polymers, additives, and chemicals. Whilst reuse/recycling of the extracted additives/additives may be possible, safe disposal of any unusable additives and chemicals would need to be ensured to avoid unintended negative consequences.

This technology is being used to manage EPS in Europe [26]. At present, we do not have access to this technology in New Zealand.

In 2023, a trial was commenced to test the feasibility of this process for managing EPS in NZ. The EPS Product Stewardship Working Group connected with those running the trial and stakeholders from the Higher Risk of Contamination working group collected material to be processed. Unfortunately, the company running the trial ended operations and the trial did not reach completion.

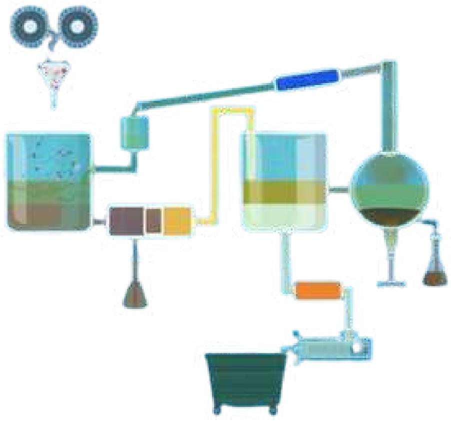


Figure 41: CreavSolv's Dissolution Process

Although this may be technically feasible within New Zealand, non-expanded PS in only used in a few specific applications onshore including:

- Packaging, which is in process of being phased-out, or
- Medical, where very specific properties and regulatory testing must be carried out prior to use.

As such, this may not be an economically feasible onshore option or output rPS would need to be exported.

[26] https://www.creasolv.de/en/the-process.html

8.4.6 Analysis of Recovery & Reprocessing Options for EPS Product Stewardship in Aotearoa New Zealand

The PSWG identified a broad range of recovery and reprocessing options, each with its own benefits. To determine which of these could support EPS product stewardship in New Zealand, the options were analysed in the local context. Access, whether onshore or offshore, was assessed and the options were categorised as 'available,' 'possible,' or 'unlikely.' The Aotearoa-specific benefits and challenges of each option were then summarised.

Available

Containment	**Cages**: Stores EPS **Benefits**; Low cost; Easy to install/move; Can display visual aids; Easy to use. **Challenges**; Contamination/leakage risk as not enclosed; Fills quickly; Bulky	**Bins**: Stores EPS **Benefits**; Low cost; Can display visual aids; Easy to install/move; Closable lids. **Challenges;** Fills quickly; Large/bulky; Contamination/leakage risk if left open.	**Bags**: Stores EPS **Benefits**; Can be secured (zip or straps); Low cost; Easy to install/move; Easy to store when empty **Challenges;** Easy leakage if not secured or damaged; Fills quickly
Compaction	**Hot Melt compactor**: Compresses EPS **Benefits**; Improves transport efficiency; 90:1 compression; Opens access to offshore markets **Challenges;** Costly to purchase and install; Large; Not compatible with onshore recycling; Clean, dry material only	**Cold compactor**: Compresses EPS **Benefits**; Improves transport efficiency; 50:1 compression; Opens access to offshore markets; Handles some moisture **Challenges;** Costly to purchase and install; Large; Not compatible with onshore recycling	**Cardboard compactor**: Compresses EPS **Benefits**; Many businesses have them; Cheaper compactor; Handles some moisture; Improves transport efficiency; Compatible with offshore recycling. **Challenges;** Large; Lower compression compacter; Unsure if compatible with onshore recycling.
Reprocessing	**Offshore recycling**: Reprocesses EPS **Benefits**; Manages majority of New Zealand's EPS recycling; Capacity exists for additional material to be recycled offshore; Material is purchased - offsets some costs; End product is 100% recycled **Challenges;** Uncontaminated material only; Emissions produced from overseas transport; Export markets can be variable.	**Onshore recycling**: Reprocesses EPS **Benefits**; Material retained in NZ economy; Lower emissions than overseas transport; Reduces imported raw material. **Challenges;** Uncontaminated material only; Virgin bead usually required as well; Limited capacity; Challenging to make cost effective.	

Possible

Compaction

Mobile Compactor: Compacts & transports EPS

Benefits; Improves transport efficiency; Saves time; Supports rural collection.

Challenges; Feasibility study needed; Costs required to set up; Not compatible with onshore recycling.

Static Compactor: Collects & compresses EPS

Benefits; Easy access & use; Improves transport efficiency; Takes up relatively small space; Support rural collection.

Challenges; Costs required to set up; Not compatible with onshore recycling; Staff employment and training needed to run.

Reprocessing

Dissolution - Globally: Reprocesses EPS

Benefits; Virgin grade output; Can be used in 100% recycled content product; Contaminated material accepted; Repolymerisation not required.

Challenges; rPS output - additional steps required make EPS; Feasibility study needed to determine access/effectiveness.

Conversion - Globally: Reprocesses EPS

Benefits; Virgin grade output; Can be used in 100% recycled content product; Contaminated material accepted.

Challenges; Repolymerisation required; Feasibility study needed to determine access/effectiveness.

Circular Mechanical Recycling: Reprocesses EPS

Benefits; Fully circular system; Material retained in NZ economy; Lower emissions than overseas transport; Reduces reliance on imported raw material.

Challenges; Feasibility study needed to determine access/effectiveness; Costs required to set up

Unlikely

Reprocessing

Conversion - Onshore: Reprocesses EPS

Benefits; Virgin grade output; Can be used in 100% recycled content product; Handles contamination.

Challenges; Repolymerisation required; Onshore access unlikely.

Dissolution - Onshore: Reprocesses EPS

Benefits; Virgin grade output; Can be used in 100% recycled content product; Handles contamination; Repolymerisation not required.

Challenges; rPS output - further steps needed to convert this to EPS bead; Onshore access unlikely.

Depolymerisation: Reprocesses EPS

Benefits; Virgin grade output; Can be used in 100% recycled content product; Handles contamination.

Challenges; Repolymerisation required; Access on or offshore is unlikely

Mobile Dissolution: Transports & reprocesses EPS

Benefits; Virgin grade output; Can be used in 100% recycled content product; Handles contamination; Repolymerisation not required.

Challenges; Health and safety concerns; Access on or offshore is unlikely.

Through this analysis the group identified that there is not a 'one size fits all' recovery and reprocessing option for EPS in Aotearoa. The following factors all impact which material recovery and reprocessing options are most suitable:

- Material location and use (e.g. type of facility, type of product packaged, etc.)
- Collection site size and use (e.g. warehouse, CRC, medical centre, large/small retail, grocery, etc.)
- Collection site location (e.g. urban, rural, close to manufacturer, close to port, etc.)
- Availability of funding (e.g. industry funding, govt funding, product stewardship funding, etc.)
- Access to technologies (e.g. availability of technologies on and offshore)
- Effectiveness of technologies (e.g. output type, output quality, sustainability, demand, cost effectiveness etc.)

To support recovery of as much material as possible, including material used in diverse applications and locations, EPS product stewardship should make use of a range of recovery and reprocessing options.

Whilst a range of recovery and reprocessing options are currently available, further opportunities are possible in the medium term. To continue advancing towards improved circularity, an EPS product stewardship scheme should set aside some funding for R&D to investigate new, potentially more effective/sustainable technologies. These could include new recovery and reprocessing options.

There is a risk of material contamination and leakage at all handling points. It is important that a product stewardship scheme promotes proper handling at recovery points through training, proper signage, and auditing. Steps such handling materials indoors, quickly containing crumbled material, avoiding contaminants at recovery points, and properly sorting materials will help ensure safe recovery and maximise reprocessing.

Recommendation 1: A range of recovery and reprocessing models and technologies will need to be investigated and employed to support improved recovery and recycling for EPS packaging used across different sectors. This to allow for variances in contamination levels and local infrastructure.

Recommendation 10: Support Research and Development (R&D)
Include allowance to support R&D into circular opportunities such as reuse systems and recovery/reprocessing technologies.

Recommendation 11: Promote proper handling at recovery points.
Mitigate contamination and environmental leakage at recovery points by providing training and consistent signage.

8.5 Disposal

Disposal sits at the bottom of the waste hierarchy. However, it is important to consider how product stewardship will work towards mitigating the risk of improper disposal, such as illegal dumping, and support managed disposal of EPS packaging where appropriate.

There is colloquial evidence of EPS entering the environment through illegal dumping in Aotearoa. As the material is lightweight and crumbly, it is easily dispersed by weather. The material is likely to break apart and be blown into waterways, risking ecosystems and animal health.

Various measures have been taken to tackle this issue. For example, in Auckland, manufacturers will collect EPS from the environment when delivering construction products to building sites. However, recovering illegally dumped material only manages the impacts of an on-going issue and not all illegally dumped material will be discovered. By creating an easy to access and use material collection system, product stewardship can help to reduce the volume of illegally dumped material. In addition, through the mandated PPPS, recovery and reprocessing costs will be covered by liable parties for in-scope material. This removes the costs barrier, further supporting proper disposal.

The following steps could help to ensure that a product stewardship scheme helps to recover EPS correctly and reduces illegal dumping:

- Implement easy to access and use collection points.
- Employ a strong communications plan to educate users about how to properly dispose of material.
- Use gamification to incentivise the use of EPS collection points.
- Utilise scheme funding to remediate and mitigate environmental pollution.

Recommendation 1: A range of recovery and reprocessing models and technologies will need to be investigated and employed to support improved recovery and recycling for EPS packaging used across different sectors. This to allow for variances in contamination levels and local infrastructure.

Recommendation 8: Clear guidelines should be provided highlighting how to engage with the Product Stewardship Scheme. This should include information regarding drop off/pick up options and acceptable material standards.

Recommendation 9: Additional strategies should be used to boost correct engagement with the scheme. 'Gamification' and rewards would help to incentivise material recovery of clean, drop, non-contaminated EPS packaging.

Recommendation 12: Support opportunities to mitigate environmental harm by including allowance to develop or support initiatives that mitigate or remediate EPS environmental pollution.

9. Trans-Tasman Alignment

The PSWG felt that it was important to consider Australia's plans for EPS to ensure alignment for trans-Tasman trade. Aligning with Australia could help to streamline compliance for businesses operating in both markets, ensure consistent environmental standards, and optimise cross-border waste management. This would benefit industry and consumers by simplifying regulations, enhancing consumer awareness, and improving logistical efficiency. Coordinated schemes also facilitate better use of shared recycling infrastructure and supply chain management, making stewardship efforts more effective and economically viable for both countries.

In 2022, Western Australia announced plans to ban Expanded Plastic Packaging [27] including EPS, EPE, and EPP. Within the PSWG, concerns arose regarding the negative externalities that could occur as a result of removing or replacing EPS from certain products, as shown in the *Phaseout of Business-to-Consumer EPS Protective Packaging* [1] report's traffic light system (Appendix B). However, since the announcement of the ban, a list of exemptions that corresponds well with the traffic light system has been produced. The result is that the WA EPS Ban will enforce removal of EPS from product that the PSWG would recommend a voluntary ban on within New Zealand.

In late 2022, APCO published their *Roadmap to Phaseout B2C EPS* [28]. This also aligned with the PSWG, highlighting where EPS can be safely removed and the need for product stewardship where there are no viable alternatives. The roadmap set out plans for a voluntary, industry led approach to product stewardship for EPS in Australia.

Although the paths have varied, the outcomes for Aotearoa and Australia have been similar. A summary is shown in Figure 42.

Figure 42: New Zealand and Australia Plans for EPS Packaging

	VOLUNTARY	MANDATED
AOTEAROA	Phase out of EPS where feasible	Plastic Packaging Product Stewardship
AUSTRALIA	Phaseout of EPS* where feasible and product stewardship	Phaseout of EPS where feasible**

*Outside of Western Australia
**In Western Australia

[27] https://plasticsbanwa.com.au/items/#epp
[28] https://documents.packagingcovenant.org.au/public-documents/Roadmap%20to%20Implement%20the%20National%20Phase%20Out%20of%20Business-To-Consumer%20EPS%20Packaging

The design of product stewardship for EPS in Aotearoa and Australia has run concurrently through the PSWG and APCO respectively. The process thus far has been similar, first addressing volumes data and material flows before considering scheme functionality. It is recommended that a product stewardship scheme for EPS in New Zealand maintains strong lines of communication with APCO as they progress their plans.

Recommendation 13: Maintain communication with Australian partners to support scheme efficiencies and Trans-Tasman trade.

10. Next Steps

The PPPS have now finalised their Scheme Design Proposal for consultation. A series of briefings was held in order to gather feedback. This assisted in completion of the PPPS co-design project and recommendations will be put forward to Government.

Once the PPPS recommendations are put forward, there may be a significant wait before a scheme is implemented. The recommendations will undergo a review process by government. If the recommendations are accepted, the government then needs to design and draft regulations, conduct public consultations, and secure legislative approval. After this, an implementation plan needs to be developed, and the scheme can begin to be established. A 6 month international notification period is also required under World Trade-Organisation rules.

Intermediary action could be taken to commence the recovery and reprocessing of EPS during this potentially long process. As EPS is recyclable, steps could be taken to preemptively develop recycling pathways to create a system that works for users of EPS ahead of the PPPS coming into effect.

In addition, the PSWG have highlighted opportunities to recovery and reprocess EPS outside of the scope of the proposed PPPS scheme design. Non-contaminated EPS can be recovered from both the medical and seafood sectors. Setting up industry led product stewardship in advance of the PPPS could help to ensure that the scheme meets the industry's need and tackles material outside of the scope of the PPPS.

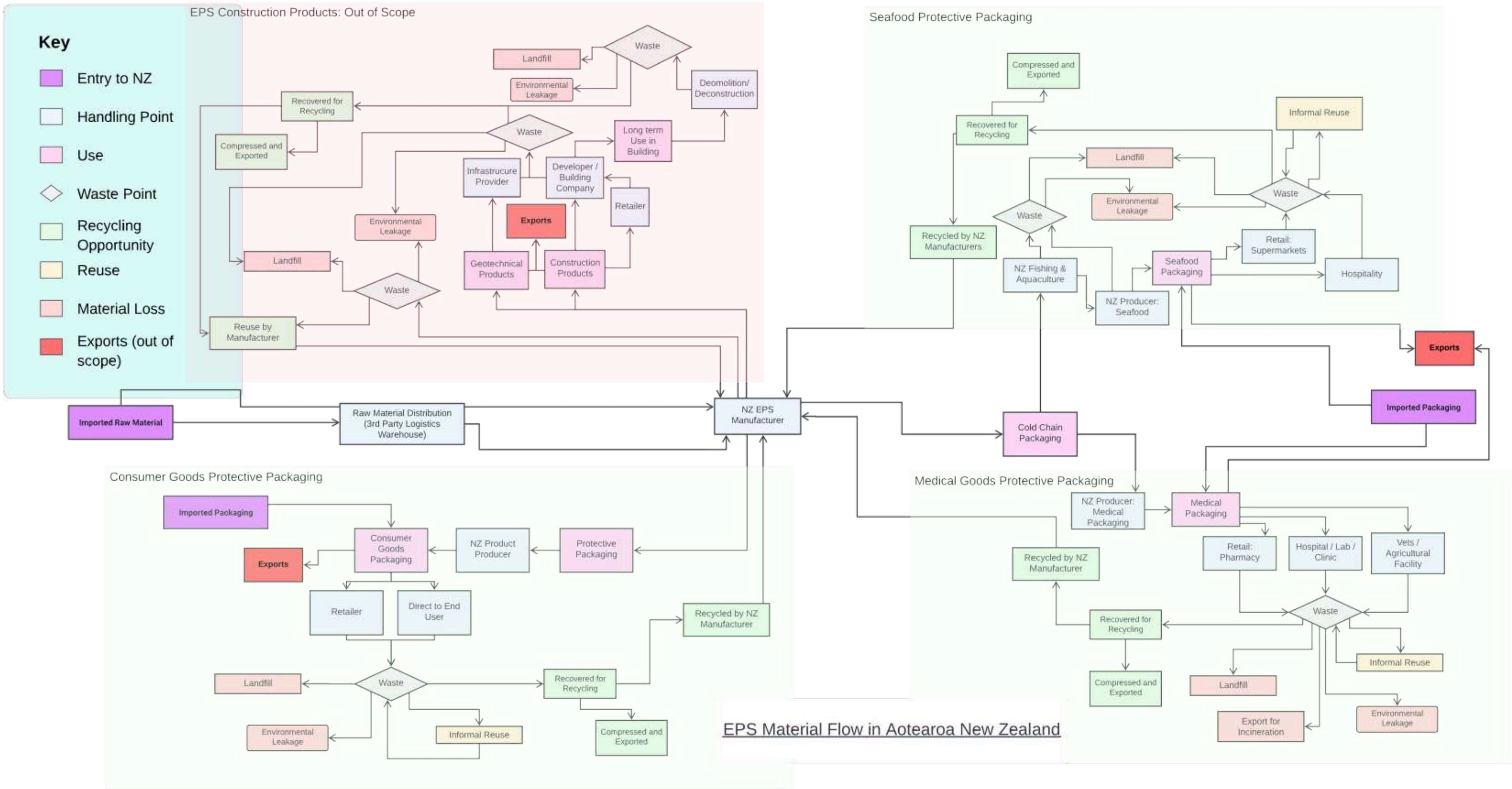
Additional analysis is needed to determine the options for setting up an industry led scheme ahead of the PPPS. This should include analsysis of how an industry led scheme would ultimately fit into the PPPS. It is recommended that this analysis is carried out to determine the opportunity to set up an industry led scheme ahead of the PPPS coming into effect.

Recommendation 14: Work should be undertaken to support the set up of an industry-led scheme ahead of the PPPS in order to establish recycling pathways preemptively and tackle materials beyond the PPPS scope. Additional research is needed to facilitate this, including analysing possible scheme design options, costs to progress, and eventual integration with the PPPS.

11. Appendices

11.1 Appendix A - Initial EPS Material Flow Analysis

The following material flow map outlines the initial analysis by Plastics NZ to provide a starting point to the subgroups.



11.2 Appendix B - Phaseout Options Table from the Phaseout of Business to Consumer EPS packaging Working Group

The following table shows the 2022 Phaseout of Consumer Goods EPS Packaging Traffic Light system identifying where EPS can and can't be safely remove, and where it may be able to be removed with additional R&D.

	Product Applications	Examples Not a comprehensive list of examples for each category	Viable Alternatives Available	Difficulty to phase out Not Possible - NP High - H Medium - M Low - L	Any existing initiatives?	Benefits of Alternatives	Disadvantages of Alternative	Recommended "Traffic Light"	Notes
1	EPS protective packaging for Large Appliances or Electronics (e.g. ≥45kg)	Fridge, Oven, Television, Computer, Large Printers, Heavy Equipment	No viable alternatives	NP	R&D into alternatives such as Honeycomb Cardboard, Moulded fibre, etc	N/A	N/A	Later than 2025 as brands need to continue undertaking R&D into alternatives.	EPS cannot be fully eliminated in large appliances and electronics as shown by R&D efforts into replacements have failed transport testing. Cost, carbon impacts, and shipping efficiency also major factors. Mandated product stewardship for EPS needs to align with declared plastic packaging priority product stewardship framework. Do NOT use EPE, EPP or other foamed plastic as alternatives
2	EPS protective packaging for Fragile or Sensitive Appliances and Electronics	Microwave, Television, Heat pump, Cooktop, Computer, Printer, Solar PV hardware, Gaming	Cardboard, Moulded Fibre	M-H	R&D into alternatives such as Honeycomb Cardboard, Moulded fibre, etc	Higher recycling rates as alternative must be kerbside recyclable Public perception	Larger dimensions / weight – higher climate impacts Higher cost Less protection than EPS – higher rates of product damage/loss Possible use of fibre coating fibre to prevent scuffing	Alternatives may be in development, but brands need time to test.	Refer Decision Tree Do NOT use EPE, EPP or other foamed plastic as alternatives
3	EPS Protective Packaging for Small Appliances and Electronics (e.g. ≤ 10kg)	Electric Jug, Hairdryer, Air Fryer, Vacuum cleaner, Laptop, Toner, Mobile Phone, Handheld Power Tools	Cardboard / Honeycomb Cardboard / moulded fibre, Bubble Wrap	L	Already used in some categories such as coffee makers, toasters, vacuums, laptops, mobile phones	As Group 2 above	As Group 2 above, but while less protection, likely to be suitable for purpose	Able to be phased out	Do NOT use EPE, EPP or other foamed plastic as alternatives

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	Product Applications	Examples Not a comprehensive list of examples for each category	Viable Alternatives Available	Difficulty to phase out Not Possible - NP High - H Medium - M Low - L	Any existing initiatives?	Benefits of Alternatives	Disadvantages of Alternative	Recommended "Traffic Light"
4	EPS Protective Packaging for Fragile or Sensitive Lighting, Homewares and General Merchandise	Glass Lighting, Large Mirrors, Ceramic Ornaments, Art, Musical Instruments, stainless steel sinks	Moulded Fibre, Honeycomb Cardboard, Cardboard, PE Pillows	M-H	R&D into alternatives such as Honeycomb Cardboard, Moulded fibre, etc	As Group 2 above	As Group 2 above	As Group 2 above
5	EPS Protective Packaging for Lighting, Homewares and General Merchandise	Lampshade, Table Lamp, Cookware, Sports Equipment	Bubble Wrap, card/fibre	L	Already being phased out by some suppliers	As Group 2 above	As Group 3 above	As Group 3 above
6	EPS Protective Packaging for Furniture	Flatpack furniture (but excluding glass, ceramic, stone)	Cardboard, Bubble Wrap, Other Foamed Plastics	L	Already being phased out by some suppliers	As Group 2 above	As Group 3 above	As Group 3 above
7	EPS Protective Packaging for Fragile or Sensitive Furniture	Furniture (including flatpack) with large glass, ceramic, or stone panels or tops	Moulded Fibre, Honeycomb Cardboard, Cardboard, PE Pillows	M-H	R&D into alternatives such as Honeycomb Cardboard, Moulded fibre, etc	As Group 2 above	As Group 2 above	As Group 2 above
8	EPS Protective Packaging for Garden/Outdoors	BBQs, Lawnmowers, Larger Power Tools, Pavers, Tiles, Pots, Outdoor furniture	Cardboard	M-H	Trials underway by some suppliers	As Group 2 above	As Group 2 above	As Group 2 above
9	EPS Protective packaging for shipping of consumer goods	Loose Fill EPS (Peanuts) or Void Fill EPS (e.g. Sheets or Blocks)	PE pillows, Bubble Wrap, Shredded Cardboard / Fibre	L	Mostly phased out by suppliers already (except for online orders from O/S)	As Group 2 above	As Group 3 above	As Group 3 above

11.3 Appendix C - Data Analysis

The following table shows the PSWG's data analysis regarding EPS packaging placed on market and recovered for recycling in New Zealand.

Row	Description	Value	Certainty	Year
1	New Zealand EPS bead imported per annum	~9kt [1]	High	2021 - 2023 avg.
2	Construction vs. Packaging EPS ratio for NZ made EPS	~72:28[2].	High	2021
3	NZ Manufactured Packaging per annum (calculated from rows 1 and 2)	~2,520 t	High	N/A
4	Export vs. Onshore Sale Ratio (estimated through cross sector discussions*)	80:20	Medium	2023
5	NZ Manufactured Packaging within NZ Market (calculated from rows 3 and 4).	~504 t	Moderate	N/A
6	On-shore recycling (including packaging and construction material)	~637 t[3]	Moderate	2019
7	Packaging:Construction Product Recycling Ratio (estimated through subgroup discussions)	~70:30	Moderate	2023
8	Estimated on-shore recycling from packaging (calculated from rows 6 and 7)	~450 t	Moderate	2023
9	Off-shore recycling[4] per annum	~780 t	High	2023
10	Australia EPS bead imported per annum	~48kt	High	2023
11	Australia EPS packaging production[5].	~14,000 t	High	2023
12	Australia:NZ population ratio	~5:1	High	NA
13	Australia:NZ EPS packaging production	~5:1	High	NA
14	Australia estimated imported EPS packaging per annum.[6]**	24,000 t	low	2018
15	NZ estimated imported packaging per annum (calculated using 5:1 ratio)***	4,800 t	low	N/A

*Most NZ made EPS packaging is on Seafood, ~90% seafood exported. Smaller percentage of NZ made EPS packaging on other products (wine, biologics, art, etc.) which is exported and distributed locally. Overall export ratio estimated at about 80%.

** This estimate is based on limited data and we expect this to be a minimum. An accurate figure might be between 24,000 tonnes to 50,000 tonnes. More recent figures from APCO suggest closer to the latter.

***Low confidence data, +/- 30% range should be applied.

[1] Estimated figure based on average of import data from the last three years provided by Polymer Agencies

[2] Estimated ratio from EPS Sector Group (https://www.plastics.org.nz/about-us/sector-groups-main/eps-sector-group)

[3] EPS sector group figures circa 2019.

[4] Derived from Intco sales per month 2023 data.

[5] Data provided by APCO 2023

[6] Taken from APCO's 2018 EPS Working Group Report which is no longer available online