PackFlow Refresh 2023: Plastic

A review of the quantity of packaging placed on the market and recycled in 2022 with compliance projections to 2028.

Shannon Moxham, James Skidmore and Peter Mitchell

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PackFlow Refresh 2023: Project Remit

This project seeks to estimate packaging POM and recycling figures, observe changes in packaging flow trends, and assess the UK's compliance position in 2022, and projecting forward to 2028.

This has been achieved by:

- Calculating UK packaging POM (placed on the market) and recycling by material and by industry sector in 2022 to provide a baseline for future scenarios.
- Using relevant data sources and industry insight to estimate by packaging material type on:
    - The total amount of material that is likely to be placed on the market (POM) by sector;
    - The impact of the change in POM on the UK recycling rate;
    - The changes to the level of obligated tonnage; and
    - The scenarios for packaging materials flow and recycling up to 2028.

Scenarios, assumptions, and data sources have been agreed with the steering committee made up of key industry stakeholders representing individual materials and sectors.

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Executive Summary

Introduction

The PackFlow 2023 reports (available here: https://www.valpak.co.uk/knowledge-hub/?category=flow-reports) cover all packaging materials and have been produced to provide industry, Governments, and other stakeholders with evidence to better understand packaging materials flows, packaging materials collection and recycling, and to assess potential compliance risks versus the packaging targets.

The PackFlow 2023 project has two phases:

Phase 1

- Updates the baseline year to 2022 for estimates of packaging materials POM, collections, recycling and end markets (from 2019 in the previous flow reports[1]).

Phase 2

- Develops scenarios for packaging materials flow and recycling up to 2028; and
- Assesses potential compliance risks versus recycling targets for packaging materials.

To support Defra and Governments in their packaging policy work and assist other industry stakeholders, this Phase 1 report focuses on generating robust estimates of UK plastic packaging placed on the market (POM)[2] that are as accurate as is reasonably possible. The report also considers the quantities of plastic packaging recycling, both in the UK and abroad, and provides insights into the end markets and products that are manufactured by plastic recyclers in the UK.

Data robustness assessments have been conducted and error margins are calculated and provided wherever possible throughout report.

Plastic Packaging POM

This project estimates UK plastic POM for 2022 to be 2,082k tonnes (+/- 6%)[3].

This represents a potential decrease of 208k tonnes[4] from the estimated 2019 flow figure of 2,290k tonnes. It is likely that the decrease in plastic packaging POM has been influenced by packaging material light-weighting and a shift in consumer purchasing habits.

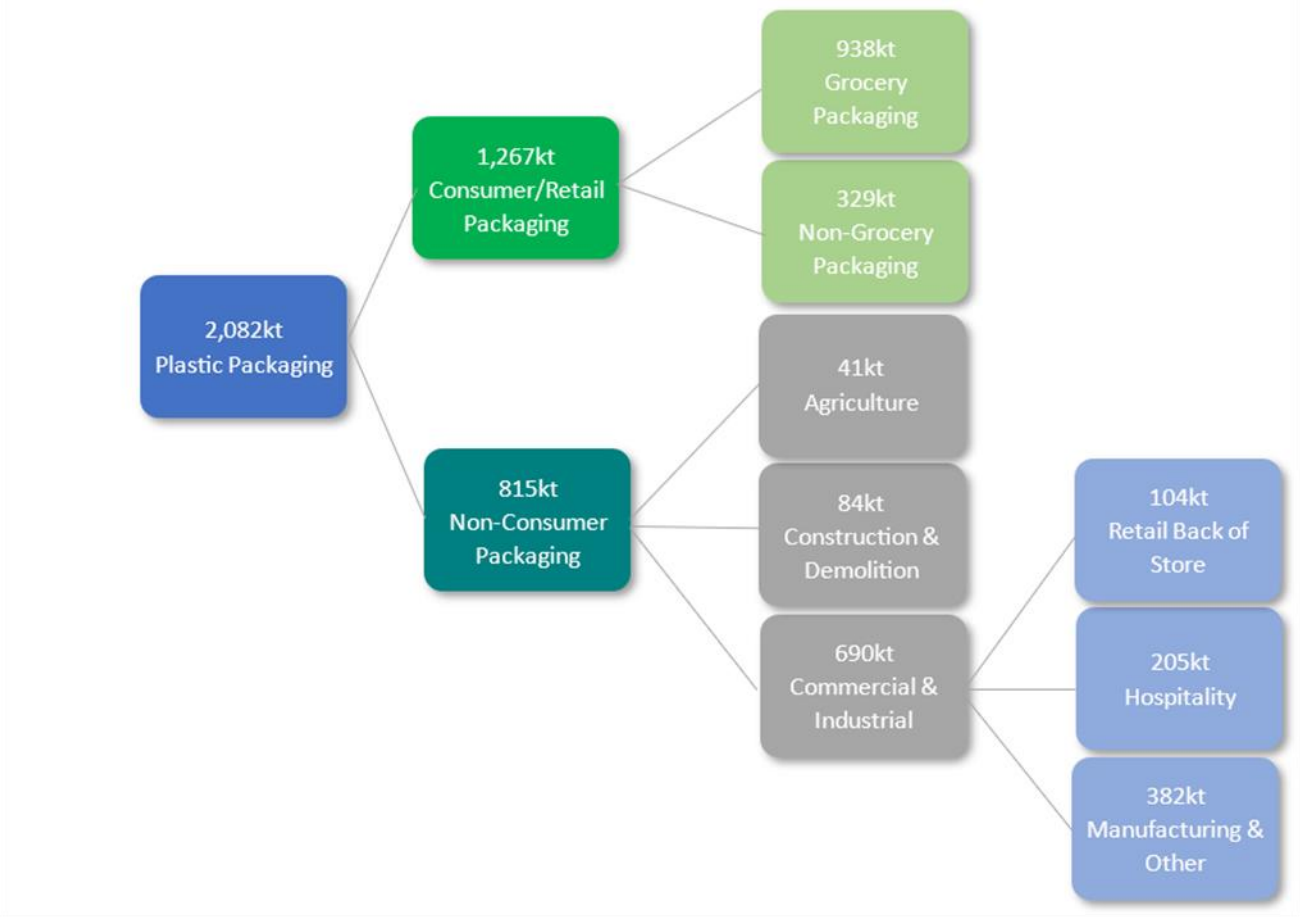
Plastic packaging POM in the consumer retail sector is estimated to be 1,267k tonnes in 2022 (+/-6%).

Plastic packaging POM in the non-consumer sector is estimated to be 815k tonnes in 2022 (+/-13%).

A further breakdown of plastic packaging POM in these sectors is shown in Figure 1[5].

[1] The previous packaging materials flow reports can be found at Knowledge Hub | Valpak Limited
[2] Plastic packaging placed on the market means all household and non-household plastic packaging used around products sold and transported within the UK.
[3] The error margins are assumed estimates based on the robustness assessment and are not the outputs of statistical calculation.
[4] 208k tonnes is a decrease of 10%.
[5] Figures may not add due to rounding.

Figure 1: Plastic Packaging POM by Sector, 2022



The plastic POM figure is built up using a variety of components, based on the key sectors for plastic packaging, including:

- Plastic packaging around food/drinks/other groceries, including body care/clothing/DIY products etc., as sold by supermarkets and other non-grocery retailers, sourced from the Environment Agency and Valpak's EPIC database[6];
- Plastic packaging around food/drink as consumed in the hospitality sector, sourced from Valpak's EPIC database;
- Plastic packaging discarded by retailers back-of-store, obtained through a survey undertaken for the purposes of this study;
- Plastic packaging used by the construction industry, based on secondary research sources, such as the Green Construction Board and BRE, using the same approach as in Plastic Flow 2025;
- Plastic packaging used in the manufacturing industry, using the POM calculated in Plastic Flow 2025, which was sourced from Steering Group member data; and data collected in a survey as part of the Valpak/WRAP 2015 C&I Plastic Packaging[7] project; and
- Plastic packaging used in agricultural sector, based on a Valpak report, 'UK AWP Waste Arisings, Valpak 2007', itself based on 2006 data and government issued statistics for crop and livestock output.

The total plastic POM estimate was cross-checked and found to be 206k tonnes higher than data reported by obligated companies under the Packaging Waste Regulations (using the UK net pack/fill calculation method[8]). This suggests that non-obligated companies, handling fewer than 50 tonnes of packaging or with lower than £2 million turnover and free riders account for 10% of plastic packaging in the UK. This proportion has decreased from the 13% non-obligated POM identified in 2019. It is important to stress that the net pack/fill estimates are themselves subject to a degree of error because they rely on the robustness of the data submitted to the National Packaging Waste Database (NPWD). In addition, there have been a number of late registrants in 2023. Valpak therefore undertook two methods to adjust the aggregated data tables provided by the Environment Agency under FOI. The NPWD data is widely recognised as being the best available as there is a legal obligation for companies to submit data that is as accurate as reasonably possible, which is then audited by the regulating body. This data is used by policy makers and their agencies.

Polymer/ Format Composition of Plastic POM

The estimated composition of consumer plastic packaging in the UK in 2022 is shown in Table 1. The category 'Other' includes elements of packaging such as caps & lids, toothpaste tubes, chocolate/sweet wrappers, egg boxes, blister packs and clothing hangers.

[6] *The database is based on information collected direct from suppliers as well as information sourced internally, meaning that it holds a wide coverage of information across multiple product ranges. Product specific data collection is completed through site visits, supplier mailings and weighing in-house (purchasing product and collecting used product from staff). All data goes through a comprehensive checking process on receipt and is stored in Valpak's database - Environmental Product Information Centre (EPIC).*

[7] *http://www.wrap.org.uk/sites/files/wrap/Rigid_Plastic_Packaging_report_0.pdf*

[8] *The net pack fill figure is used to estimate the amount of packaging placed on the UK market by obligated companies. It is obtained from the total data reported by obligated packaging producers that is available on the NPWD website. The calculation is as follows:*

Net Pack Fill = Packing/Filling Table 1 (pack/filling)
+ Imports Table 3A (imported for selling) + Imports Table 3B (packaging removed from around imports)
– (Exports Table 2A + Table 2B (pack/filling))

Table 1: Consumer Plastic Packaging by Format and Polymer, 2022 (k tonnes)

	HDPE	LDPE	PE	PET	PP	PS	PVC	Other	Grand Total	
Bottle	148	1	1	338	4	0	0	0	**493**	*39%*
Film	9	79	41	31	98	0	1	78	**336**	*27%*
Other	9	4	6	23	44	13	1	9	**109**	*9%*
PTT	1	0	1	218	92	12	0	4	**329**	*26%*
Grand Total	**168**	**84**	**49**	**610**	**237**	**26**	**3**	**91**	**1267**	
	13%	*7%*	*4%*	*48%*	*19%*	*2%*	*0.2%*	*7%*		

To provide a breakdown by format and polymer of consumer plastic packaging, supermarket packaging composition (both grocery and non-grocery product types) was used as a proxy for grocery packaging, but only the non-grocery categories of supermarket packaging (around toys, electrical, clothing, etc.) were used as a proxy for non-grocery packaging. In addition to non-grocery items, a certain quantity of drinks are sold through non-grocery retailers and so allowances have been made for these non-grocery drinks sales in the non-grocery composition. This follows the same methodology as Plastic Flow 2025.

There are fewer data sources to estimate non-consumer POM than consumer POM and the levels of uncertainty around the data are greater. This is especially true of format and polymer composition data and therefore the splits in the below summary table should be regarded as indicative, with a high level of uncertainty.

Table 2: Summary of Indicative Total Non-consumer POM Composition, 2022 (k tonnes)

	HDPE	LDPE	PE	PET	PP	PS	PVC	Other	Grand Total	
Bottle	211	0	0	63	2	0	0	1	**277**	*34%*
Film	10	227	100	2	21	0	7	4	**371**	*46%*
Other	6	0	1	1	5	0	0	1	**14**	*2%*
PTT	17	0	1	14	98	22	0	1	**152**	*19%*
Grand Total	**243**	**228**	**103**	**79**	**126**	**22**	**7**	**7**	**815**	
	30%	*28%*	*13%*	*10%*	*15%*	*3%*	*1%*	*1%*		

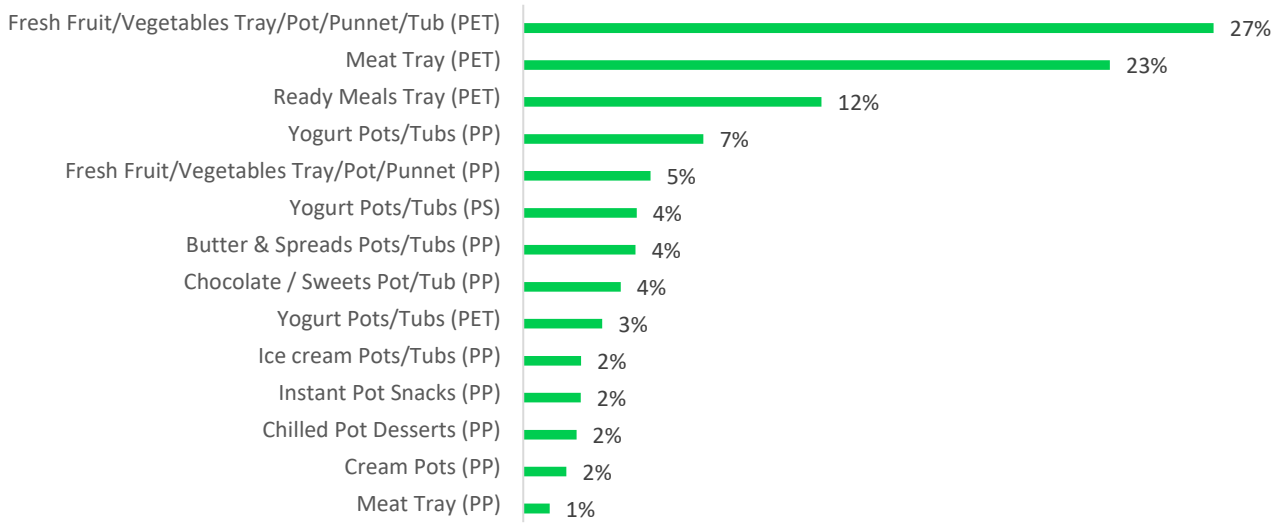
Although this non-consumer POM composition is indicative, the format and polymer splits are consistent with those identified in 2017 and 2019.

Due to the quantity of packaging data available in Valpak's EPIC database, further analysis was undertaken on consumer POM as part of the PackFlow project. This included an assessment by format and polymer type of consumer pots, tubs and trays (PTTs) and of consumer drinks packaging.

The dominant polymer in consumer PTTs remains PET, with 66% of PTTs being made of PET. The second most popular polymer is PP, constituting 28% of PTTs in the UK[9]. In terms of usage, the most common category of PTTs (PET) is fresh fruit and vegetable packaging, with 27%. This is illustrated in Figure 2.

[9] *Polymer composition of PTTs as given in this analysis vary slightly from those provided in the overall POM composition table. This is due to the film element of PTTs (closures, lids, etc) being included as part of PTTs in this analysis, being included within the film category of the overall POM composition table. Including the film element of PTTs in this analysis allowed for comparison with previous work undertaken.*

Figure 2: Key PTT Applications, 2022



Fruit and vegetable punnets and meat trays account for just over half of PP PTTs.

Since Deposit Return Schemes (DRS) are being developed in each of Scotland, England, Wales and Northern Ireland, it was considered of interest to present the plastic primary packaging data relating to the drinks market.

The total number of drinks POM is shown within Table 3.

Table 3: Plastic Drinks Packaging POM, 2022 (k tonnes)

Drinks	Consumer	Non-consumer	**Total**
HDPE	84	17	**101**
PET	222	57	**279**
Other	11	0	**11**
Total	**317**	**74**	**391**

The DRS applies to drinks that come in containers between the sizes of 50ml-3L[10]. For plastics, only PET drinks containers are included within the DRS[11][12]. This is shown in Table 4 below.

[10] *Within Scotland container sizes in scope of the DRS are proposed to be between 100ml-3L since an announcement made by the Minister for Green Skills on 20th April 2023. Prior to this announcement container sizes in scope of the DRS were 50ml-3L.*
[11] *https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1130296/DRS_Government_response_Jan_2023.pdf*
[12] *https://www.netregs.org.uk/environmental-topics/carbon-reduction-and-efficiency/scotland-s-deposit-return-scheme/what-is-the-deposit-return-scheme-drs/#:~:text=The%20DRS%20applies%20to%20drinks,Aluminium*

Table 4: Plastic Drinks Packaging POM in Scope of the DRS, 2022 (k tonnes)

Drinks	Consumer	Non-consumer	**Total**
PET	219	10	**229**

The analysis indicates that in 2022 there was 391k tonnes of plastic drinks packaging placed onto the UK market[13]. In order to verify this data, Dairy UK data relating to the milk market was assessed, with total milk sales for the UK in litres and by each key market, such as retail and hospitality, being identified[14]. Of the 390k tonnes POM, 229k tonnes is within the scope of the DRS under specifications published at the time of conducting the PackFlow 2023 report.

Scheme Administrator Submissions

The total tonnage of packaging POM that is like to be declared by obligated business to the scheme administrator as meeting the criteria of being for public/consumer use (formally referred to as 'household / household like') is 1,324kt, or 1,095kt when DRS material is excluded.

Table 5: Total Expected Scheme Administrator Submissions (k tonnes)

Material / Situation	Total POM	Total Consumer	Total Non-Consumer	Total Hospitality	Total Hospitality - Takeaway Only	Estimate of total scheme administrator submissions (consumer in scope)
Plastic - All	**2,082**	1,267	815	205	57	**1,324**
Plastic - excluding DRS	**1,853**	1,048	805	195	47	**1,095**

Consumer Packaging in the Household Waste Stream

The total proportion of consumer plastic packaging from Grocery retailers that is disposed of in the household waste stream is 80%. The total proportion of consumer plastic packaging from Non-Grocery retailers that is disposed of in the household waste stream is 93%. This is based on the same sample of retailers as is used in the rest of this report and equates to 1,050kt (83%) of packaging in total across both Grocery and Non-Grocery retail (consumer packaging).

Consumer Packaging in the 'Litterable' Categories

The total proportion of consumer plastic packaging from Grocery retailers within the 'litterable' categories (as described in the material specific reports) is 26%. The total proportion of consumer plastic packaging from Non-Grocery retailers within the 'litterable' categories is 3%. This is based on the same sample of retailers as is used in the rest of this report and equates to 257kt of packaging in total.

Plastic Packaging Recycling

The PackFlow Refresh report estimates the quantity of accredited UK plastic packaging recycled to have been between 926k tonnes and 1,285k tonnes in 2022. A range is used to express recycling levels as the point at

[13] *Bottled drinks only, including all caps and labels.*
[14] *http://www.dairyuk.org/images/documents/publications/THE-WHITE-PAPER-2017.pdf*

which recycling is measured can vary, and therefore the quantities are shown as a maximum (recovered plastic into recyclers[15]) and a minimum (recycled polymer out of recyclers[16]).

The table below shows a summary of the modelling results for waste plastic packaging delivered to recyclers, either in the UK or overseas, and the resulting recycled plastic produced by them.

Table 6: UK Domestic Plastic Packaging Recycling & Export, 2022 (k tonnes)

Stream	Recovered Plastic into Recyclers	Recycled Polymer out of Recyclers
Consumer UK Recycling	409	270
Consumer Export	197	130
Non-consumer UK Recycling (films)	201	161
Non-consumer UK Recycling (rigids)	81	73
Non-consumer Export (films)	258	181
Non-consumer Export (rigids)	139	111
TOTAL Recycled in / Recycled out	**1285**	**926**

Key data sources used for the analysis were RECOUP's UK Household Plastics Collection Survey 2022[17] and modelling of estimated inputs and outputs to UK plastic recyclers in 2022. The was combined with NPWD export data to firstly assess consumer waste plastic packaging exports (RECOUP's survey minus what is believed to have been recycled in the UK). The remainder of exports is assumed to be C&I waste plastic packaging, which was further split into C&I films and C&I rigids.

Unaccredited recycling is when plastic packaging is recycled without a PRN/PERN being raised for it.

The total tonnage for plastic packaging delivered to recyclers in 2022 was estimated to be 1,285k tonnes based on the bottom-up modelling. NPWD has a figure of 1,244kt, 3% lower. Whilst the difference may be related to unaccredited recycling, as the average PRN value in 2022 was £231 (Letsrecycle.com) it is felt more likely to be due to assumptions made during the modelling. Due to the high PRN value an assumption of no unaccredited recycling in 2022 was made as a recycler or exporter would not be able to compete for feedstock without being accredited and using the PRN / PERN value.

[15] *Plastic packaging waste accepted for recycling (input)*
[16] *Recycled polymer produced (output)*
[17] *RECOUP's most recent survey based on 2023 data was not published at the time of writing this report and so the 2022 survey (based on 2021 data) was used.*

Table 7: Summary of UK Plastic Packaging Waste into and out of Recyclers as a Percentage of POM, 2022 (k tonnes,%)

Waste Plastic Stream	POM (kt)	Recycled Plastic into Recycler (kt)	Recycled Plastic Out of Recycler (kt)	Recycled Plastic in as % of POM	Recycled Plastic out as % of POM
Consumer Total	**1267**	**606**	**400**	**48%**	**32%**
Consumer PTTs/Bottles	929	581	385	63%	41%
Consumer Film	338	25	15	7%	4%
Non-consumer Total	**815**	**679**	**525**	**83%**	**65%**
Non-consumer Rigids	429	220	184	51%	43%
Non-consumer Film	371	459	342	124%	92%
Non-consumer Other	14	0	0	0%	0%
Grand Total	**2082**	**1285**	**925**	**62%**	**44%**

It is important to note that neither recycled plastic in as a percentage of POM or recycled plastic out as a percentage of POM aligns with the official recycling rate (as measured in the UK). The latter is based on the waste plastic packaging supplied to recyclers minus any non-target material. The non-target material is based on sampling and so, in reality, does not fully account for factors such as food contamination or moisture. Looking at NPWD, we can see that the PRN / PERNs issued overall are 93% of the waste received / exported. An approximation of the UK recycling rate for plastic, as measured based on PRN / PERN issuing, could therefore be made by taking 93% of the of the modelled waste plastic inputs to recyclers and calculating this as a percentage of POM. This gives a recycling rate of 57%.

As with previous reports, the figures for non-consumer film are high. The recycled plastic into recyclers as a percentage of POM is likely to be particularly high due the percentage of non-target material in some grades of retail and supermarket film. Some of the non-target material is packaging and is recycled, however, it is generally rigid items such as PET and PP trays and strapping. As such, this will act to overstate the C&I film percentage and understate the rigid C&I percentage. The recycled plastic out figure is also higher than is likely to be the case. This could be due to a number of factors. Firstly, a high-level assumption has had to be made on the split of film and rigid C&I packaging exported due to the lack of data in this area. A second factor is that some of the film exported may not in fact be packaging. This could be a due the difficulties in separating packaging and non-packaging film but may also be due to miss-issuing of PRNs / PERNs on non-packaging material.

Of the plastic packaging not recycled for both consumer and non-consumer packaging, 997k tonnes (80%) is sent for energy recovery and 159k tonnes to landfill (20%) in 2022, estimated using WDF and published statistics on UK disposal routes for plastic packaging.

This is based on an estimated total of 661k tonnes of consumer plastic packaging not being recycled and 206k tonnes process waste generated within the recycling process (assumed to be disposed of within EfW). For non-consumer, 135k tonnes has been estimated as not being recycled and 154k tonnes process waste generated within the recycling process (assumed to be disposed of within EfW).

End Markets for UK Plastic Packaging

Table 8 provides a summary of key areas of usage of UK recycled polymer. The breakdown of how recycled polymer produced in the UK is used is based on in-house knowledge, and discussions with industry experts and

recyclers. For PET, the recycled polymer is produced from bottles and trays (consumer and non-consumer from the hospitality sector). For HDPE the largest volume of recycled polymer comes from bottles/ household trays, but rigid C&I packaging also forms part of this stream. For PP there is a roughly equal split between recycled polymer produced from bottles/ trays and PP from rigid C&I packaging. Recycled LDPE is nearly all derived from C&I and manufacturing films.

Table 8: Summary of End Markets for UK Recycled Plastic Packaging

PET		
Application	Examples	Indicative usage
Sheet manufacture	Thermoform trays, etc.	25%
Bottles	Food and non-food bottles	70%
Fibre	Polyester fibre for fill	5%

HDPE		
Application	Examples	Indicative usage
Packaging	Food and non-food bottles	50%
Construction	Pipes, chambers, roof spacers, plumbing items	30%
Horticultural	Compost bins, water butts, wheel bins, watering cans, etc.	10%
Household items	Garden furniture, household items such as boxes and buckets.	5%
Mixed PO application	Plastic wood and board, etc	5%

PP		
Application	Examples	Indicative usage
Automotive	Interior design items, wheel arches, ducting, battery cases, etc.	40%
Packaging	Paint pots, pallets, crates, trays, boxes	40%
Horticulture	Plant pots, seed trays	15%
Mixed PO applications	Plastic wood and board, etc	5%

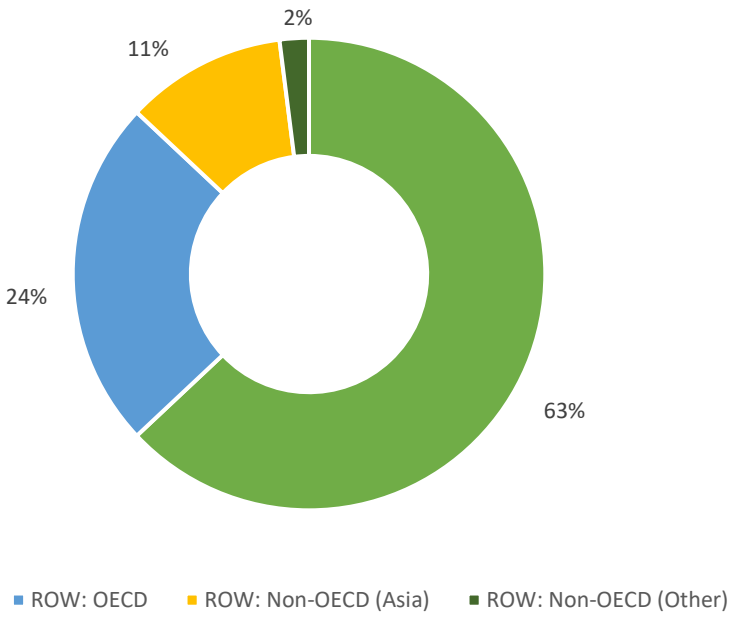
LDPE		
Application	Examples	Indicative usage
Construction films	Damp proof membranes, building films for temporary protection, gas barrier protection	40%
Plastic bags & sacks	Refuse sacks, recycling sacks, carrier bags	25%
Agricultural films	Crop cover (mulch film)	10%
Packaging	Shrink wrap, pallet hoods, etc.	15%
Mixed PO applications	Plastic wood and board, etc.	10%

Based on a conversion rate of 58% for consumer and 83% for non-consumer, 121k tonnes of PET is estimated to be recovered from the recycling process. If 70% of this material is used in the manufacture of new bottles, that would be approximately 84k tonnes of UK PET being utilised in the process.

As a result of the restrictions on imports of post-consumer waste plastic into China implemented at the end of 2017, a lot of the material was diverted to South East Asia and Turkey. Although some recycled pellet will be used in domestic applications, these markets often supply some back into China. It is likely that domestic end markets in Turkey would be broadly similar to those in Asian markets, for example, recycled PET used in the production of polyester fibre. Since the Plastic Flow 2025 report was published, the end markets for recycled LDPE polymer have changed. It is thought that more is used in film applications, such as construction films and plastic bags, and slightly less in agricultural film production and foamed applications.

A Freedom of Information Act request was made to the Environment Agency for information on where UK waste plastic packaging was exported to in 2022. Reproduction of this data is subject to the conditions set out in the Open Government License version 3.0. Please see conditions here: Open Government Licence (nationalarchives.gov.uk)

Figure 3: Export Destinations for UK Plastic Packaging Waste by Region, 2022 (%)



Packaging Future Trends and Scenarios

Two EPR scenarios relevant to plastic are;

- EPR scenario 1: All packaging materials subject to recycling obligations under 2007 Regulations for 2024 and under new EPR regulations from 2025 onwards (all packaging is in scope of current producer responsibility obligations from 2022 to 2025);
- EPR scenario 2: DRS drinks containers *excluding* glass removed from recycling obligations under EPR in 2028 onwards.

EPR Scenario 1

Plastic POM tonnage is projected to reduce in 2023 compared to 2022, and while growth resumes it is projected to be below its 2022 level until 2028. Business targets are projected to increase by 1% point per annum and reach 65% in 2028. The POM projection is reflected in the projection of obligated tonnage for plastic packaging, and (with assumed constant collection rates) the projection of accredited recycling. Based on this plastic packaging is projected to be in a surplus relative to the business target 2023 to 2028.

EPR Scenario 2

Plastic POM tonnage is projected to reduce in 2023 compared to 2022, and while growth resumes from 2024 it remains below its 2022 to 2026. Plastic drinks containers (PET Bottles) are removed from EPR from 2027 onwards (~399kt). The business targets for the remaining material are projected as constant at 2024 level of 61%. The POM projection is reflected in the projection of obligated tonnage for plastic packaging, and (with assumed constant collection rates) the projection of accredited recycling. Based on this a surplus relative to the business target 2024 to 2026 is projected for plastic packaging. The reduction in the recycling obligation relative to the projection for accredited recycling results in a larger surplus relative to the business target from 2027 onwards.

Conclusions and Recommendations for Further Work

Conclusions: POM

The project's estimate of UK plastic packaging POM for 2022 is 2,082k tonnes +/-6%, a decrease of 208k tonnes[18] from the previous figure of 2,290k tonnes for 2019[19].

The POM figure is the most robust estimate that can be derived using a variety of the most authoritative methods, including industry estimates, Valpak data and publicly available data.

Plastic packaging POM in the consumer sector is estimated to be 1,267k tonnes +/-6% in 2022.

This is based on primary data alongside reliable market share data. No other method is used for deriving consumer data as this method is considered the most robust available and is accepted by industry as such.

Plastic packaging POM in the non-consumer sector is estimated to be 815k tonnes +/-13% in 2022.

For film, this method is based on a combination of primary (survey) data and secondary research. For rigids, this is based on the findings of the WRAP/ Valpak report into rigid packaging in the C&I sector, and on secondary research.

It is likely that any increase in sales of products using plastic packaging have been offset by light-weighting and a shift towards other packaging materials between 2017 and 2022.

[18] *208k tonnes is a decrease of 10%.*

[19] *Knowledge Hub Page – PackFlow Covid-19 Phase 1: Plastic | Valpak*

The plastic packaging industry has believed for some time that packaging producer activity to light-weight plastic packaging[20] has negated any potential growth in consumption and the results of this work would seem to support this assumption.

Plastic drinks packaging is estimated to account for 391k tonnes of the total POM in 2022. 229k tonnes comes under the scope of the DRS.

Valpak EPIC data and additional market data suggests that 81% of this tonnage is sold via the retail or consumer market and 19% via the non-consumer or hospitality sector, with 100k tonnes being HDPE, 279k tonnes PET and 11k tonnes other polymers. These figures have been cross-checked with industry and published industry data.

Conclusions: Recycling

The UK's domestic plastic packaging recycling rate in 2022 is between 44% and 62%.

If measuring recycling (by weight) on entry to a reprocessor, the UK's domestic plastic packaging recycling rate is estimated at 62% (1,285k tonnes recycled). If measured after conversion on exit from reprocessing, the rate is lower at 44% (925k tonnes recycled).

The consumer plastic packaging recycling rate for the UK in 2022 is between 32% and 48%.

If measuring recycling (by weight) on entry to reprocessing, the UK's consumer plastic packaging recycling rate is estimated at 48% (606k tonnes recycled). If measured after conversion on the exit of reprocessing, the rate would be lower at 32% (400k tonnes recycled).

The non-consumer plastic packaging recycling rate for the UK in 2022 is between 65% and 83%.
If measuring recycling on entry to reprocessing, the UK's non-consumer plastic packaging recycling rate is estimated at 83% (679k tonnes recycled). If measured after conversion on the exit of reprocessing, the rate would be lower at 65% (525k tonnes recycled).

The non-consumer film recycling rate for the UK in 2022 is unfeasibly high.

The recycling rates of non-consumer film are estimated at 93%-126%[21]. One explanation for this could be the incorrect allocation of PRN/ PERNs against either non-packaging film or non-UK packaging due to the presence of contamination and moisture in bales. Research is recommended both into non-consumer film POM and the incorrect issuing of PRNs.

Of the total 1156k tonnes of plastic packaging not recycled and lost during the recycling process, 997k tonnes (80%) is sent for energy recovery and 159k tonnes to landfill (20%) in 2022.

This is based on an estimated total of 867k tonnes of consumer plastic packaging not being recycled and 289k tonnes of non-consumer not being recycled, estimated using WDF and published statistics on UK disposal routes for plastic packaging.

Conclusions: Plastic Packaging End Markets

The main application for UK recycled PET is in food and non-food bottles.

Approximately 70% of UK recycled PET is used within food and non-food bottles. The majority of PET not used in this way is used within sheet manufacture to make products such as thermoform trays.

UK recycled HDPE is used comprehensively in a variety of applications, such as packaging, construction and horticultural..

Approximately 50% of UK recycled HDPE is used in the packaging sector, a further 30% in the construction sector, 10% in horticultural and 5% in household items. The remainder is used in a variety of products such railway sleepers, garden furniture and boxes.

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[20] Including down-gauging activity and a shift to using non-plastic packaging materials.
[21] An unfeasibly high non-consumer film recycling rate was also reported in the Pack Flow 2019 and the Plastic Flow 2025 report. It was outside the scope of this project to follow the recommendations made within the Plastic Flow 2025 report, however this report acknowledges that further work is needed in this area to improve data accuracy.

UK recycled PP is predominantly used to make automotive products and packaging.

Approximately 40% of UK recycled PP is used in automotive products and a further 40% in packaging.

UK recycled LDPE is mainly used to make new films for construction, bags, sacks and agriculture.

Approximately 40% of UK recycled LDPE is used for construction films, 25% for plastic bags & sacks and around 10% for agricultural films. The remainder is used in other applications such as packaging and the production of plastic wood.

Recommendations for Further Work

Recyclability of Packaging

This report recommends that more research be carried out to quantify the recyclability of packaging.

Quantification of Stretch wrap

It is currently difficult to accurately calculate the amount of stretch wrap used in transit packaging. This report recommends further work to quantify films used for delivery/transport packaging.

C&I plastic packaging film/rigids

The estimate of C&I film packaging appears low in comparison to the rigids figure. Furthermore, non-consumer film POM as a whole appears low when used to calculate non-consumer film recycling rates. This report recommends further work in this area to improve data accuracy.

Agricultural Films

This report recommends further work on the definition of agricultural films. For example, to define what is classified as a packaging application e.g., bale wrap. and what is not e.g., silage wrap/poly tunnels.

Non-consumer film being allocated PRN/PERNs

In 2022 the recycling rates for non-consumer film were unfeasibly high. This may be due to the incorrect allocation of PRN/PERNs to non-packing films or non-UK packaging film. This report recommends further work in this area to improve data accuracy and the assumption of a 90% yield for exported bales.

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Glossary

ACP – Advisory Committee on Packaging

bn – billion

BPF – British Plastics Federation

CA – Civic amenity

C&I – Commercial and Industrial

C&D – Construction and demolition

DRS – Deposit Return Scheme

EA – Environment Agency

EfW – Energy from Waste

EPIC – Environmental Product Information Centre

FPA – Foodservice Packaging Association

HDPE – high-density Polyethylene

HWRC – Household waste recycling centre

INCPEN – Industry Council for Packaging & the Environment

k – Thousand

kt – Thousand tonnes

LA – Local authority

MRF – Materials Recovery Facility

NPWD – National Packaging Waste Database

ONS – Office of National Statistics

PE – Polyethylene

PERN – Packaging Export Recovery Note

POM – Placed on the market

PP – Polypropylene

Primary Packaging – Any packaging that the customer will take home, remove and throw away e.g. plastic bottle

PRN – Packaging Recovery Note

PS – Polystyrene

PTT – Pots, Tubs and Trays

PVC – Polyvinyl Chloride

RECOUP – Recycling of Used Plastics Ltd

Secondary Packaging – Inner packaging used to transport or display goods to/in store, usually cardboard boxes or shelf-ready packaging

SEPA – Scottish Environment Protection Agency

Transit/Tertiary Packaging – Any transit packaging e.g. pallets, shrink wrap, staples or strapping

WDF – Waste Data Flow

WRAP – Waste and Resources Action Programme

Acknowledgements

Valpak Limited and the Waste Resources Action Programme (WRAP) would like to thank the following organisations for their contributions to the plastic PackFlow project:

- The Advisory Committee on Packaging (ACP)
- The British Plastic Federation (BPF)
- Berry
- Child Safe Packaging Group
- The Department for the Environment, Food and Rural Affairs (DEFRA)
- The Department of Agriculture, Environment and Rural Affairs (DAERA)
- The Environment Agency (EA)
- Flexographic Industries Association
- The Foodservice Packaging Association (FPA)
- Natural Resources Wales
- The Packaging Federation
- Plastics Europe
- Recycling of Used Plastics Ltd (RECOUP)
- The Recycling Association
- The Scottish Environment Protection Agency (SEPA)
- The Scottish Government
- The Welsh Government
- Wastepack
- The Waste and Resources Action Programme (WRAP)
- Zero Waste Scotland (ZWS).

1. Introduction

1.1. Background

The PackFlow Refresh 2023 reports (https://www.valpak.co.uk/more/material-flow-reports) cover all packaging materials and have been produced to provide industry, governments, and other stakeholders with evidence to better understand the potential implications of lockdown and the ensuing recession on packaging materials flows, packaging materials collection & recycling, and to assess potential compliance risks versus the packaging targets.

The PackFlow Refresh 2023 project has two phases:

Phase 1

- Updates baseline year to 2023 for estimates of packaging materials POM collections, recycling and end markets (from 2019 & 2017 in the previous flow reports[22]).

Phase 2

- Develop scenarios for packaging materials flow and recycling from 2022 to 2028; and
- Assess potential compliance risks versus targets.

To support Defra, Governments and other industry stakeholders in their packaging policy work and assist other industry stakeholders, this report focuses on generating robust estimates of UK plastic packaging placed on the market (POM) that are as accurate as is reasonably possible. The report also considers the quantities of plastic packaging recycling, both in the UK and abroad, and provides insights into the end markets and products that are manufactured by plastic packaging recyclers in the UK.

The report also analyses packaging within the scope of the Deposit Return System (DRS), littering and household/household like packaging.

1.2. Objectives

The PackFlow 2023 Refresh Project for plastic packaging has the following key objectives for Phase 1:

- Provide updated (and cross-checked) baseline estimates of plastic packaging placed on the UK market in 2022, by packaging format, polymer type, nation, sector and source:
    - Format (bottles, PTTs, film, etc);
    - Polymer (PET, HDPE, PP, PS etc);
    - Sector (consumer, non-consumer);
    - Source (handled by obligated producers who are registered, non-obligated producers, or free riders); and
    - POM split by nation (England, Northern Ireland, Scotland and Wales).
- Estimate the amount of packaging POM that could be disposed of within the DRS;
- Identify scheme administrator submissions;
- Identify commonly littered items;
- Estimate the proportion of plastic packaging collected through kerbside and other collection types, by stream;
- Estimate the quantities of plastic packaging recovered and recycled, sent for incineration with energy recovery, and sent to landfill for both UK and overseas end destinations; and

[22] *The previous packaging materials flow reports can found at Knowledge Hub | Valpak Limited.*

- Provide estimates of the quantities of plastic packaging that is recycled (i.e. is recorded as accredited recycling) and plastic packaging that is recycled but does not generate a PRN/PERN (i.e. is unrecorded or unaccredited).

1.3. Methodology

In order to calculate plastic packaging recycling rates, the quantity of plastic packaging recycled is divided by the quantity of waste arisings. However, it is commonly accepted, and indeed is accepted by the EU, that establishing packaging POM is an appropriate method of estimating packaging waste arisings. It has been the commonly accepted approach in the UK for many years, that recycling rate calculations based on packaging materials POM is an appropriate method. However, approaches using packaging POM have recently been called into question by Eunomia (2018)[23] in the case of plastic packaging recycling, particularly as estimates of packaging waste arisings established through composition analyses applied to waste data collated from multiple sources tend to yield higher tonnages The Eunomia report claims that data reported to NPWD is likely to be subject to systematic underestimation, as it suggests that obligated companies may have a vested interest in under-reporting their POM figures. Therefore, this may result in an overestimate of the recycling rate.

Other methodologies have been considered and discounted, such as waste composition analysis. Whilst this approach is valid, it has several significant limitations, relying on accurate data for:

- The composition of household waste;
- Waste arisings from local authorities; and
- Waste arisings and composition from commerce and industry.

The justification of the use of POM data over alternatives is provided in full in section 1.3.1. of Plastic Flow 2025[24]. An overview of how the POM and recycling rates are calculated for this project is provided below.

1.3.1. POM

Plastic packaging POM was estimated using a bottom-up approach that references a variety of data sources of plastic packaging products placed on the market combined with a gathering of data and estimates from industry. The results of this method have been cross-checked against an assessment of the plastic packaging POM reported on the National Packaging Waste Database (NPWD) by obligated producers. The baseline year was 2022. However, where 2022 data was not available the most recent available data was used.

1.3.1.1. POM Method (Bottom-Up Approach)

This approach built up the POM figure using a variety of components, based on the key sectors for plastic packaging including:

- Plastic packaging around food/drinks/other groceries, including body care/clothing/DIY products etc., as sold by supermarkets and other non-grocery retailers, sourced from the Environment Agency and Valpak's EPIC database[25];
- Plastic packaging around food/drink as consumed in the hospitality sector, sourced from Valpak's EPIC database[26];

[23] *Eunomia: Plastic Packaging – Shedding Light on the UK Data, http://www.eunomia.co.uk/reports-tools/plastic-packaging-shedding-light-on-the-uk-data/*
[24] *http://www.wrap.org.uk/content/plasticflow-2025-plastic-packaging-flow-data-report*
[25] *The database is based on information collected direct from suppliers as well as information sourced internally, meaning that it holds a wide coverage of information across multiple product ranges. Product specific data collection is completed through site visits, supplier mailings and weighing in-house (purchasing product and collecting used product from staff). All data goes through a comprehensive checking process on receipt and is stored in Valpak's bespoke software Environmental Product Information Centre (EPIC).*
[26] *The database is based on information collected direct from suppliers as well as information sourced internally, meaning that it holds a wide coverage of information across multiple product ranges. Product specific data collection is completed through site visits, supplier*

- Plastic packaging discarded by retailers back of store, obtained through a survey undertaken for the purposes of this study;
- Plastic packaging used by the construction industry, based on secondary research sources, such as the Green Construction Board and BRE, using the same approach as in Plastic Flow 2025 with updated expenditure figures from the Construction Skills Network[27];
- Plastic packaging used in the manufacturing industry, using the POM calculated in Plastic Flow 2025, which was sourced from Steering Group member data and that collected in a survey as part of the Valpak/WRAP 2015 C&I Plastic Packaging[28] project and updated using the UK statistics on waste[29]; and
- Plastic packaging used in agricultural sector, based on Valpak report, 'UK AWP Waste Arisings, Valpak 2007', based on 2006 data. These figures were updated based on the UK crop and livestock output[30]. The detail of how the amount of rigid and film plastic were estimated is given in section 2.

1.3.1.2. POM Cross-check (Net Pack Fill)

The report uses NPWD[31] data estimates for 2023 submissions to reflect obligated packaging POM in 2022. These estimates are obtained by using NPWD data for data year 2021 and applying an estimate of the percentage change in obligated packaging by material between 2022 and 2021. The estimate of the percentage change is informed by changes in packaging flow for each material between the data years 2021 and 2022 arising from approximately 1600 Valpak members, who had registered in 2022 and 2023 under the same registrations and had been registered with the same agencies as of July 2023. On a regular basis throughout the PackFlow process, Valpak have also downloaded the live 2023 submission position from NPWD (for the 2022 data year) and analysed the change in number of registrations and aggregated data to cross reference against forecast position and identify any large divergence from the expected outcomes. The 2023 NPWD estimates are used for calculating 2022 net pack fill.

The calculation applied is set out below:

Net Pack Fill	=	Packing/Filling Table 1 - pack/filling	+	Imports Table 3A - imported for selling	+	Imports Table 3B - packaging removed from around imports	-	Exports Table 2A + Table 2B – pack/filling

1.3.2. Recycling

The level of accredited reprocessing (that which is eligible to raise a PRN/PERN) was established using a combination of a bottom-up (UK recycling and all format/polymer splits) and a top-down approach (exports). Collection, recovery in[32] and recycling out[33] estimates were made for plastic packaging recycled in the UK from consumer and non-consumer waste streams. PERNs reported as issued in 2022 in NPWD were used as a proxy for plastic packaging exported for recycling. They were adjusted to reflect the actual weight of baled material exported.

Primarily, UK recycling estimates (and export polymer/ format splits) were made from the findings of a survey and discussions with UK reprocessors and exporters. All gathered information and internal project team knowledge were inputted into an Excel model, which was used to generate estimates. RECOUP's Local

mailings and weighing in-house (purchasing product and collecting used product from staff). All data goes through a comprehensive checking process on receipt and is stored in Valpak's bespoke software Environmental Product Information Centre (EPIC).

[27] https://www.citb.co.uk/media/2nfpuwdc/csn-uk-full-report-final.pdf
[28] http://www.wrap.org.uk/sites/files/wrap/Rigid_Plastic_Packaging_report_0.pdf
[29] https://www.gov.uk/government/statistics/uk-waste-data/uk-statistics-on-waste#waste-from-commercial-and-industrial-ci-activities%20and%20packflow%20cov%2019%20and%20the%20Wrap%202017%20paper
[30] https://www.gov.uk/government/statistical-data-sets/agriculture-in-the-united-kingdom
[31] www.npwd.environment-agency.gov.uk
[32] *Plastic packaging waste accepted for recycling (input)*
[33] *Recycled polymer produced (output)*

Authority survey results[34] on the quantity of plastic packaging collected for recycling from the consumer sector were also fed into the model. Although this is based on 2021 collections, it was believed that these would be a close proxy for 2022. The estimate for plastic packaging recycled in the UK was cross-checked with the number of PRNs that were raised on plastic according to figures submitted to NPWD.

For this report it is assumed that there is minimal unaccredited recycling, which is supported by the increase in the number of accredited recyclers. The average monthly PRN prices in 2022, taken from Letsrecycle, was very high at £231 per tonne[35]. As such, it has been assumed that there is no unaccredited recycling in 2022. The fee for registering as a small recycler or exporter to issue PRNs / PERNs is £505[36] and so for anyone issuing more than 2 or 3 PRNs/PERNs it would be worth becoming accredited. In 2019 there were 194 accredited recyclers and exporters of plastic, rising to 279 reprocessors in 2022.

1.3.3. Data Robustness

As there are levels of uncertainty around the data used to establish the various elements that are combined to make the total POM, consumer, non-consumer and total plastic packaging POM are presented with error margins, providing a range around the estimate. The robustness scores established for each data piece used are presented in Appendix I and these have been converted into a percentage and related to appropriate indicative margins of error[37], as shown below. The respective margins of error are provided throughout the report.

Table 9: Relating Robustness Scores to Indicative Margins of Error

Robustness Score			Error Margin	
96%	To	100%	+/-	3%
91%	To	95%	+/-	6%
86%	To	90%	+/-	9%
81%	To	85%	+/-	12%
76%	To	80%	+/-	15%
71%	To	75%	+/-	18%
66%	To	70%	+/-	21%

To calculate an indicative margin of error for the total POM, the margins of error for the sub-elements that make up the total are converted to tonnages and then expressed as an overall percentage using a Root of Sum of Squares calculation (to approximate the overall error of a summation of subcategories with different error margins).

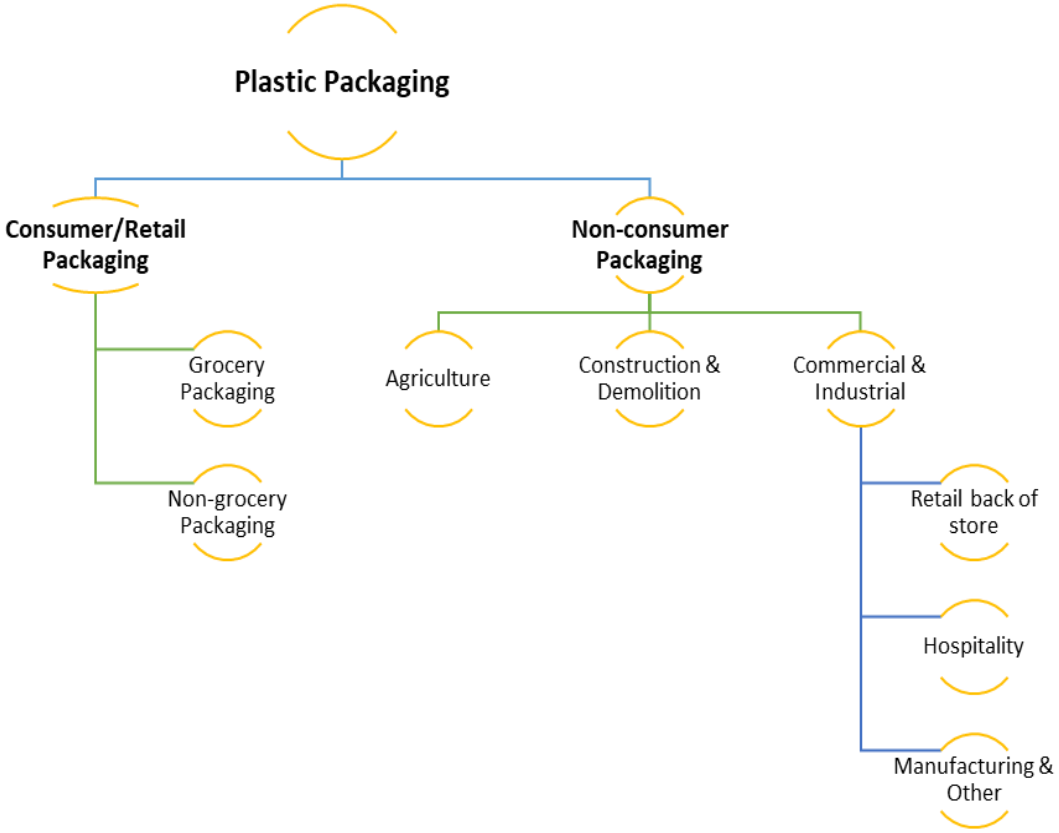
[34] *RECOUP's most recent survey based on 2022 data was not published at the time of writing this report and so the 2022 survey (based on 2021 data) was used.*
[35] *https://www.letsrecycle.com/prices/prns/prn-prices-2022/*
[36] *https://www.gov.uk/guidance/packaging-waste-apply-to-be-an-accredited-reprocessor-or-exporter*
[37] *These are assumed to be indicative estimates of error margin and not the outputs of a statistical calculation.*

2. Phase 1: Plastic Packaging POM

2.1. Introduction

This section of the report provides an explanation of the method used to review the total plastic packaging POM in the UK in 2022. This method splits the POM into different elements and builds a picture from the bottom to the top. The key elements are shown in Figure 4.

Figure 4: Plastic Packaging POM - Sector Breakdown



Packaging is considered plastic if plastic is the predominant material by weight in a composite[38].

2.2.Consumer POM

2.2.1. Grocery Retail

In order to estimate the amount of packaging POM by the grocery retail market, aggregated Environment Agency (EA) data was used. The data provided by the EA was 2022 plastic quantities reported in Table 1 Selling from NPWD (less exports) for 92% of UK grocery retailers[39]. This data was scaled up to 100% of the UK grocery market and resulted in an estimated plastic POM for 2022 of 938k tonnes.

[38] *The EA definitions of composite and multi-layered packaging are defined in, the 'Agreed position and technical interpretations – producer responsibility for packaging'. Composite packaging is: 'multi-layered sheets of dissimilar materials which are bonded together and cannot be separated by hand', such as laminated paperboard, whereas multi-material packaging is: 'packages constructed of assembled components of different material', such as a blister pack made from cardboard and plastic and can be separated by hand. Within the technical interpretations guidance, the packaging weight for laminate packaging 'should be recorded under the predominant material by weight', compared to multi-material packaging weights, which should be recorded separately, by the different component materials.*

[39] *The figure does not include free-riders or non-obligated producers.*

This estimate was cross referenced with Valpak's Environmental Product Information Centre (EPIC)[40] which was assessed to provide data on annual sales and packaging weights for all relevant products packaged in plastic. This was taken from a selection of Valpak's supermarket clients representing a cross-section of grocery retailers in the UK. Using market share information from Kantar World Panel for these supermarkets, which represented 46% of the grocery retail market by sales value for 2022, the resulting quantity of plastic packaging was scaled up to represent an estimate for the UK grocery retail market. In 2019 the supermarkets made up 43% of the grocery retail market. This method assumes that the plastic packaging profile of the supermarkets in EPIC is representative of those not represented. The plastic packaging in the grocery retail sector was estimated to be 1,018k tonnes in 2022. This represents a 18% increase on the consumer grocery retail figures identified for 2019 of 865k tonnes using the same methodology. This increase may have been caused by the difference in the selection of supermarket clients for the 2022 that may have a different plastic packaging composition than the supermarkets previously selected.

The EA data was found to be 8% lower than that produced using EPIC. In previous years the EPIC and EA data have been much more closely aligned and as such EPIC has been used, due to a greater confidence in the quality of the data, greater detail of plastic packaging composition and its representation of the full grocery market. However, based on the EA having higher market coverage, the EA data was selected for use. This was also the approach taken in the Plastic Flow 2019 and 2025 project.

Recommendations from the Steering Group identified that the POM for drinks packaging was too low. Across the grocery and non-grocery retail sectors and hospitality, total drinks POM was estimated to have reduced by 19% from 2019 to 2022. It was felt that this was too big a decrease and that a decline of 2.4% during that period would be more realistic aligning with the figures released in the British Soft Drinks Association's Annual Report[41]. Drinks POM was updated to reflect this. More detail on drinks packaging can be found in section 2.8.1.

The final grocery retail plastic packaging POM for 2022 of 938k tonnes +/-6% error margin was therefore used. This is a tonnage decrease of 10% compared to that identified for 2019. This difference in tonnage is outside of the margin for error so does indicate that there has been a decrease in the amount of plastic POM in 2023.

Appendix II provides a detailed assessment of relative levels of confidence in the data.

2.2.2. Non-grocery Retail

To scale up the grocery retail sales figure to represent total UK retail sales, including non-grocery retail, the Office of National Statistics (ONS) retail sales figures are used. The ONS retail sales figures show grocery retail sales accounted for 42% of total UK retail sales in 2022.

However, simply scaling up using market shares is not considered robust, since it is likely that plastic packaging usage in the grocery and non-grocery sectors is very different. The difference in usage of packaging in the grocery sector and the non-grocery retail sector is analysed using Valpak members in the non-grocery retail sector reported packaging data and reported turnover, total grocery packaging POM (calculated using existing PackFlow methodology) and ONS retail sales data.

The analysis involved the following key stages:

- Calculation of non-grocery packaging POM (tonnes) per billion-pound retail sales by:
    - Identification of non-grocery retail members within Valpak's membership and extraction of data from the 2023 packaging submission detailing per business:
        - Retail sales data (turnover); and
        - Total (non-grocery) packaging POM
- Calculation of total grocery packaging POM (tonnes) per billion-pound retail sales from:
    - Existing PackFlow methodology (as detailed previously in this report);
    - ONS data detailing Total Sales made by Predominantly Food Stores from All Retailing Excluding Automotive Fuel; and

[40] The database is based on information collected direct from suppliers as well as information sourced internally, meaning that it holds a wide coverage of information across multiple product ranges. Product specific data collection is completed through site visits, supplier mailings and weighing in-house (purchasing product and collecting used product from staff). All data goes through a comprehensive checking process on receipt and is stored in Valpak's bespoke software Environmental Product Information Centre (EPIC).
[41] UK Soft Drinks Report 2022, British Soft Drinks Association

- In previous iterations of PackFlow, data provided by Valpak's grocery retailer members has been used alongside stated turnover in their packaging returns.

This was deemed an improved methodology due to concerns about stated turnover as it is not a compulsory field in a packing submission (a long as the turnover is over £2m, a business meets the relevant threshold for participation). Some of the issues include:

- Use of historic or estimated turnover values;
- Use of rounding;
  - for example, input in thousands of pounds.
- Sometimes turnover is included twice;
  - for example, where a supermarket completes a GB registration and an NI registration and includes total UK turnover on both submissions (double counting).
- Inclusion of non-packaging related turnover, such as
  - fuel (petrol stations); and
  - and, potentially, sale of assets like land.

Instead, this iteration of PackFlow calculates the Grocery tonnes per £bn of turnover using total Grocery POM from existing PackFlow methodology (relating to 92% of the grocery market) and the ONS total sales in stores specialising in food, derived by taking Total Sales made by Predominantly Food Stores from All Retailing Excluding Automotive Fuel.

Non-Grocery tonnes per £bn of turnover is calculated in the same way as in previous iterations of PackFlow, using checked and cleansed data submissions from non-grocery retailers within the Valpak membership base (excluding petrol retailers from the sample).

In addition to wholesale supply of soft drinks to non-grocery retailers (estimated through EPIC), soft drinks are also supplied to outlets directly from manufacturers, or indirectly from manufacturers through distribution companies. It is estimated that the tonnage of PET soft drinks bottles unaccounted for using Valpak EPIC data only is approximately 1.3k tonnes and this has been included in the Total Non-grocery POM figure provided below. Valpak were able to establish this estimate by comparing the estimated proportion of units sold of soft drinks in plastic established in EPIC, with the proportion of soft drinks volume sold in plastic[42].

The total estimate of non-grocery POM is 329k tonnes (+/- 18%).

[42] *UK Soft Drinks Report 2022, British Soft Drinks Association.*

2.2.3. Total Consumer POM

In summary the following key steps were taken to estimate total consumer retail plastic packaging POM (consumer grocery retail + consumer non-grocery retail) in 2022:

Total grocery plastic packaging flow in 2022 (see section 2.2.1)	938kt
Proportion of grocery spend of total retail spend in the UK in 2022[43]	42%
Total retail plastic packaging flow, assuming like-for-like packaging[44]	2,225kt
Non-grocery plastic packaging tonnes/£bn turnover as a proportion of grocery plastic packaging tonnes/£bn turnover[45]	26%
Applied 26% to the difference in tonnage between grocery (938kt) and total retail (2,225kt) and added in 1.3kt direct from manufacturer soft drinks sales to get the total non-grocery	329kt
Total	**1,267kt**

Therefore, total retail plastic packaging flow in 2022 was estimated at 1,267k tonnes +/- 6%. This is a 12% decrease on the 2019 estimate for consumer plastic packaging POM of 1,447k tonnes and supports the project Steering Group's view that packaging light-weighting and a shift in plastic packaging to alternative materials have contributed to a reduction in the amount of plastic POM.

2.3. Consumer POM Composition

2.3.1. Methodology

To provide a breakdown by format and polymer of consumer plastic packaging, supermarket packaging composition was used as a proxy for grocery packaging, but only the non-grocery categories of supermarket packaging (around toys, electrical, clothing, etc.) were used as a proxy for non-grocery packaging. This follows the same methodology as Plastic Flow 2025.

In addition to non-grocery items, a certain quantity of drinks are sold through non-grocery retailers, although far less than is sold through supermarket groceries. For example, drinks are sold in shops such as Boots, Poundland and WH Smith and milk is also sold direct to consumers from farms and through doorstep delivery[46]. Allowances have been made for these non-grocery drinks sales in the non-grocery composition. For further details on drinks composition, please see section 2.8.1.

2.3.2. Results

The estimated composition of consumer plastic packaging in the UK is shown in Table 10.

[43] https://www.ons.gov.uk/businessindustryandtrade/retailindustry/datasets/poundsdatatotalretailsales *In 2019 this was 42.5%, and although there is less than 1% change (from 42.5% in 2019 to 42.1% in 2022), this indicates some reduction in non-grocery sales.*
[44] *Grocery packaging is scaled up to full retail based on the proportion of grocery spend of total retail spend in the UK, with grocery being assumed to be 42% of the retail market, and non-grocery assumed to be the remainder at 58% of the total retail market.*
[45] *Plastic packaging usage calculated from Valpak member data as: grocery 5,052 tonnes /£bn and non-grocery as 1,292 tonnes /£bn*
[46] *Milk supplied through these routes is outside of traditional grocery and non-grocery retail and therefore would not be captured by the grocery calculations or non-grocery calculations and must instead be calculated separately.*

Table 10: Consumer Plastic Packaging by Format and Polymer, 2022 (k tonnes)

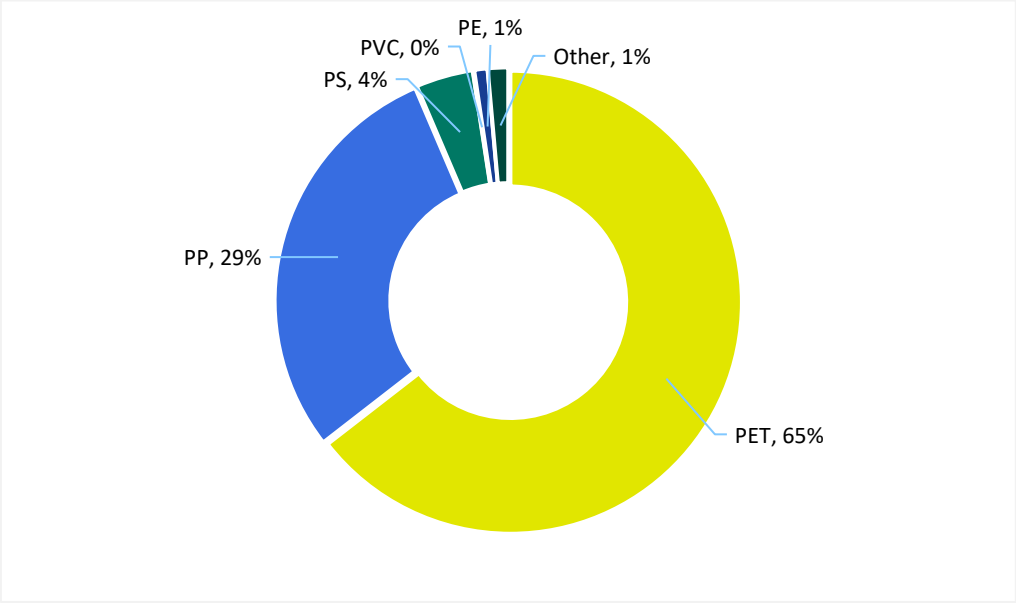
	HDPE	LDPE	PE	PET	PP	PS	PVC	Other	Grand Total	
Bottle	148	1	1	338	4	0	0	0	**493**	*39%*
Film	9	79	41	31	98	0	1	78	**336**	*27%*
Other	9	4	6	23	44	13	1	9	**109**	*9%*
PTT	1	0	1	218	92	12	0	4	**329**	*26%*
Grand Total	**168**	**84**	**49**	**610**	**237**	**26**	**3**	**91**	**1267**	
	13%	*7%*	*4%*	*48%*	*19%*	*2%*	*0.2%*	*7%*		

The category 'Other' includes elements of packaging such as caps & lids, toothpaste tubes, egg boxes, blister packs and clothing hangers.

The estimated 2022 format splits are similar to those estimated within the Pack Flow 2019 project, with less than 6%-point difference in each format. The polymer splits are comparable to those identified in 2019, also showing less than a 10%-point difference across polymer types. The largest point difference comes from HDPE with a reduction of 10.1%-points (23% in 2019) and 6.8%-point increase in PET (41% in 2019).

2.4. Consumer PTT Composition Update

Figure 5: Polymer Split UK PTTs, 2022 (%)

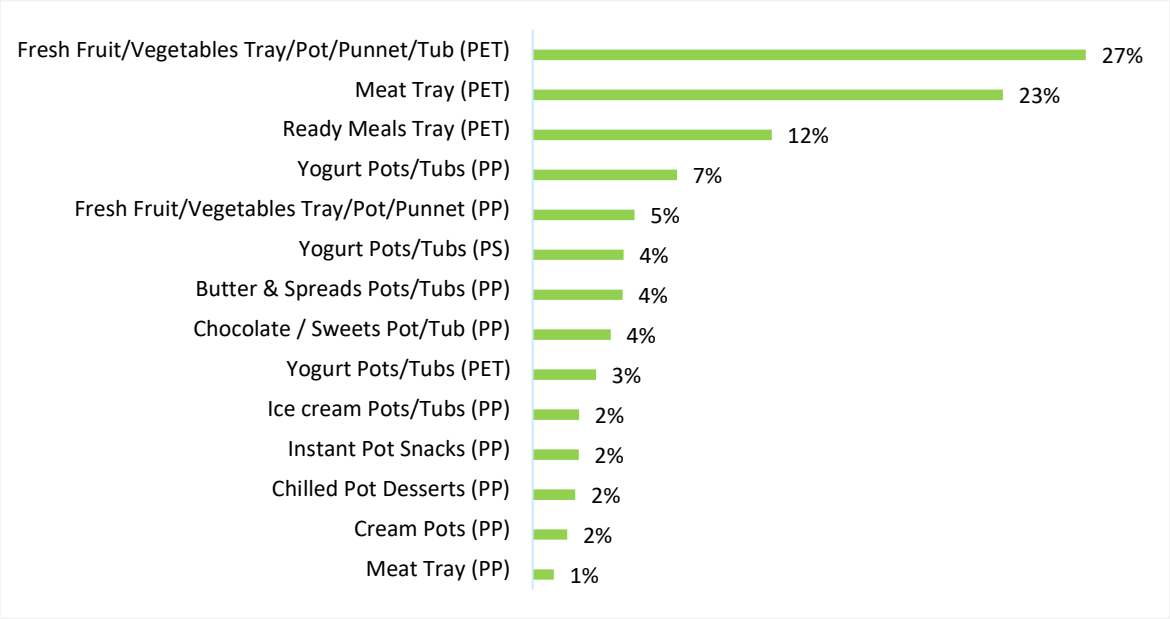


After interrogating and analysing data from Valpak's EPIC database, it is estimated that over half (64%) of PTTs are made of PET. The second most popular polymer is PP, constituting around 29% of PTTs in the UK[47].

[47] *Polymer composition of PTTs as given in this analysis vary slightly from those provided in the overall POM composition table. This is due to the film element of PTTs (closures, lids, etc) being included as part of PTTs in this analysis, but being included within the film category of the overall POM composition table. Including the film element of PTTs in this analysis allowed for comparison with previous work undertaken.*

Further interrogation of the database showed that just over 40% of PET used in PTT is used to package fruit and vegetables. Yoghurt pots, fruit and vegetable punnets, and butter and spread tubs account for just over half of PP PTTs.

Figure 6: Key PTT Applications, 2022 (%)



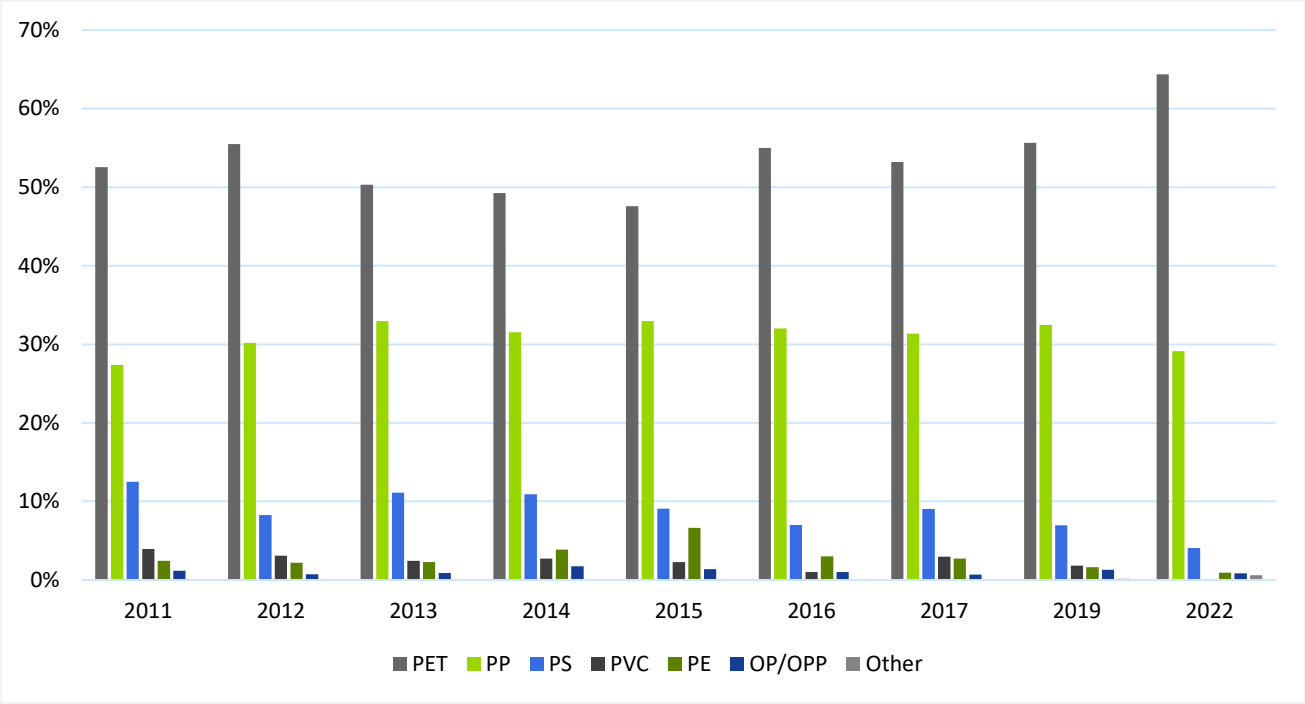
PET PTTs are considered 'less recyclable' because they are more brittle than bottle grade PET[48] even though PTTs are readily collected in the UK (~88% of LAs collect PTTs[49], an increase from ~81% in 2019[50]).

2.4.1. Polymer Switching Trends

Comparing 2022 EPIC data to snapshots taken in 2011 through to 2022, there is a reducing proportion of PS and PVC used in PTTs. There is no data for 2018, 2020 and 2021 because the aim of this project was to update the previous estimate of plastic packaging POM from 2019 to 2022, and the previous Pack Flow 2019 report from 2017 to 2019, which would then act as the baseline for future projections. PTT polymer usage within 2020 and 2021 was not seen as essential to this specific project.

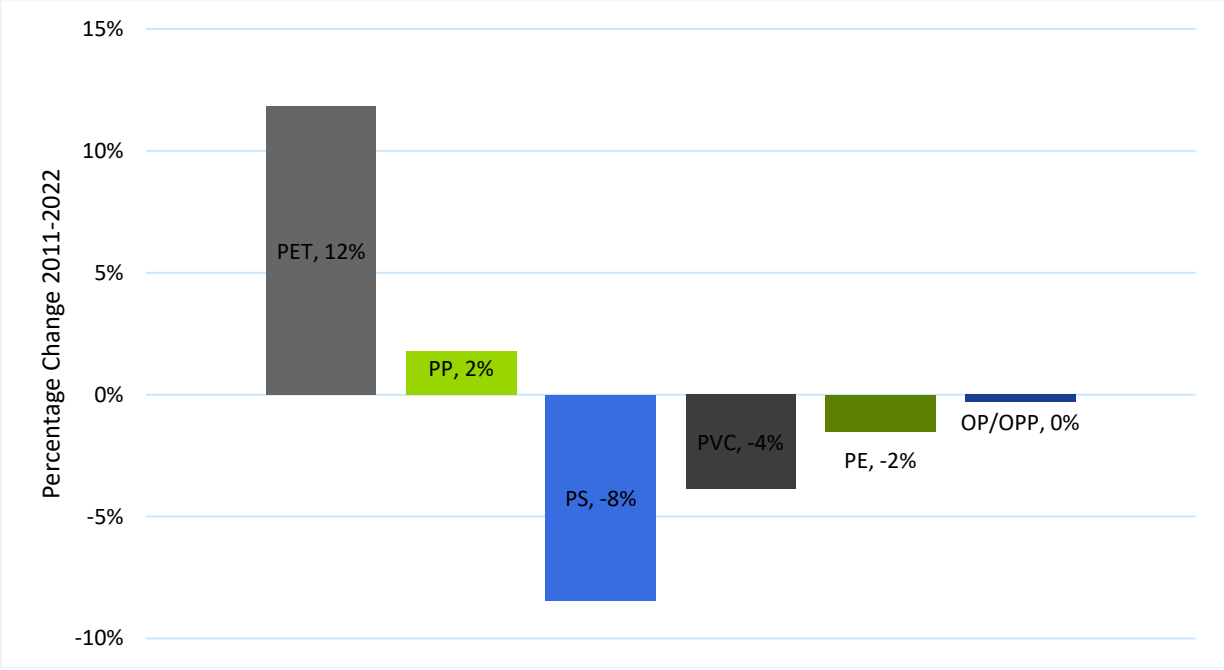
[48] *https://www.letsrecycle.com/news/latest-news/ptt-plastic-going-to-efw-recoup-claims/ and RECOUP Local Authority Plastics End Market Analysis (May 2019)*
[49] *RECOUP UK Household Plastics Collection Survey 2022*
[50] *RECOUP UK Household Plastics Collection Survey 2019*

Figure 7: Polymer Split Snapshots, 2011-2022



This data also shows an increase in the proportion of the 'more recyclable' polymer PP between 2011 and 2022.

Figure 8: Change in PTT Polymer Usage, 2011-2022



It is impossible to say from our data set whether these changes represent switching from one polymer type to another, as factors such as light weighting may also have had an impact. Be that as it may, initiatives such as

the UK Plastics Pact may have influenced polymer switching out of PS and PVC[51] in to easier to recycle polymers such as PET.

2.5. Consumer Grocery POM by Category

It was considered of interest to identify the plastic primary packaging POM used for key product categories. Valpak used its EPIC database covering 45.5% of the UK grocery market and scaled this up to represent 100% of grocery sales[52]. The data presented in the chart covers all plastic primary packaging attributed to each of the identified categories sold via the grocery market[53].

[51] https://www.wrap.org.uk/content/eliminating-problem-plastics *PS and PVC packaging are included in the list of eight problem plastics to be eliminated by the end of 2020, to feed into the UK Plastics Pact 2025 targets.*
[52] *Data included in the chart relates to the grocery market only, not total sales made to consumers or those made through the hospitality sector for example.*
[53] *This is a selection of categories of interest and does not account for all plastic primary packaging handled by the sector.*

Figure 9: Grocery Plastic Packaging POM by Category across All Formats, 2022 (k tonnes)

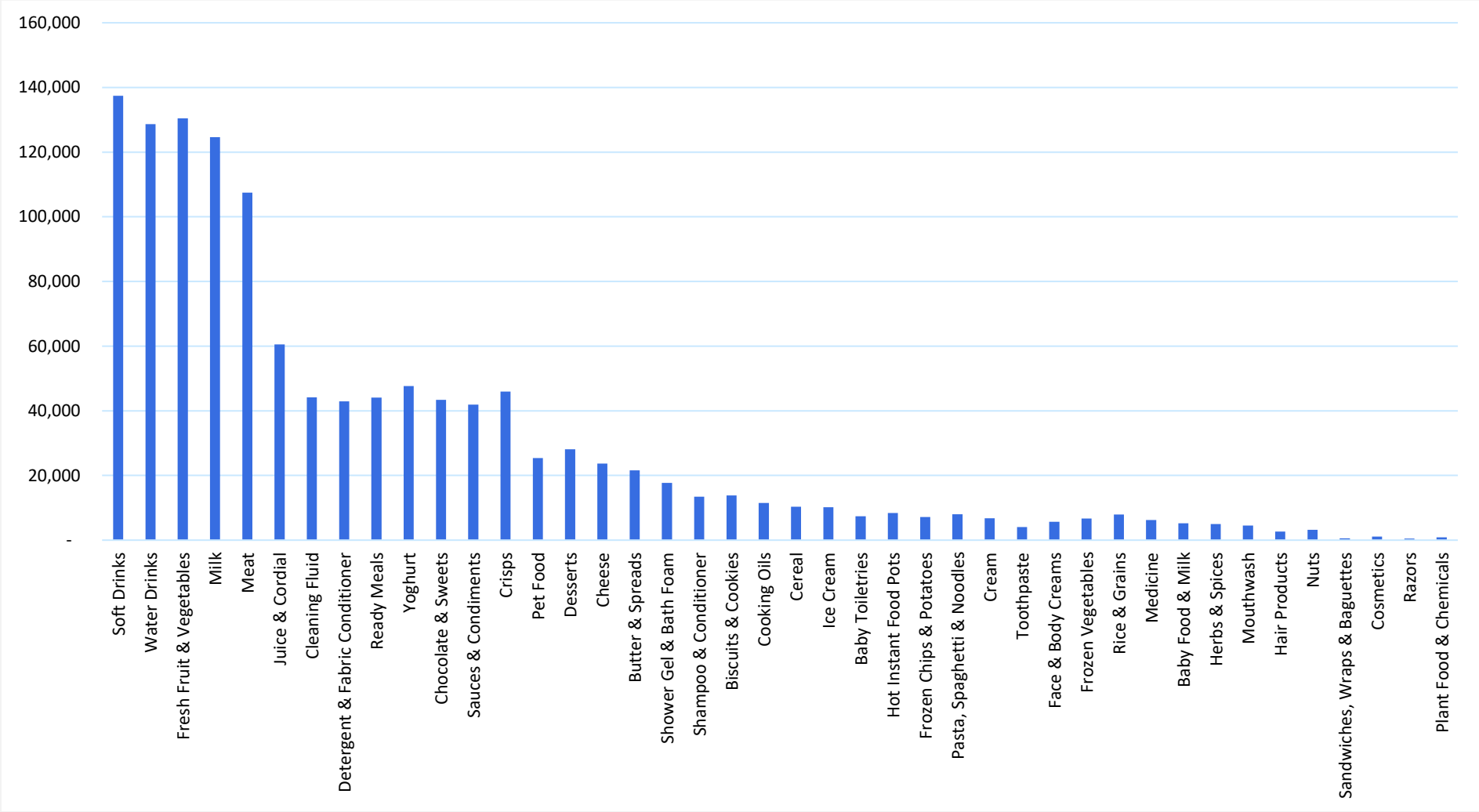


Figure 9 indicates that drink products (soft drinks, water drinks, milk and juice & cordial) represent the largest tonnage of plastic primary packaging POM by the grocery sector of those categories covered, accounting for around 451k tonnes, with fruit and vegetables representing 130k tonnes, meat 107k tonnes and cleaning fluids 44k tonnes.

2.6. Non-Consumer POM

In order to avoid duplication between consumer and non-consumer packaging (i.e. including packaging within the non-consumer sector that has already been included in the consumer sector) non-consumer waste production is assessed using the bottom-up method[54].

The non-consumer sector is broken down into sub-sectors:

- Construction and demolition (C&D);
- Agricultural; and
- Commercial and Industrial (C&I).

2.6.1. Construction & Demolition

Since the Plastic Flow 2025 report was published in 2018, there has not been any new research into the volumes or composition of plastic packaging waste consumed within the construction and demolition sector. Therefore, the same methodology and assumptions from the Plastic Flow 2025 report for 2017 and 2019 POM have been used to produce an estimate for 2022 POM, but based on an updated construction spend.

To quantify plastic packaging consumption within the construction industry, a variety of secondary research sources were used, including the finding from UK construction companies surveyed in 2014 that estimated approximately 15% of packaging used in the sector is plastic[55].

In 2014 the BRE Smartwaste Portal was reviewed and using information for data for projects across all industry sectors (commercial, industrial, houses etc.) showed an average 0.3 tonnes of packaging per £100k spend[56]. If this quantity of packaging per spend is applied to the total construction spend of £186 billion (10% higher than in 2019) in the UK estimated for 2022[57], this results in an estimate of 559k tonnes of packaging used in the sector. Applying the estimated plastic composition of 15% as per the finding reported above, gives a figure of plastic packaging arising in the sector in 2022 of 84k tonnes.

Research commissioned by the Green Construction Board[58] (GCB) estimates that 289k tonnes of packaging (all materials) arose in the UK construction sector in 2009. Based on the estimate of total packaging arising in the sector, this would equate to approximately 40k-45k tonnes of plastic packaging. When this was used to estimate 2019 POM using the increase in construction spend reported as a proxy for growth, the 2019 estimate was between 67k to 74k tonnes of plastic packaging in construction. Following the same approach and using the 10% growth in construction spend reported above for 2022, it provides an estimate of between 74k tonnes and 82k tonnes.

Although the upper end of this estimate is within 2% of the 84k tonnes calculated using the Plastic Flow 2025 methodology, it is based on research commissioned by the GCB in 2009, and extrapolations from then should be treated with caution.

The final project estimate for the construction sector is therefore 84k tonnes, +/-24% error margin. The film/rigid split identified in the WRAP/ Valpak 2011 plastics packaging composition study[59] has been applied to provide an

[54] *It is assumed that waste production is equal to POM in this case. An example would be where retailer sales is included within consumer but retail back of store waste within the non-consumer sector. The justification for assessing the POM in this way is included in section 1 of this report.*
[55] *It is recognised that estimating the proportion of plastic packaging used in construction is very challenging, even for those companies active in the sector.*
[56] *Derived independently of the other similar estimate above using different data.*
[57] *The Skills Construction Needs, United Kingdom Five Year Outlook 2022 – 2026, CITB in association with Experian*
[58] *Internal research only.*
[59] *http://www.wrap.org.uk/sites/files/wrap/Plastics%20Composition%202011%20Report.pdf*

indicative film (75k tonnes) and rigid (9k tonnes) packaging split. It is also possible to derive an indicative polymer split from the compositional study, as illustrated below:

Table 11: Indicative Composition of Plastic Packaging in C&D, 2022 (k tonnes)

Polymer	Format	% of Arisings	Approximate Tonnage	Film	Rigids
PE	Film	86%	72	72	
PP	Pots	10%	8		8
HDPE	Pots & Bags	4%	3	3	0.3
Total			**84**	**75**	**9**

Appendix I provides a detailed assessment of relative levels of confidence in the data.

2.6.2. Agriculture

As per the Plastic Flow 2025, Pack Flow 2017 and 2019 reports, figures relating to plastic packaging used around goods consumed in the agricultural sector are derived from the Valpak report, 'UK AWP Waste Arisings, Valpak 2007', based on 2006 data. This dataset is relatively old, and evidence would suggest[60] that total crop and livestock output has increased by ~10% since 2006. The increase of crop and livestock output has been applied to the plastic POM provided within the 'UK AWP Waste Arisings, Valpak 2007' report to calculate the total for rigids and film as 41k tonnes +/- 24% in 2022. However, as there has also been down-gauging of most non-consumer films and light weighting of rigid plastic containers it may be plausible that the total tonnage has remained the same as quoted within the Plastic Flow 2025, Pack Flow 2017 and 2019 reports (37k tonnes).

The film/rigid split identified in the WRAP/Valpak 2011 plastics packaging composition study[61] has been applied to provide an indicative film (33k tonnes) and rigid (7k tonnes) packaging split. It is also possible to derive an indicative polymer split from the compositional study, as illustrated below.

Table 12: Indicative Composition of Plastic Packaging in Agriculture, 2022 (k tonnes)

Polymer	Format	% of Arisings	Approximate Tonnage	Film	Rigids
PE	Film	56%	23	23	
PP	Film	26%	11	11	
HDPE	Bottles	14%	6		6
HDPE	Cores	4%	2		2
Total			**41**	**33**	**7**

Appendix I provides a detailed assessment of relative levels of confidence in the data.

[60] https://www.gov.uk/government/statistical-data-sets/agriculture-in-the-united-kingdom
[61] http://www.wrap.org.uk/sites/files/wrap/Plastics%20Composition%202011%20Report.pdf

2.6.3. Commercial & Industrial

For the purposes of this work, the commercial and industrial sectors were broken down into three key sub-sectors:

- Retail back of store;
- Hospitality; and
- Manufacturing and other.

2.6.3.1. Retail Back of Store

The quantity of plastic packaging discarded by grocery retailers at back of store was derived from surveying retailers during August/September 2022, with data collected representing 18% of the grocery retail market. Data was then scaled up to UK level for grocery. The final figure for grocery retail back of store was 68.3k tonnes of plastic packaging, which represents an increase of 0.2% since 2019 (68.1k tonnes).

This was then scaled up to include the non-grocery retail back of store plastic packaging. However, simply scaling up using market share was not considered robust, since it was likely that packaging usage within both sub-sectors differed. Therefore, this difference in plastic packaging used by the grocery sector and other retail sectors was analysed using Valpak membership's reported data[62]. Analysis involved the following key stages:

- Identification of grocery and non-grocery retail members;
- Gathering of company reported data and information; and
- Calculation of plastic packaging tonnage per £billion turnover for grocery and non-grocery retailers (using Valpak data).

The method used assumes the packaging profile of those retailers within the sample is representative of those not in the sample.

Therefore, the following key steps were taken to estimate total back of store retail plastic packaging consumption in the consumer (retail) sector in 2022:

Total grocery back of store plastic packaging calculated through member survey	68kt
Proportion of grocery spend of total retail spend in the UK in 2022[63]	42%
Total retail back of store plastic packaging flow, assuming like for like packaging[64]	162kt
Non-Grocery back of store plastic packaging assumed difference in tonnage between grocery (68kt) and total retail (162kt)	93kt
Proportion of grocery spend of total UK retail spend £thousands[65]	37%
Applied 37% to the non grocery tonnage (93kt) and added to the grocery tonnage (68kt) to get the total retail final with the t/£b turnover adjustment applied.	104kt
Total	**104kt**

[62] Valpak membership represents approximately one third of all obligated companies, by obligation. The entire NPWD database was considered for analysis; however, for confidentiality reasons it was not possible to gain access to NPWD to conduct the same analysis on the complete dataset.
[63] https://www.ons.gov.uk/businessindustryandtrade/retailindustry/datasets/poundsdatatotalretailsales. In 2019 this was 43% and although there is less than 1% change (from 42.5% in 2019 to 42.1% in 2022), this indicates some reduction in non-grocery sales.
[64] Grocery packaging is scaled up to full retail based on the proportion of grocery spend of total retail spend in the UK
[65] https://www.ons.gov.uk/businessindustryandtrade/retailindustry/datasets/poundsdatatotalretailsales. In 2019 this was 35% in 2019, meaning a 2% increase in 2022. This again indicates some reduction in the non-grocery sales.

Plastic Flow 2025 used confidential survey data from two retailers to estimate the split between rigid and film packaging. Assuming the format of back of store packaging has remained similar, the same methodology has been used, resulting in 1k tonnes rigids and 102k tonnes film in 2022. In order to provide an indicative breakdown by polymer type, Valpak/Verde internal knowledge was used, resulting in a film split of 90% LDPE, 5% PP and 5% HDPE. For rigids, a simple 50:50 split was applied between the two most likely polymers of PET and PP[66]. The baseline year for Plastic Flow 2025 was based on 2017 data, and so the same format and polymer splits have been assumed for 222. The indicative composition of plastic packaging in the Retail BoS sector is shown below.

Table 13: Indicative Composition of Plastic Packaging in Retail BoS, 2022 (k tonnes)

	HDPE	LDPE	PET	PP	Total
Bottle					
Film	5	92		5	102
Other					
Rigids			1	1	1
Total	**5**	**92**	**1**	**6**	**104**

Appendix I provides a detailed assessment of relative levels of confidence in the data.

2.6.3.2. Hospitality

Hospitality plastic packaging is plastic packaging that is primarily 'household-type' but is consumed in pubs, cafés, hospitals etc. It includes primary, secondary, and tertiary packaging found at back of wholesale store of associated distribution centres. The household-type packaging is generally similar in type to that consumed at home but may not be collected by a local authority for recycling or disposal, and includes some non-household type packaging such as large tubs and buckets used for items such as oils and sauces.

2022 estimates for the quantity of rigid and film plastic packaging used in the hospitality sector have been updated using newly available Valpak EPIC data relating to 33% of the cash and carry and delivered foodservice industry[67]. Market share information for the companies included in the sample were used to scale up the resulting tonnage to represent the whole foodservice, catering and hospitality sector.

[66] *No further data was available to provide a split between PP and PET, therefore 50:50 was used.*
[67] *Valpak's EPIC database holds sales data and packaging weights information for clients signed up for the fully managed service.*

Figure 10: Overview of the Foodservice, Catering and Hospitality Sector[68]

Customer ordering platform

£m	Online	Telesales/PLOF	In-depot	Total
Retail	7,962	2,029	5,682	**15,673**
Catering	3,153	5,785	2,008	**10,946**
PBUs	87	1	1,575	**1,663**
Total	**11,202**	**7,815**	**9,265**	**28,282**

Customer fulfilment

£m	Delivery	Collect	Total
Retail	10,023	5,650	**15,673**
Catering	8,987	1,959	**10,946**
PBUs	88	1,575	**1,663**
Total	**19,098**	**9,184**	**28,282**

In addition to foodservice, hospitality and catering suppliers, soft drinks are also supplied to hospitality outlets directly from manufacturers, or indirectly from manufacturers through distribution companies. It is estimated that the tonnage of PET soft drinks bottles unaccounted for using Valpak EPIC data only is approximately 12k tonnes and this has been included in the total hospitality figure provided below. Valpak were able to establish this estimate by comparing the estimated proportion of units sold of soft drinks in plastic established in EPIC, with the proportion of soft drinks volume sold in plastic[69].

This assessment resulted in a total plastic packaging POM for the hospitality sector of 205k tonnes +/- 18%, approximately 7% lower than the Pack Flow 2019 report (220k tonnes). This decrease was supported by the project steering group which indicated that consumers eating habits are changing and that consumption of takeaway meals (and consequently the packaging associated with takeaways) have decreased since the lifting of the Covid-19 restrictions and the impact the cost of living is having on the public's disposable incomes. Secondary research has confirmed this, finding that households are ordering 12% less takeaway food in January 2023 than the previous year[70].

Based on the data held by Valpak relating to 33% of the foodservice, catering and hospitality sector, 50k tonnes of this total was film and 154k tonnes was rigid packaging. This represents a change from the 2019 estimates (40k tonnes and 181k tonnes respectively).

It was also noted from the data that 77% of the plastic packaging identified for the sector was primary or consumer packaging and 23% was secondary/tertiary packaging. The proportion of primary packaging has decreased from 90% in 2019. The table below illustrates the film and rigid tonnages, broken down by polymer as per Valpak's EPIC hospitality dataset.

[68] https://retailanalysis.igd.com/presentations/presentation-viewer/t/uk-grocery--foodservice-wholesaling-2019-sector-performance--statistics/i/9027
[69] *UK Soft Drinks Report 2023, British Soft Drinks Association*
[70] UK's taste for takeaways slides as eating out returns and food prices rise | Hospitality industry | The Guardian

Table 14: Indicative Composition of Plastic Packaging in Hospitality, 2022 (k tonnes)

	HDPE	LDPE	Other	PE	PET	PP	PS	PVC	**Total**
Bottle	26	0	1	0	61	2	0	0	**91**
Film	2	26	4	6	2	5	0	7	**51**
Other	4	0	1	1	1	5	0	0	**13**
PTT	1	0	1	1	4	41	2	0	**51**
Total	**33**	**26**	**7**	**8**	**68**	**54**	**2**	**7**	**205**

Appendix I provides a detailed assessment of relative levels of confidence in the data.

2.6.3.3. Manufacturing & Other

The manufacturing sector includes the following sub-sectors[71]:

- Food, drink & tobacco;
- Textiles/wood/paper/publishing;
- Power and utilities;
- Chemicals/non-metallic minerals manufacturing;
- Metals manufacturing;
- Machinery & equipment (other manufacturing);
- Transport & storage; and
- Other Services.

The rigid packaging element of C&I Manufacturing and Other was the focus of a dedicated project undertaken by WRAP and Valpak in 2015. Manufacturing industry's plastic packaging usage is notoriously difficult to quantify, and the Plastic Flow 2014 project failed to provide a robust estimate for the sector.

The non-consumer film tonnage was calculated as 117k tonnes within the Pack Flow 2019 report. Pack Flow 2019 adopted the rigid plastic packaging figure (292k tonnes) for manufacturing and other established in the 2015 C&I Plastic Packaging[72] project. To calculate the waste generation change within the industry, the UK government's UK statistics on waste have been used[73] to provide an update on the manufacturing and other tonnage. There has been a 7% decrease in the plastic waste generated between 2017 and 2020[74] equating to 382k tonnes of plastic waste +/-24% in 2022.

UK manufacturing statistics[75] show minimal change in manufacturing output in recent years, and so the material split estimated in Pack Flow 2019 report have been assumed to be still relevant. Members of the steering group felt that any increase in plastic packaging usage would be largely offset by downgauging. Therefore, the C&I manufacturing and other rigid and film plastic packaging POM are estimated at 272k tonnes and 109k tonnes respectively.

[71] *Commercial and Industrial Waste Survey 2009: Final Report. Defra, 2010.*
[72] *http://www.wrap.org.uk/sites/files/wrap/Rigid_Plastic_Packaging_report_0.pdf*
[73] *UK statistics on waste - GOV.UK (www.gov.uk)*
[74] *Latest data provided for waste generated within the manufacturing and other sector published in 2020.*
[75] *http://www.parliament.uk/briefing-papers/SN01942.pdf*

Pack Flow 2019 recommended that further work be undertaken to verify the total non-consumer film estimate and to investigate potential incorrect issuing of PRN/PERNs. It has not been possible to do this within the scope of this project, but it is believed that more work is needed to improve the accuracy of the data.

Appendix I provides a detailed assessment of relative levels of confidence in the data.

2.6.3. Total Non-consumer POM

A summary of the sectoral estimates for non-consumer POM in 2021 are given in the table below. The final total non-consumer POM estimate is 815k tonnes +/- 13%. Section 2.1 of this report outlines the method used to establish the margin of error on a total derived from tonnages with differing margins of error.

Table 15: Summary of Non-consumer Plastic Packaging POM by Sector, 2022 (k tonnes)

Sector	Film	Rigid	Total	Error Margin
C&D	75	9	84	+/- 24%
Agriculture	33	7	41	+/- 24%
C&I Retail BoS	102	1	104	+/- 15%
C&I Hospitality	51	154	205	+/- 18%
C&I Manufacturing + Other	109	272	382	+/- 24%
Total	**371**	**444**	**815**	**+/- 13%**
Lower Total	**– 13% margin of error**		**712**	
Upper Total	**+ 13% margin of error**		**917**	

This estimate is 3% (28k tonnes) lower than that of 2019 non-consumer plastic packaging POM estimate (843k tonnes); it does not necessarily mean that POM has remained at a relatively consistent level between 2019 and 2022.

The tonnages for C&D and agriculture have increased from 2019 by 10% and C&I retail by 3%. Whilst the estimates for C&I hospitality and Manufacturing and other have decreased by 7%. Where there has been a change in sectoral POM volumes, the overall non-consumer POM tonnage has increased only marginally.

2.7. Summary of Indicative Non-consumer POM Composition

Summing the indicative non-consumer sectors' compositions gives the indicative total non-consumer POM composition shown in Table 16.

Table 16: Summary of Indicative Non-consumer POM Composition, 2022 (k tonnes)

	HDPE	LDPE	PE	PET	PP	PS	PVC	Other	Total	
Bottle	211	0	0	63	2	0	0	1	**277**	*34%*
Film	10	277	100	2	21	0	7	4	**371**	*46%*
Other	6	0	1	1	5	0	0	1	**14**	*2%*
PTT	17	0	1	14	98	22	0	1	**152**	*19%*
Total	**243**	**228**	**103**	**79**	**126**	**22**	**7**	**7**	**815**	
	30%	*28%*	*13%*	*10%*	*15%*	*3%*	*1%*	*1%*		

Although this non-consumer POM composition is indicative, the format and polymer splits are consistent with those identified for 2019 in Pack Flow 2019 report.

2.8. Plastic Packaging POM by Format and Polymer

The combined consumer and non-consumer plastic packaging POM by format and polymer type are summarised in Table 17.

Table 17: Total UK Plastic Packaging POM Composition, 2022 (k tonnes)

	HDPE	LDPE	PE	PET	PP	PS	PVC	Other	Total	
Bottle	359	1	2	401	6	0	0	1	**770**	*37%*
Film	19	306	141	33	118	0	8	82	**707**	*34%*
Other rigid	15	4	7	24	49	14	1	9	**124**	*6%*
PTT	18	0	2	232	190	34	0	5	**481**	*23%*
Total	**411**	**312**	**151**	**689**	**363**	**48**	**10**	**97**	**2082**	
	20%	*15%*	*7%*	*33%*	*17%*	*2%*	*0%*	*5%*		

The 2022 total plastic packaging POM is estimated at 2,082k tonnes with film accounting for 34%. The remaining 63% is mainly rigids, however the consumer 'Other' category contains packaging such as toothpaste tubes. Consumer accounts for 61% of plastic packaging POM and non-consumer 39%. The 2022 total plastic packaging POM estimate of 2,082k tonnes is lower than the 2019 estimate of 2,290k tonnes, a decrease of 9%.

There is a good degree of confidence in the estimates for the consumer sector with an estimated error margin of only +/-6%. There is, however, a much lower level of confidence in the estimates for the non-consumer sector and an error margin of +/-13% for the total non-consumer figure has been estimated. This is due to the fact that many of the estimates have been derived from single sources (often with small data sets) and it has not been possible to cross-reference them. Appendix I provides a detailed assessment of relative levels of confidence in the data.

2.8.1. Drinks Packaging POM

As a Deposit Return Scheme (DRS) in Scotland, England, Wales and Northern Ireland is being developed, it was considered of interest to present the plastic primary packaging data relating to the drinks market. This data has been derived from the following sources:

- Consumer:
    - Drinks packaging sold via the grocery market has been estimated using Valpak's EPIC database, covering 43% of the UK grocery sales. Drinks packaged in plastic have been identified and the total tonnage scaled up to represent the UK. Some further drinks packaging was identified as sold via non-grocery retailers and this has also been estimated using Valpak's database and included.
    - 0.5k tonnes of HDPE has been included to represent sales of milk through a traditional milkman and 1k tonnes through direct sales from farmers to consumers, which would not otherwise have been included using only Valpak's EPIC database[76].
- Non-Consumer:
    - Drinks packaging sold via the hospitality sector were estimated using Valpak's EPIC database relating to 33% of the cash and carry and delivered foodservice industry and scaled up to represent the UK.
    - Additionally, it was identified that in some cases this sector purchases milk direct from dairies and soft drinks via distributors rather than from the foodservice sector. As such, data relating to disposable coffee cup usage was used to estimate consumption of milk purchased directly and scaled to represent the UK[77]. This equated to around 10k tonnes of milk packaging. For soft drinks, data relating to the full market in litres[78] was used to estimate the proportion sold via distributors, which was estimated to be approximately 12k tonnes[79].

Table 18: Plastic Drinks Packaging POM, 2022 (k tonnes)

Drinks container by polymer	Consumer	Non-Consumer	**Total**
HDPE	84	17	**101**
PET	222	57	**279**
Other	11	0	**11**
Total	**317**	**74**	**391**

The initial calculations estimated a decline of 19% in PET drinks bottles from 2021. It was felt by stakeholders that although the volume of drinks sold in plastic bottles had reduced over this period, a decline of 19% was greater than expected. Based on the annual reports issued by the BSDA, a 2.4% decline from 2019 to 2021 was estimated and agreed by stakeholders to be a more realistic level. A number of reasons were highlighted by stakeholders as to why there has been fewer drinks sold in plastic bottles, such as light-weighting, material switching and consumers opting to purchase larger formats. The use of reusable bottles is increasing as well, especially for water. It was noted that the high PRN price for plastic in 2022 (relative to the early years of the PRN system) may have stimulated companies to improve the accuracy of their packaging weights in order to minimise costs.

Consequently, the tonnage of drinks in PET bottles was recalculated for both the consumer and non-consumer sectors. The final analysis indicates that in 2022 there was 391k tonnes of plastic drinks packaging placed onto

[76] *1% of HDPE milk sales were found to be through a traditional milkman and 1% direct from farmers. Average packaging weights have been applied to calculate the tonnage of HDPE this relates to http://www.dairyuk.org/images/documents/publications/THE-WHITE-PAPER-2017.pdf. Milk supplied through these routes is outside of traditional grocery and non-grocery retail and therefore would not be captured by the grocery calculations or non-grocery calculations and must instead be calculated separately.*
[77] *Assessment of Disposable Cups Placed on the Market 2012-2021, Valpak*
[78] *BSDA 2020 UK Soft Drinks Report https://www.britishsoftdrinks.com/write/MediaUploads/BSDA_Annual_Report_2020.pdf*
[79] *The total soft drinks market in litres was compared to that covered by the data held by Valpak for the retail and hospitality sector and the difference assumed to be that sold directly via distributors (5% or 12k tonnes) and was added onto the total.*

the UK market[80]. In order to verify this data, Dairy UK data relating to the milk market was assessed, with total milk sales for the UK in litres and by each key market, such as retail and hospitality, being identified[81]. This revealed that approximately 82% of milk is sold in the UK (after exports have been excluded) via the retail sector, direct from farmers or via a milkman and 16% through the hospitality sector[82]. Valpak's estimate of 82% of all milk packaging being sold through retail markets and 18% through hospitality aligns closely with the Dairy UK data. However, it is possible that there have been changes in consumer trends since the Dairy UK report was published in 2017. For example, increasing growth in demand for milk alternatives[83], as well as a reduction in the coffee shop sector[84]. Using this data and average packaging weights, a total milk packaging estimate of 93k tonnes was made. Valpak's estimate of 89k tonnes[85] is 3% lower than that found using average weights and litres sold data.

The DRS applies to drinks that come in containers between the sizes of 50ml-3L[86]. Polymers in scope of the DRS include PET[87] [88].

It is estimated that 229k tonnes of drinks are sold in plastic bottles that are within the scope of the DRS based on the full market estimate for milk in plastic bottles being 89k tonnes and the full drinks market being estimated at 391k tonnes. A breakdown of the drinks packaging in scope of the DRS can be found in Table 19.

Table 19: Plastic Drinks Packaging POM in Scope of the DRS, 2022 (k tonnes)

Drinks	Consumer	Non-consumer	**Total**
PET	219	10	**229**

2.9. POM Cross-check (Net Pack Fill)

2.9.1. Introduction

This section of the report is used as a cross-check of the total plastic POM in the UK in 2022, based on the data stored on NPWD, as reported to the EA by obligated organisations.

This method is not used to estimate total flow as it does not include non-obligated businesses or those not reporting in the system as described below, but to provide a sense check on the total flow and allow for non-obligated flow to be estimated.

2.9.2. Net Pack Fill

The 2022 UK flow of plastic packaging was calculated using the packaging weights reported to the EA by registered producers and is made publicly available on the NPWD website. On discussion with the Steering Group, Valpak selected the below methodology as the most appropriate for plastic.

The net pack fill calculation used is shown below:

[80] *Bottled drinks only, including all caps and labels.*
[81] *http://www.dairyuk.org/images/documents/publications/THE-WHITE-PAPER-2017.pdf*
[82] *Including caps and labels*
[83] *UK Dairy Alternatives Market Report 2023 (mintel.com)*
[84] *IBISWorld Market Research Report https://www.ibisworld.com/united-kingdom/market-research-reports/cafes-coffee-shops-industry/*
[85] *Including caps and labels*
[86] *Within Scotland container sizes in scope of the DRS are proposed to be between 100ml-3L since an announcement made by the Minister for Green Skills on 20th April 2023. Prior to this announcement container sizes in scope of the DRS were 50ml-3L.*
[87] *https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1130296/DRS_Government_response_Jan_2023.pdf*
[88] *https://www.netregs.org.uk/environmental-topics/carbon-reduction-and-efficiency/scotland-s-deposit-return-scheme/what-is-the-deposit-return-scheme-drs/#:~:text=The%20DRS%20applies%20to%20drinks,Aluminium*

Net Pack Fill	=	Packing/Filling Table 1 - pack/filling	+	Imports Table 3A - imported for selling	+	Imports Table 3B - packaging removed from around imports	-	Exports Table 2A + Table 2B – pack/filling

This methodology took the weight reported at the *packing* stage of the supply chain as opposed to the *selling* stage of the supply chain. This was used as it is believed by stakeholders[89] that there would be fewer unobligated packers in comparison to unobligated sellers, due to the likely size of the businesses. In addition, raw material manufacturing will include process losses, i.e. not everything manufactured will be converted or pack/filled, so it is expected that the tonnage goes down moving down the supply chain.

Using this method, the total obligated plastic POM in 2022 is 1,875k tonnes.

Table 20: Obligated Plastic Packaging (Net Pack Fill), 2022 (k tonnes) Registrations to Date[90]

	Plastic
Table 1 Pack/Fill (UK pack/filling)	1,400
Imports:	
3A Selling (filled imports)	530
3B (packaging removed from imports)	75
Total	**2,006**
2A P/F (direct exports)	171
2B P/F (third party exports)	7
Total Exported	178
Net Pack Fill	**1,828**

[89] *No evidence data is available to support this.*
[90] *Consolidated tables for all activities extracted from NPWD on 28th September 2023.*

This method does not account for plastic packaging handled by:

- Producers who are yet to register in 2023;
    - Valpak have made an estimate as to the additional tonnage that will be added – this takes the full projected net pack fill to 1,875k tonnes; and
    - This projection has been shared with stakeholders throughout the process.
- Unregistered producers, which was likely to include the following;
    - Non-obligated producers – those below the registration thresholds of 50 tonnes of packaging or £2 million turnover;
    - Free-riders – those obligated to register but not doing so; and
    - Illegal importers.

There is no way of robustly quantifying the unreported quantity of packaging. Based on feedback from the stakeholder group, it is believed that the number of pack/fillers who are unobligated is small due to the likely volumes handled by the types of companies performing this activity.

An estimate of the unobligated tonnage (206k tonnes, 10%) has been made by subtracting the net pack fill figure of 1,875k tonnes from the project's POM estimate of 2,082k tonnes. Further details are provided in section 4 of this report.

3. Scheme Administrator Submissions (formally referred to as 'household/household-like')

Through the course of the PackFlow projects, the definition of that subset of the total packaging POM which will attract additional fees to meet the costs of collecting packaging from households has evolved. Previously through the development of the UKs EPR system this had been referred to as 'household/household-like' packaging placed on the market.

This section of the report details the latest interpretation of this requirement, referred to here as Scheme Administrator Submissions (that is to say, the total tonnage of packaging POM that is like to be declared by obligated business to the scheme administrator as meeting the criteria of being for public/consumer use). Within this analysis, the packaging that should be included in the scheme administrator submissions is that around products which are 'consumed' by citizens as a part of their daily lives, as opposed that which goes to businesses for use part of their commercial operations. With this in mind, the way citizens buy products (and therefore get packaging) within the packaging flow breakdown identified in the PackFlow reports is through retail (only, be that online or bricks and mortar) or from takeaway hospitality.

In most instances, it is fairly clear as to whether products are provided for public/consumers or not. One such specific nuance is around some products that are bought within a hospitality setting but that could be consumed within premises or could be taken away. Particularly prevalent to the final tonnage of material that could (or could not) fall within Scheme Administrator Submissions is products within the HORECA sector, such as wine bottles in restaurants and beer bottles or cans in pubs. These packs are intended for public/consumers and may or may not be sold in a hospitality setting, and when they are, may or may not leave the business setting and corresponding private waste stream. As such these packs have been included in Scheme Administrator Submissions within this analysis.

Table 21: Total Expected Scheme Administrator Submissions

Material / Situation	Total POM	Total Consumer	Total Non-Consumer	Total Hospitality	Total Hospitality - Takeaway Only	Estimate of total scheme administrator submissions (consumer in scope)
Plastic - All	**2,082**	1,267	815	205	57	**1,324**
Plastic - excluding DRS	**1,853**	1,048	805	195	47	**1,095**

The total tonnage of packaging POM that is like to be declared by obligated business to the scheme administrator as meeting the criteria of being for public/consumer use (formally referred to as 'household / household like') is 1,324kt, or 1,095kt when DRS material is excluded.

4. Summary of Plastic Packaging POM

This project's estimate of plastic packaging POM in 2022 is 2,082k tonnes (+/- 6%).

This is made up of a combination of top-down (non-consumer total film) and bottom-up (consumer, non-consumer rigid packaging and non-consumer film sector breakdown) methods. It has been cross-checked with reported obligated data on NPWD.

The estimate of plastic packaging POM in the consumer sector is 1,267k tonnes (+/- 6%) in 2022.

This method is based on primary data alongside reliable market share data. No other method is used to derive consumer data as this method is considered the most robust there is available and is accepted by industry as such.

The estimate of plastic packaging POM in the non-consumer sector is 815k tonnes (+/- 13%) in 2022.

For film, this method is based on a combination of primary (survey) data and secondary research. For rigids, this is based on the findings of the WRAP/Valpak report into rigid packaging in the C&I sector and on secondary research.

Table 22: Plastic Packaging POM by Sector and Format, 2022 (k tonnes)

	Total	Bottles/PTTs	Film	Other
Consumer	**1,267 +/- 6%**	822	336	109
Non-consumer	**815 +/- 13%**	429	371	14
Total	**2,082 +/- 6%**	1,251	707	124

The total POM estimate was found to be 206k tonnes higher than data reported by obligated companies under the Packaging Waste Regulations (using the UK net pack/fill calculation method). This suggests that non-obligated companies (handling fewer than 50 tonnes of packaging or with lower than £2 million turnover), account for 10% of plastic packaging in the UK. This has decreased from the 13% non-obligated POM identified in 2019.

It is important to stress that the net pack/fill estimates are themselves open to the possibility of a degree of error because they rely on the robustness of the data that is submitted to NPWD. The NPWD data is widely recognised as being the best available as there is a legal obligation for companies to submit data that is as accurate as reasonably possible, which is then audited by the regulating body. This data is used by policy makers and their agencies.

This report recommends further work to improve the data accuracy of the C&I sector as well as clarifying the definition of what is classified as agricultural film for a packaging application, for example bale wrap, and what is not e.g., silage wrap/poly tunnels.

5. Consumer Packaging in the Household Waste Stream

In July 2022, Valpak delivered a report to WRAP and Defra entitled Producer Reporting of Household Vs Household-Like Packaging ((POS101-030). Within this project, Valpak developed a methodology for estimating the quantity of consumer packaging that entered the household waste stream.

5.1. Methodology

The process of mapping retail packaging POM to household waste streams was to first assign a ruleset based on likely disposal location against each of the 2,655 EPIC product categories. The end goal was to assign each EPIC category a robust percentage 'likelihood of being disposed of in a household bin'.
For consumer packaging, it was assumed that consumer packaging which was not disposed of within the household waste stream would instead be disposed of within a household-like waste stream, such as 'on the go' litter bins, mixed recycling in business premises such as work, leisure venues, hospitality / HORECA settings (including hotels) or other destination locations.

5.2. First Iteration – Indicative Disposal Routes

The first iteration of the analysis used Valpak staff judgement to assign an indicative disposal route to each EPIC category as follows:

- 100% likely disposed of in households (default);
    - These are product categories that are deemed to always be consumed in the home.
- 92.15% disposed of in households;
    - This acknowledged that there are some products that are distinctly household in nature, but for which it would not be surprising to see such items in a commercial general waste or recycling bin;
    - 92.15% is used as a proxy as this is the proportion of households to commercial properties, excluding those properties at which there are unlikely to be any employees, such as residential or other buildings registered as businesses due to hosting advertising; and
    - This assumption is based on ONS data[91] [92].
- Estimates of split where products are deemed to be consumed away from the household as a matter of course, applying an arbitrary split of:
    - 50% HH, 50% HH-L default, or
    - 25% HH, 75% HH-L by exception, or
    - 75% HH, 25% HH-L by exception

5.3. Second Iteration – Sensitivity Analysis

These percentages were subject to a sensitivity analysis to define which product categories (and associated assumptions as to point of disposal) had the highest impact on the final split of POM between household and household-like disposal. Categories with the highest impact were included in the consumer engagement exercise detailed below, generating increased levels of accuracy as to the likely disposal point.

[91] www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/families/datasets/householdsbyhouseholdsizeregionsofenglandandukconstituentcountries
[92] www.gov.uk/government/statistics/non-domestic-rating-stock-of-properties-2020

5.4. Third Iteration - Consumer Engagement

Valpak identified 23 key product types which were the most sensitive in defining the overall outcome of the HH and HH-L waste stream split by weight, across all materials. 2,007 consumers, selected across all age ranges, demographics and nations within the UK, were surveyed for each product type.

The questions posed were as follows:

1. Small Milk - Think about the last time you finished a small bottle (approx. 1 pint or less) or carton of milk or non-dairy alternative. Where was that bottle or carton thrown away?
2. Medium Milk - Think about the last time you finished a medium size (1-4 pints) bottle or carton of milk or non-dairy alternative. Where was that bottle or carton thrown away?
3. Large Milk - Think about the last time you finished a very large (4 or 6 pints) bottle or carton of milk or non-dairy alternative. Where was that bottle or carton thrown away?
4. Tinned Food - Think about the last time you consumed canned food – e.g. baked beans or soup. Where was the can thrown away?
5. Multipack Ice Cream - Think about the last time you unwrapped an ice cream cone, ice lolly, ice pop, choc ice or similar that was bought as a part of a multipack. Where was the plastic or paper wrapper (not the multipack box) thrown away?
6. Large Soft Drink - Think about the last time you finished a large (greater than one serving / greater than 500ml) bottle or carton of soft drink (fizzy or still prepared drinks, juice carton etc). Where was the bottle or carton thrown away?
7. Large Snacking (Not Singles) - Think about the last time you finished a large (greater than one serving) snack product (for example a multiple serving packet or tube of crisps, crackers or nuts, or packet of biscuits). Where was the packaging thrown away?
8. Deodorant - Think about the last time you finished a deodorant or anti-perspirant (spray, stick, roll on or other). Where was the empty packaging thrown away?
9. Ready Meal - Think about the last time you ate a small hot ready meal (serves one or two people). Where was the packaging thrown away?
10. Cereal - Think about the last time you finished a box or bag of cereal, porridge or Muesli. Where was the packaging thrown away?
11. Spread - Think about the last time you finished a pack of spread such as, jar of jam, marmalade or curd, peanut butter, honey, yeast extract, chocolate spread or similar (excluding butter, margarine and similar). Where was the packaging thrown away?
12. Fruit Packs - Think about the last time you bought packaged fruit from the supermarket (bags, nets or boxes, excluding the purchase of loose products). Where was the packaging thrown away?
13. Soft Drink Multipack - Think about the last time a single serve soft drink (cans, bottles or single serve cartons) that you purchased as a part of a multipack was consumed. Where was that packaging (can, bottle or single serve cartons) thrown away?
14. Single Soft Drink - Think about the last time you purchased a single unit of soft drink (a single can, bottle or carton). Where was the packaging thrown away?
15. Snack Multipack - Think about the last time that a snack item that you bought as part of a multipack (such as a 6-pack of crisps, cereal bars, small raisin boxes, chocolate bars) was consumed. Where was the packaging thrown away?
16. Single Snack - Think about the last time you purchased a single serve snack item (such as a single packet of crisps or a single chocolate bar – this would include where such items are sold as part of a 'meal deal'). Where was the packaging thrown away?
17. Pot Noodle - Think about the last time you ate a snack pot or a similar item requires the addition of boiling water, such as a noodle pot, instant soup or instant pasta and sauce. Where was the packaging thrown away?
18. Smoking - Think about the last time you bought smoking items (such as cigarettes, cigars, matches, cigarette papers, vape liquid or single use vape sticks). Where was the packaging thrown away the last time one such item was finished?
19. Supermarket Sandwich Etc - Think about the last time you bought 'food on the go' items from a supermarket, such as pre-packed sandwiches, potted salads, sushi, sausage rolls etc. Where was the packaging thrown away?
20. Fast Food (Non-Supermarket) - Think about the last time you ate 'food on the go' items that were purchased from somewhere other than a supermarket (for example a coffee shop, sandwich shop or fast-food outlet). This may include but is not limited to sandwiches, sushi and rolls or hot and cold fast food. Where was the packaging thrown away?

21. Takeaway - Think about the last time you ate a takeaway meal. Where was the packaging thrown away?
22. Wine - Think about the last time you finished wine bought from a retailer (supermarket, off licence or local store). Where was the packaging thrown away?
23. Beer/Cider - Think about the last time you consumed beer or cider (with or without alcohol) bought from a supermarket, off licence of local independent store (whether that is cans or bottles, singles or multipacks). Where was the last can or bottle that you finished thrown away?

The Response options given were as follows (where required, the language was adapted to best suit the product in question):

- In the bin at my home (into recycling or general waste);
- In the bin at my work (into recycling or general waste);
- Into a litter bin in a public space;
- Somewhere else; and
- I/We don't use this type of product, or I can't remember the last time I/we used this product.

Analysis was undertaken to check the logic of responses, for example to make sure that no participants provided the same answer to all questions.

Results suggested a range of values to represent the probability of disposal within the household (and, therefore, household-like) waste streams for those categories for which any inaccuracy would have a high impact on the overall result. These values ranged from 21.2% to 78.4% and were shared in full with both WRAP and Defra within the Producer Reporting of Household Vs Household-Like Packaging report.

5.5. Fourth Iteration – Similar Categories

Finally, Valpak undertook an analysis to establish similar categories in terms of likely consumption, such that insight from the consumer engagement could be shared across a wider set of categories. Where appropriate, the indicative disposal routes from the first iteration of this exercise were updated to provide a more robust probability of ending up in the household waste stream.

5.6. Application to 2022 POM

Valpak have applied the same probabilities to the 2022 POM figures as calculated within this project to create the total amount of consumer packaging disposed of in the household waste stream (household bins).

5.7. Proportion of Packaging Disposed of Within the Household Waste Stream

Based on the methodology detailed above, the total proportion of consumer plastic packaging from Grocery retailers that is disposed of in the household waste stream is 80%. The total proportion of consumer plastic packaging from Non-Grocery retailers that is disposed of in the household waste stream is 93%. This is based on same sample of retailers as is used in the rest of this report and equates to 1,050kt (83%) of packaging in total across both Grocery and Non-Grocery retail (consumer packaging).

The proportion of Grocery plastic packaging within the household waste stream is detailed in Table 23 below.

Table 23: Proportion of Plastic Grocery Packaging Disposed of Within the Household Waste Stream

	HDPE	LDPE	Other	PE	PET	PP	PS	PVC
Bottle	79%	77%	64%	68%	74%	86%	62%	100%
Film	77%	85%	84%	85%	87%	79%	70%	85%
Other rigid	71%	84%	89%	78%	74%	83%	85%	83%
PTT	82%	99%	83%	99%	82%	83%	70%	89%

The proportion of Non-Grocery plastic packaging within the household waste stream is detailed in Table 24 below.

Table 24: Proportion of Plastic Non-grocery Plastic Packaging Disposed of Within the Household Waste Stream

	HDPE	LDPE	Other	PE	PET	PP	PS	PVC
Bottle	98%	99%	99%	99%	79%	98%	-	-
Film	97%	94%	95%	90%	91%	95%	99%	97%
Other rigid	93%	76%	98%	76%	95%	86%	90%	95%
PTT	99%	99%	99%	98%	93%	98%	97%	99%

6. Consumer Packaging in the 'Litterable' Categories

In the project entitled Producer Reporting of Household Vs Household-Like Packaging (POS101-030), delivered to WRAP and Defra in July 2022, Valpak developed a methodology for estimating the total quantity of consumer packaging that fell within the 'litterable' categories as defined by WRAP using analysis outlined in a corresponding report[93] produced by Keep Britain Tidy (KBT).

Flagging was applied to product categories within the Valpak EPIC database to align to those product and packaging types identified by KBT. Where the boundaries of inclusion within the litterable categories did not align to EPIC categories, for example but not limited to where the size thresholds within EPIC spanned over the size threshold identified by KBT, additional analysis was undertaken on the EIPC categories to identify proportion of sales (by weight of packaging) that did fall within the KBT categories. In these instances, these proportions were used in place of a binary 1 (in a litterable category) or 0 (not in a litterable category) to give a true indication of the total weight of packaging material that falls within these category types.

6.1. Proportion of Packaging that Falls Within the Litterable Categories

Based on the methodology detailed above, the total proportion of consumer plastic packaging from Grocery retailers within the 'litterable' categories detailed above is 26%. The total proportion of consumer plastic packaging from Non-Grocery retailers within the 'litterable' categories is 3%. This is based on same sample of retailers as is used in the rest of this report and equates to 257kt of packaging in total.

The proportion of Grocery plastic packaging within the litterable categories is detailed in Table 25 below.

Table 25: Proportion of Plastic Grocery Packaging that Falls Within the Litterable Categories

	HDPE	LDPE	Other	PE	PET	PP	PS	PVC
Bottle	4%	2%	80%	66%	68%	12%	80%	0%
Film	31%	10%	14%	11%	10%	37%	9%	4%
Other rigid	60%	3%	3%	41%	19%	6%	3%	6%
PTT	4%	0%	4%	2%	10%	2%	0%	0%

The proportion of Non-Grocery plastic packaging within the litterable categories is detailed in Table 26 below.

Table 26: Proportion of Plastic Non-Grocery Plastic Packaging that Falls Within the Litterable Categories

	HDPE	LDPE	Other	PE	PET	PP	PS	PVC
Bottle	0%	0%	0%	0%	33%	0%	-	-
Film	0%	0%	0%	1%	0%	0%	0%	0%
Other rigid	21%	0%	0%	19%	0%	0%	0%	0%
PTT	0%	0%	0%	0%	0%	0%	0%	0%

[93] www.keepbritaintidy.org/sites/default/files/resources/20200330%20KBT%20Litter%20Composition%20Report%20-%20FINAL.pdf

7. By Nation Reporting

7.1. Introduction

This section of the report separates the total amount of packaging placed on the market (POM) by the four nations of the UK (England, Northern Ireland, Scotland, and Wales). These indices are intended to be indicative of the total amount of packaging placed on the market each of the nations and consider each sector identified as a source of packaging for each material in isolation. Appropriate economic indicators are then applied to each of the sectors. At this time, neither Valpak nor Government have access to data from obligated businesses which describes accurately the total POM by nation (although 'by nation reporting' from 2024 will provide such insight) and as such this is proposed to be an appropriate method of estimating such a split by apportioning total POM by sector to each nation by a suitable scaling factor.

7.2. Scaling Factors - Background

An appropriate scaling factor for each of the sectors identified in the reports are detailed below, along with alternative factors which were also considered where appropriate.

Factors were found and applied to the sectors identified in the PackFlow reports by material. The sectors identified and the associated factors are detailed below.

7.2.1. Agriculture

Valpak considered national statistics for agriculture relating to employment[94], income, the number of holdings and the total hectares[95] in each of the nations as follows.

Table 27: Metrics Relating to Agriculture in the Nations of the UK in 2022

	Employment	No of Holdings	income / farm 21/22	Total income	Hectares
England	297,400	104,476	448,500	£46,857,486,000	9,098,253
Northern Ireland	52,200	25,952	83,500	£2,166,992,000	1,035,642
Scotland	67,400	23,345	332,000	£7,750,540,000	5,012,957
Wales	50,400	37,116	113,000	£4,194,108,000	1,765,566

Note, that in this instance, the total income was calculated using the total income per farm multiplied by the number of holdings.

These metrics were then calculated as proportions of the UK packaging sector to be assigned to each nation as follows.

Table 28: Proportion of Key Metrics Relating to Agriculture in the Nations of the UK

	Employment	No of Holdings	Total income	Hectares
England	64%	55%	77%	54%
Northern Ireland	11%	19%	7%	10%
Scotland	14%	12%	13%	30%
Wales	11%	14%	4%	6%

94 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1106562/AUK_Evidence_Pack_2021_Sept22.pdf

95 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1088518/AUK-Chapter2-14jul22.ods

In this instance, it was decided that the proportion of total holdings and total hectares were inappropriate factors to use because these are likely to be skewed by very large farms for grazing livestock (for which the packaging may not be proportional to the size or number of farms). As such employment and total income were then considered. Whilst neither is likely to be entirely accurate, employment was chosen as the reasonable metric on the basis that total income again could be skewed by the relative value of the output of the farm itself. Instead, the assumption is that a farm worker is equally likely to open packaged product as any other as a farm work on their or any other farm during their day-to-day duties. As such, it was decided that the most appropriate figure for this calculation was to use employment.

7.2.2. Population

Population statistics were obtained from ONS from census data in 2021. Whilst there are some estimates of 2022 populations, it was decided that actual numbers in 2021 would be a reasonable proxy for working out the proportion of residents across the UK that live in each country in 2022 (when applied and reported in kt).

Table 29: Scaling Factor for Each Area

	Population mid-2021	Population proportion
England	56,536,000	84%
Northern Ireland	1,905,000	3%
Scotland	5,480,000	8%
Wales	3,105,000	5%

7.2.3. Construction

Various factors were considered within construction sector, however, as is the case in agriculture, the total employment[96] [97] was deemed to be a suitable factor for defining the relative size of the corresponding sector in each the nations. This removes issues such as the relative size of the individual business, cost and availability of materials and value of the building, any discrepancies over land value that may exist and any other issues around other cost complexities or differences in the sizes of building.

Table 30: Proportion of the Employees Within the Construction Sector in Each of the Nations of the UK

	Employment in construction	Employment proportion
England	1,213,614	85%
Northern Ireland	35,135	2%
Scotland	123,000	9%
Wales	54,500	4%

7.2.4. GDP

Those aspects of POM in the Non-Consumer (manufacturing) sectors were scaled by GDP[98] to represent manufacturing output.

[96] GB data: https://www.ons.gov.uk/file?uri=/businessindustryandtrade/constructionindustry/datasets/constructionstatisticsannualtables/2021/constructionsannualtables2021.xlsx
[97] Northern Ireland Data: https://www.nisra.gov.uk/system/files/statistics/2022q2soti.xlsx
[98] https://www.ons.gov.uk/economy/grossdomesticproductgdp/bulletins/gdpukregionsandcountries/januarytomarch2022, https://www.gov.scot/publications/gdp-quarterly-national-accounts-2022-q2/, https://www.nisra.gov.uk/statistics/economic-output-statistics/ni-composite-economic-index

Table 31: Proportion of Total UK GDP by UK Nation

	GDP (£ bn)	GDP Proportion
England	1,961,238	87%
Northern Ireland	51,717	2%
Scotland	169,162	7%
Wales	79,699	4%

7.2.5. Hospitality

Data as to the relative size of the hospitality sector in each of the nations is available from Government statistics in terms of the number of establishments in 2017[99]. This data was used as a proxy for the size of the relative markets in 2022. Number of establishments was used instead of other metrics such as sales due to the potential for the outcome to be skewed by high cost establishments.

Table 32: Proportion of Total UK Hospitality by UK Nation

	Number of establishments (From 2017)	Proportion of hospitality
England	71,527	82%
Northern Ireland	3,973	5%
Scotland	6,017	7%
Wales	5,913	7%

7.3. Sector Scaling Factors Used

The scaling factors used for each sector in the by nation 2022 POM reporting is shown below in Table 33.

Table 33: Scaling Factors Used for Each Sector in the By-Nation 2022 POM Reporting

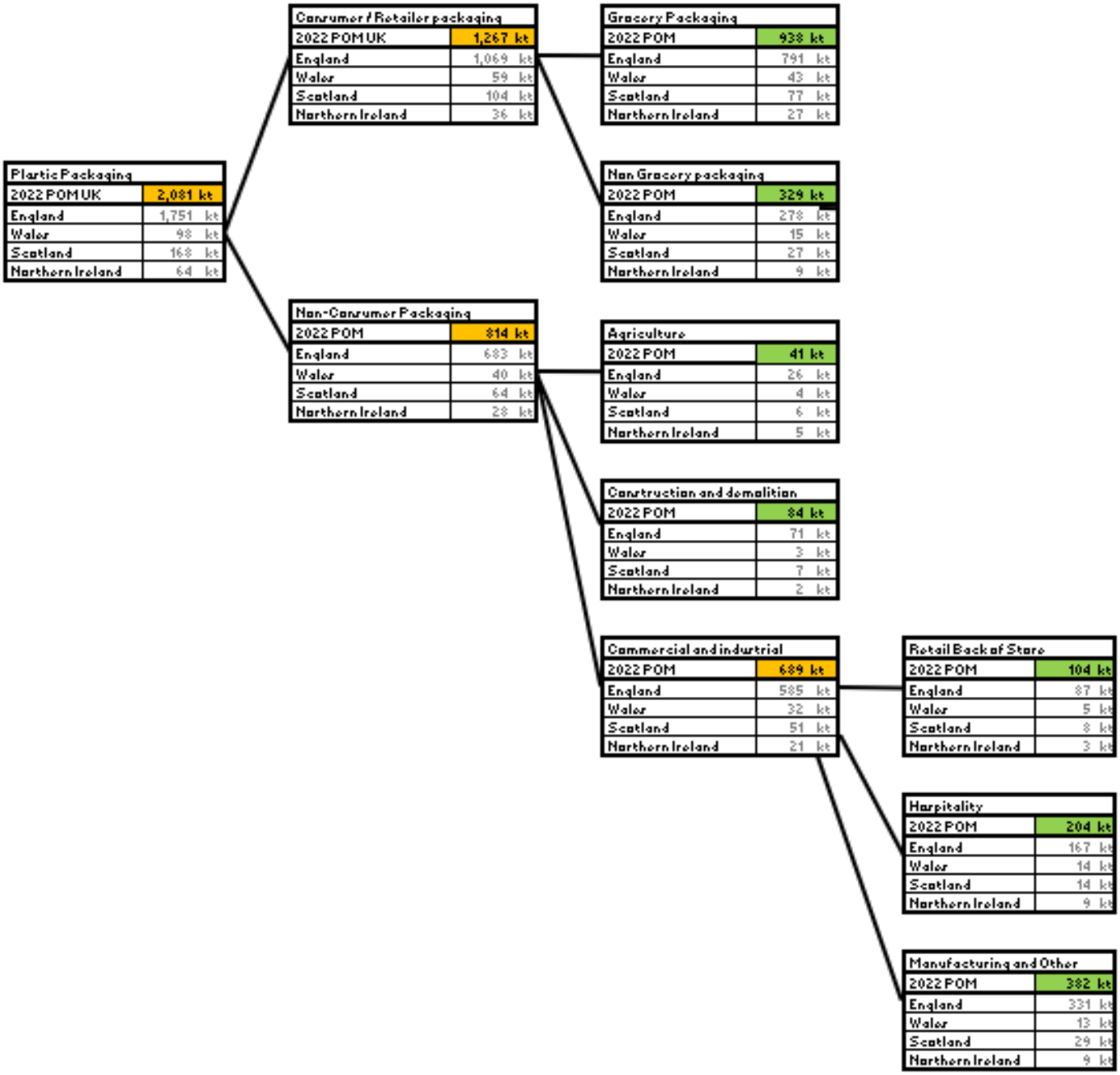
Sector	Scaling Factor
Grocery	Population
Non-Grocery	Population
Shipment	Population
Agriculture	Agriculture
Construction and demolition	Construction
Retail Back of Store	Population
hospitality	Hospitality
Manufacturing and Other / Other C&I	GDP
Non consumer Packaging (glass)	Hospitality
Non consumer Packaging (wood)	Construction

[99] https://assets.publishing.service.gov.uk/media/5d67a363ed915d53b4904899/Hospitality_and_Tourism_Workforce_Landscape.pdf

7.4. POM by Nation – Plastic

Applying the scaling factors detailed above, the total POM in 2022 broken down by nation for plastic is as follows:

Figure 11: POM by Nation – Plastic



8. Phase 1: Collection and Recycling of Plastic Packaging

8.1. Introduction

The levels of plastic packaging collected for recycling within the UK in 2022 were assessed. Plastic packaging collections and recycling are split into consumer and non-consumer waste streams. The full list of categories is shown below.

- Consumer bottles and PTTs;
- Consumer film;
- Non-consumer bottles;
- Non-consumer other rigids; and
- Non-consumer film.

Data from NPWD, UK reprocessor and exporter discussions/survey and RECOUP's UK Household Plastics Collection Survey 2022[100] were fed into an Excel model to quantify the collection and recycling of UK plastic packaging. It should be noted that the Recoup 2022 survey gives data for the year 2021, but was the latest available at the time of carrying out this work. It is not expected that there will be significant changes between 2021 and 2022. The UK reprocessor and exporter survey formed part of the Plastic Flow 2025 project and the results provided estimates for 2017 recycling. Further discussions, together with in-house knowledge of how the plastics recycling sector has changed since then, have been used to provide 2022 estimates. The results are provided below.

8.1.1. Assumptions

The outputs from recyclers were calculated based on discussions with industry and allow for removal of:

- Non-target recyclables, e.g. coloured PET bottles. These may be recycled by others or exported and so show up elsewhere in the analysis;
- By-products, such as the polyolefin float fraction (caps, labels from PET recycling). As with the above, this fraction may be recycled by others and so show up elsewhere in the analysis;
- Process loss; and
- Non-plastic waste.

Based on in-house expertise and Steering Group guidance, the conversion rates (percentage of r-polymer out compared to recovered plastic in) for UK recycling used in this report are:

- PET bottles / trays: 57.5%[101];
- HDPE bottles / trays: 80%;
- PP bottles / trays: 70%;
- LDPE film (household): 60%;

[100] *RECOUP's most recent survey based on 2022 data was not published at the time of writing this report and so the 2022 survey (based on 2021 data) was used*

[101] *Whilst it is acknowledged that PET bottles tend to have a higher conversion rate than PET trays/other rigid packaging, separate conversion rates have not been included within this project. Conversion rates vary between reprocessors due to quality and levels of contamination as well as different packaging formats, and it was felt that after several discussions with reprocessors within the PET recycling sector, a PET bottle/tray conversion rate of 57.5% was a reasonable estimation of the mid-range. All of the conversion rates have also been checked and agreed on by the Steering Group.*

- LDPE film (C&I, agricultural and C&D): 80%; and
- C&I rigids: 90%.

There can be differences based on what the recycler is targeting and input quality, but these are felt to be reasonable averages across the sector. It should be noted that the conversion rates are estimated in increments of 2.5%. The non-consumer LDPE film conversion rate reflects the fact that it is predominantly the higher grades of packaging film that are recycled in the UK. C&I other rigids recycled in the UK are assumed to be items such as crates and other large plastic items with minimal contamination and process loss.

The Environment Agency list of plastic reprocessors accredited to issue PRNs splits into two sizes of reprocessors, small (able to issue up to 400 tonnes of PRNs per annum) and large (able to issue over 400 tonnes per annum). Effort was focused on identifying how much those defined as large recyclers processed, in particular those believed to be handling more than 10k tonnes per annum. It was assumed that all small recyclers (as defined by the Environment Agency) processed 300 tonnes of packaging waste per annum.

8.1.2. UK Recycling Cross-check

The final figures from this exercise, in relation to output of recycled polymer, were sense checked against PRNs issued in the UK in 2022. The total waste delivered into recyclers from the bottom-up model, based on the research described above, was 690.5kt tonnes across all polymers. NPWD has a waste received figure of 651kt, about 6% lower. A calculation was also done on the 690.5kt of waste delivered to recyclers to model it into the number of PRNs we would expect to generate from it. This was done by polymer. This gave a modelled PRN figure of 641kt, which is around 4% higher than the actual NPWD figure of 619kt. Considering that the reprocessing model was built using assumptions across 138 recyclers, the figures were felt to be relatively close.

8.1.3. Export

The RECOUP LA Collection Survey data was used as a basis for household (consumer) waste plastic packaging collected in the UK. Having produced an estimate for how much of the collected material was recycled in the UK, it was assumed the remainder was exported for recycling.

To identify the tonnage of C&I plastic packaging exported, first the total number of PERNs issued in 2022 was adjusted to reflect the actual tonnage that was exported to generate those PERNs. It was assumed that for every one tonne of waste plastic exported 0.9 PERNs are issued. This ratio is in line data on NPWD. From the total tonnage of waste plastic exported, the consumer waste plastic was removed to leave a balancing figure for C&I waste plastic.

An estimate was made on how this packaging was split between rigids and films. Based on input from industry, it was assumed that rigid non-consumer packaging accounted for 35% of total non-consumer exported packaging, and films accounted for 65%.

Films are known to be a key component of waste plastic exported from the UK. Large volumes of LDPE films are produced in the UK from C&I sources. Historically, it has only been the highest quality C&I films recycled in the UK, such as 100% and 98:2 grades. This is starting to change with more 95:5 and retail grades now recycled in the UK, sometimes after sorting in specialist facilities. However, export is still weighed towards the mid and lower quality films.

The findings derived from the aforementioned methodology resulted in the following 2022 outputs:

- Consumer recycling (in/out);
- Non-consumer UK recycling (in/out);
- Consumer exports;
- Non-consumer exports; and
- Total recycling.

Each of these are discussed in more detail in the sections below.

8.1.4. Consumer Collections

The consumer (Local Authority) collection figure of plastic packaging in the UK in 2021 from the RECOUP survey was used as a proxy for 2022 collections[102], as it was felt that there would be little difference between the two years. Details of the collection figures can be found in Table 34.

Table 34: Consumer Plastic Packaging Collected, 2022 (k tonnes)

	Total
UK Total Bottles	407
UK Total Plastic Pots, Tubs & Trays	174
UK Total Film	25

The figure above splits the consumer collections into bottles, rigids, and films, as in the RECOUP collections report. Based on this, Note that collection rates are based on a collected waste figure that will contain some contamination and so will be an overestimate. Note that collection rates are based on a collected waste figure that will contain some contamination and so will be an overestimate.

Table 35 shows the collection tonnages, and the associated collection rates of all consumer streams in 2022. Note that collection rates are based on a collected waste figure that will contain some contamination and so will be an overestimate.

Table 35: Consumer Plastic Packaging Collection Rates, 2022 (k tonnes,%)

Stream	POM	Collected	Collection Rate
Consumer Total	1267	606	48%
Consumer PTTs/Bottles	929	581	63%
Consumer Film	338	25	7%

This shows that 606k tonnes of consumer plastics were collected for recycling in 2022. Compared to 2019, this represents an increase in PTT and bottles of 10% and 19% for film collected.

RECOUP data is used rather than WasteDataFlow (WDF) as it is considered more accurate: RECOUP receive more timely data which is relevant to the same time period as the POM. WDF data relating to all of 2022 is not yet released[103]. RECOUP is also able to calculate more appropriate splits where plastic packaging data is reported co-mingled with other materials (WDF is mainly based on averages).

[102] *RECOUP's most recent survey based on 2022 data was not published at the time of writing this report and so the 2022 survey (based on 2021 data) was used.*
[103] *At time of reporting.*

However, WDF data was used as a sense-check, which supported this estimate[104]. It was also used to identify where plastic packaging is collected and showed that the majority of consumer plastics are collected at kerbside with 99%(~600 tonnes), followed by CA sites (~3 tonnes) and bring sites (~3 tonnes) both at <1%[105][106].

Appendix I provides a detailed assessment of relative levels of confidence in the data.

8.1.5. Consumer Recycling

It is estimated that 419k tonnes of consumer waste plastic packaging was recycled in the UK during 2022, of which the majority was rigid material (bottles and PTT). RECOUP estimate that there was 581k tonnes of rigid consumer plastic collected when using 2021 as a proxy for 2022. This would mean that 63% of rigid consumer waste plastic packaging was recycled in the UK. Of the small amount of consumer films collection, it was estimated that around 17kt was recycled in the UK. There is still a limited capacity to recycle consumer films in the UK with them not being collected at scale. Consumer films recycled in the UK tend to be handled in facilities focused on commercial and industrial grades and some will have undergone pre-treatment, for example sorting, to make them suitable for the existing recycling infrastructure.

Table 36: Consumer UK Domestic Plastic Packaging Recycling, 2022 (k tonnes)

Recovered plastic grade	Recovered plastic (IN)	Recovered plastic (OUT)
Rigid PET (bottles, trays)	205	118
Rigid HDPE (bottles, trays)	118	94
Rigid PP (bottles, trays)	69	48
Films	17	10
Total	**409**	**270**

8.1.6. Non-consumer Recycling UK

For non-consumer recycling in the UK, the largest fraction being recycled is LDPE films, at almost 71% of the total. The packaging films being recycled in the UK tend to be the higher quality grades, typically the highest quality C&I films such as 98:2 and 99:1 / 100% clear and coloured grades. Non-consumer film tends to be from C&I sources; however, a small fraction will be C&D and agricultural film.

Table 37: Non-consumer UK Domestic Plastic Packaging Recycling, 2022 (k tonnes)

Recovered plastic grade	Recovered plastic (IN)	Recovered plastic (OUT)
Rigid PET (bottles, trays)	3	2.5
Rigid HDPE (bottles, trays)	21.5	19
Rigid PP (bottles, trays)	56	51
Films	201	161
Total	**282**	**234**

Rigid non-consumer plastic packaging recycled in the UK tends to be relatively clean HDPE and PP material, including items such as crates, pallets, trays and drums. Some polyolefin plastics packaging material also arises

[104] *The latest published WasteDataFlow (WDF) figures (2021/22 for England, Wales, Northern Ireland and 2021 for Scotland) were used to sense check the RECOUP estimates for consumer plastics collected in 2021. Using WDF data there were 537k tonnes of consumer plastics collected for recycling which was shared with the steering committee.*
[105] *WDF data (2021/22 for England, Wales, Northern Ireland and 2021 for Scotland)*
[106] *Due to limited insight into the split of plastic packaging collected at CA sites and bring sites, the assumption of a 0.5% collection rate has been used.*

in mixed rigid plastics from civic amenity sites. It has been assumed this has come from C&I sources (for example, small businesses and restaurants), although some will also have come from consumer sources. C&I rigid plastics that do not require washing can be processed using relatively inexpensive equipment and as a result, recycling of this stream is relatively dispersed. The majority of rigid non-consumer packaging will be C&I, however there will be a small amount from C&D and agricultural sources.

8.1.7. Consumer Export

All polymer sorted grades of consumer rigid plastics are exported for recycling, including PET, HDPE and PP. In addition, unsorted mixed bottles are also exported for polymer sorting and recycling overseas. As mentioned above, the export figure is the balance of the RECOUP collection figure not believed to be recycled in the UK.

Table 38: Consumer Plastic Packaging Exported, 2022 (k tonnes)

Recovered plastic	Tonnage exported
Bottles and PTT	189
Film	8
Total	**197**

8.1.8. Non-Consumer Export

It is believed that the majority of the LDPE films exported are C&I films sitting in the grade range of 70:30 to 98:2. These exports are driven by lower costs of processing in some overseas destinations, such as Turkey, in particular due to the level of manual intervention required to remove non-target items and labels. There is also strong demand from mainland European recyclers for the higher quality grades in this range.

Table 39: Non-consumer Export (films), 2022 (k tonnes)

Recovered plastic	Total exported
Films (agricultural)	0
Films (C&D)	10
Films (C&I)	248
Total	**258**

C&I rigids include items such as HDPE drums, PP crates & pallets, PP bulk bags, and other PRN-able scrap from C&I supply chains such discarded bottles, trays, etc. It also contains bottles and PTT derived from the hospitality sector.

Table 40: Non-consumer Export (rigids), 2022 (k tonnes)

Recovered plastic	Total exported
Rigid (agricultural)	0
Rigid (C&D)	0
Rigid (C&I)	139
Total	**139**

8.2. Unaccredited Recycling

Unaccredited recycling is when plastic packaging is recycled without a PRN/PERN being raised for it.

The total tonnage for plastic packaging delivered to recyclers in 2022 was estimated to be 1,285k tonnes based on the bottom-up modelling. NPWD has a figure of 1,244kt, 3% lower. Whilst the difference may be related to unaccredited recycling, as the average PRN value in 2020 was £231 (Letsrecycle.com) it is felt more likely to be due to assumptions made during the modelling. Due to the high PRN value an assumption of no unaccredited recycling in 2022 was made as a recycler or exporter would not be able to compete for feedstock without being accredited and using the PRN / PERN value.

The fee for registering as a small accredited reprocessor or exporter to issue PRNs / PERNs is £505 and so for anyone issuing more than 2 or 3 PRNs/PERNs it would be worth being accredited. The number of accreditations also indicates that unaccredited recycling is likely to be very small. In 2019 there were 194 accredited recyclers and exporters of plastic. In 2022 this number rose to 279.

8.3. Total Plastic Packaging Recycling

Table 41 show the total plastic packing recycled in the UK and exported out of the UK in 2022.

Table 41: Total Plastic Packaging UK Recycling & Export, 2022 (k tonnes)

Stream	Recovered Plastic IN	Recycled Polymer OUT
Consumer UK Recycling	409	270
Consumer Export	197	130
Non-consumer UK Recycling (films)	201	161
Non-consumer UK Recycling (rigids)	81	73
Non-consumer Export (films)	258	181
Non-consumer Export (rigids)	139	111
TOTAL Recycled in / Recycled out	**1285**	**926**

9. Plastic Packaging Recycling Rates

Table 42: Summary of UK Plastic Packaging Waste into and out of Recyclers as a Percentage of POM, 2022

Waste Plastic Stream	POM (kt)	Recycled Plastic into Recycler (kt)	Recycled Plastic Out of Recycler (kt)	Recycled Plastic in as % of POM	Recycled Plastic out as % of POM
Consumer Total	**1267**	**606**	**400**	**48%**	**32%**
Consumer PTTs/Bottles	929	581	385	63%	41%
Consumer Film	338	25	15	7%	4%
Non-consumer Total	**815**	**679**	**525**	**83%**	**65%**
Non-consumer Rigids	429	220	184	51%	43%
Non-consumer Film	371	459	342	124%	92%
Non-consumer Other	14	0	0	0%	0%
Grand Total	**2082**	**1285**	**925**	**62%**	**44%**

It is important to note that neither recycled plastic in as a percentage of POM or recycled plastic out as a percentage of POM aligns with the official recycling rate (as measured in the UK). The latter is based on the waste plastic packaging supplied to recyclers minus any non-target material. The non-target material is based on sampling and so, in reality, does not fully account for factors such as food contamination or moisture. Looking at NPWD, we can see that the PRN / PERNs issued overall are 93% of the waste received / exported. An approximation of the UK recycling rate for plastic, as measured based on PRN / PERN issuing, could therefore be made by taking 93% of the of the modelled waste plastic inputs to recyclers and calculating this as a percentage of POM. This gives a recycling rate of 57%.

If measuring recycling (by weight) on entry to a reprocessor, the UK's domestic plastic packaging recycling rate is estimated at 62% (1,295k tonnes recycled). If measured after conversion on exit from reprocessing, the rate is lower at 45% (925k tonnes recycled). This total has been split by sector with consumer plastic packaging recycling rate estimated at 48% (606k tonnes recycled). If measured after conversion on the exit of reprocessing, the rate would be lower at 32% (400k tonnes recycled). For non-consumer plastic packaging, the recycling rate is estimated at 83% (679k tonnes recycled). If measured after conversion on the exit of reprocessing, the rate would be lower at 65% (525k tonnes recycled).

As with previous reports, the figures for non-consumer film are high. The recycled plastic into recyclers as a percentage of POM is likely to be particularly high due the percentage of non-target material in some grades of retail and supermarket film. Some of the non-target material is packaging and is recycled, however, it is generally rigid items such as PET and PP trays and strapping. As such, this will act to overstate the C&I film percentage and understate the rigid C&I percentage. The recycled plastic out figure is also higher than is likely to be the case. This could be due to a number of factors. Firstly, a high-level assumption has had to be made on the split of film and rigid C&I packaging exported due to the lack of data in this area. A second factor is that some of the film exported may not in fact be packaging. This could be a due the difficulties in separating packaging and non-packaging film but may also be due to miss-issuing of PRNs / PERNs on non-packaging material.

9.1 Plastic Packaging Not Recycled

By taking the consumer and non-consumer recycling totals from the respective POMs the non-recycled tonnages can be identified.

For consumer plastic packaging, the non-recycled total is 661k tonnes. An analysis of municipal waste data from the Department for Environment, Food & Rural Affairs (Defra, for England), the Scottish Environment Protection Agency (SEPA), StatsWales and the Department of Agriculture, Environment and Rural Affairs (DAERA, for Northern Ireland) was used to estimate the percentage of residual household waste that was sent to Energy from Waste (EfW) and landfill.

This showed that in 2022 approximately 80% of consumer waste was disposed using EfW and 20% to landfill. The 80% to EfW includes refuse derived fuel (RDF) that is exported to EfW plants in mainland Europe. Additionally, it is assumed that for plastic, any process loss during recycling (difference between the "Recycled Plastic into Recycler" and "Recycled Plastic Out of Recycler") will be sent to EfW. Using these percentages and the process loss quantities, it is estimated that of the total consumer plastic packaging not recycled, 735k tonnes was sent for energy recovery and 132k tonnes to landfill.

For non-consumer plastic packaging, the non-recycled total is 135k tonnes. Here, an assumption was made that the plastic content of C&I wastes entering EfW and RDF plants would be similar to that in MSW waste, therefore it was assumed that is follows a similar route to household residual waste. This showed that in 2022 approximately 80% of non-consumer waste was disposed using EfW and 20% to landfill. The 80% to EfW includes refuse derived fuel (RDF) that is exported to EfW plants in mainland Europe. Using these percentages and the process loss quantities it is estimated that of the total non-consumer plastic packaging not recycled, 262k tonnes was sent for energy recovery and 27k tonnes to landfill.

In summary, of the plastic packaging not recycled for both consumer and non-consumer packaging, 997k tonnes (80%) is sent for energy recovery and 159k tonnes to landfill (20%) in 2022, estimated using WDF and published statistics on UK disposal routes for plastic packaging.

This is based on an estimated total of 661k tonnes of consumer plastic packaging not being recycled and 206k tonnes process waste generated within the recycling process (assumed to be disposed of within EfW). For non-consumer, 135k tonnes has been estimated as not being recycled and 154k tonnes process waste generated within the recycling process (assumed to be disposed of within EfW).

10. Plastic Packaging End Markets

10.1. Introduction

This section looks at the key uses/end markets for recycled polymer produced in the UK from packaging waste. A summary of areas of usage for each polymer is shown below. The breakdown in the tables that follow is based on estimates of how recycled polymer produced in the UK is used, based on in-house knowledge and discussions with industry experts and recyclers. For PET, the recycled polymer is produced from bottles and trays (consumer and non-consumer from the hospitality sector). For HDPE, the largest volume of recycled polymer comes from food and non-food bottles, but rigid C&I packaging also forms part of this stream. For PP there is a roughly equal split between recycled polymer produced from automotive and rigid C&I packaging. Recycled LDPE is nearly all derived from C&I and manufacturing films.

r-PET is used in relatively few well defined markets making it easier to assess. For HDPE and PP, there are a wide range of different products manufactured from recycled polymer, which makes it difficult to provide a detailed split across all applications. Here, discussions with recyclers focused on the key market sectors and examples of products in each. HDPE and PP polymers are also sometimes blended to produce products, and in addition, recyclers may not always know the application for which they are being used. Percentages shown in the table below should therefore be treated as indicative. The vast majority of LDPE is used to make film products of different types, although some is used to make semi-rigid and rigid items (such as plastic wood). Products tend to be those where a small degree of discoloration, which can occur with the use of r-LDPE, does not cause any concerns amongst users, or where the film is often coloured. Hence the construction and agricultural sectors being key users of film produced with recycled content.

10.2. PET

A key application from recycled PET is the production of PET sheet which is then used to produce packaging items, such as trays. The use of PET in food contact applications, notably bottles, also remains an area of high demand.

Table 43: End Markets for PET Recycled in the UK

Application	Examples	Indicative Usage (%)
Sheet manufacture	Thermoform trays	25%
Bottles	Food and non-food bottles	70%
Fibre	Polyester fibre for fill	5%

Based on the output of recycling as identified in sections 8.1.5. and 8.1.6. and the indicative usage percentages above, it is estimated that 30k tonnes of recycled PET is used in sheet manufacture, 84k tonnes is used in bottle manufacture, and 6k tonnes is used in fibre production.

10.3. HDPE

Pipe manufacture is a key use of recycled HDPE polymer, particularly for coloured HDPE pellet. Another key use of recycled HDPE (from consumer sources) is the production of bottles. This includes food contact applications such as the production of milk bottles, but also increasingly to produce non-food contact bottles. Natural HDPE pellet, produced from milk and juice bottles, are typically preferred in these applications.

Table 44: End Markets for HDPE Recycled in the UK

Application	Examples	Indicative Usage (%)
Packaging	Food and non-food bottles.	50%
Construction	Pipes, chambers, roof spacers, plumbing items.	30%
Horticultural	Compost bins, water butts, wheel bins, watering cans, etc.	10%
Household items	Garden furniture, household items such as boxes and buckets.	5%
Mixed PO applications	Plastic wood and board, etc	5%

Compared to the indicative usages identified in the Pack Flow 2019 report, the use of recycled HDPE within packaging is estimated to have increased from 45% to 50%. This is likely a result of a number of factors including an increase in domestic recycling capacity for HDPE since 2019, a greater number of brand and retailer commitments to using a more recycled content within packaging (which in some cases may be a result of initiatives such as the Plastics Pact, however some brands and retailers may have their own plastic reduction objectives too), and also in preparation for packaging EPR reform.

Based on the output of recycling as identified in sections 8.1.5. and 8.1.6. and the indicative usage percentages above, it is estimated that 57k tonnes of recycled HDPE is used in packaging manufacture, 34k tonnes is used in construction, 11k tonnes is used in horticultural products, and 6k tonnes is used in both household items and mixed PO applications.

10.4. PP

The automotive sector is a key user of recycled PP polymer. It is used in an increasing range of applications both in the car's interior (dash, etc), under the bonnet (battery cases, ducting) and externally (wheel arches, mudguards). The production of packaging is also a major use of recycling PP polymer, for example to produce crates, pallets, paint pots, etc.

Table 45: End Markets for PP Recycled in the UK

Application	Examples	Indicative Usage (%)
Automotive	Interior design items, wheel arches, ducting, battery cases, etc.	40%
Packaging	Paint pots, pallets, crates, trays, boxes	40%
Horticulture	Plant pots, etc	15%
Mixed PO applications	Plastic wood and board, etc	5%

Based on the output of recycling as identified in sections 8.1.5. and 8.1.6. and the indicative usage percentages above, it is estimated that 40k tonnes of recycled PP is used in automotive parts, 40k tonnes is used in packaging, 15k tonnes is used in horticultural products, and 5k tonnes is used in other applications.

10.5. LDPE

The construction sector is a key user of recycled LDPE polymer. The production of damp proof membranes is perhaps the largest user of recycled LDPE within the sector but it is also used to produce gas protection film

(laid under the house to act as a barrier for radon gas) and also general-purpose film used on building sites, such as to cover and protect part completed structures and materials. Recycled LDPE is also widely used in the production of refuse and recycling bags.

Table 46: End Markets for LDPE Recycled in the UK

Application	Examples	Indicative usage (%)
Construction films	Damp proof membranes, building films for temporary protection, gas barrier protection.	40%
Plastic bags & sacks	Refuse sacks, recycling sacks, carrier bags.	25%
Agricultural films	Crop cover (mulch film).	10%
Packaging	Shrink wrap, pallet hoods, etc.	15%
Mixed PO applications	Plastic wood and board, etc.	10%

Based on the output of recycling as identified in sections 8.1.5. and 8.1.6. and the indicative usage percentages above, it is estimated that 68k tonnes of recycled LDPE is used in construction films, 43k tonnes is used in plastic bags/sacks, 17k tonnes is used in agricultural films, 26k tonnes in packaging and 17k tonnes is used in other applications.

10.6. Export Markets

As a result of the restrictions on imports of post-consumer waste plastic into China implemented at the end of 2017, a lot of the material was diverted to South East Asia and Turkey. Although some recycled pellet will be used in domestic applications, these markets often supply some back into China. It is likely that domestic end markets in Turkey would be broadly similar to those in Asian markets, for example, recycled PET used in the production of polyester fibre. LDPE films that are exported get used in a wide range of applications, such as agricultural, packaging and construction films as well as foamed LDPE products such as for the manufacture of footwear or luggage. Recycled LDPE pellet produced in facilities in Southeast Asia is still exported to China, however increasingly it is used in domestic markets or exported to other destinations such as India.

10.7. Export Destinations for UK Waste Plastic Packaging Waste

A Freedom of Information Act request was made to the Environment Agency for information on where UK waste plastic packaging was exported to in 2022[107]. Reproduction of this data is subject to the conditions set out in the Open Government License version 3.0. Please see conditions in the attached link: http://www.nationalarchives.gov.uk/doc/open-government-licence/version/3/

The data provided by the Environment Agency was analysed to produce the pie chart and list of top 10 destinations below. The tonnages shown in the breakdowns below relate to PERNs issued, and as such the actual tonnage shipped may be slightly higher as any non-UK derived plastic packaging waste in the shipment should have been removed prior to PERNs being issued.

Turkey remained the key destination country for plastic packaging exports up to 2022, following the restrictions on imports of post-consumer waste plastic into China implemented at the end of 2017. Turkey has been

[107] *Destination information is provided basis of a Freedom of Information request from the Environment Agency. Entities raising PERNS should report the location as being the place that the material is recycled. Enforcement and data accuracy is managed by the Environment Agencies.*

categorised in the pie chart as an OECD member country outside of the EU (ROW: OECD) and makes up 99% by tonnage, of that category.

Germany and the Netherlands remained within the top three destination countries to receive UK plastic packaging waste in 2022. Vietnam was the key destination within the category non-OECD members in Asia.

Less than 0.1% of exports were sent to Hong Kong in 2022, seeing it drop off the top 10 list and fall by 99% from 50k tonnes in 2019 to 310 tonnes in 2022.

Compared to the data presented in the previous PackFlow report for 2019, there is a greater proportion of material sent to EU member countries than previously.

The pie chart below shows the key export destinations for UK-derived waste plastic packaging waste by region.

Figure 12: Export Destinations for UK Plastic Packaging Waste by Region, 2022 (%)

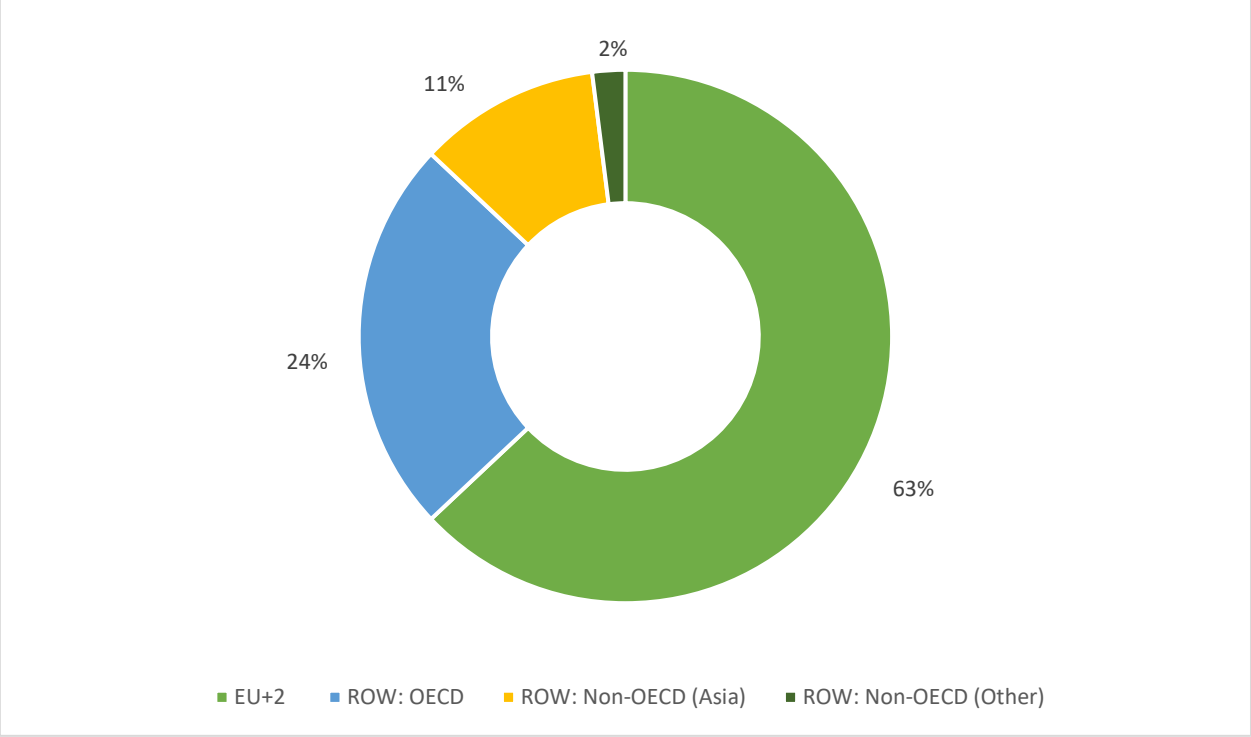


Table 47 shows the top 10 export destinations for UK derived waste plastic packaging waste.

Table 47: Export Destinations for UK Plastic Packaging Waste by Region, 2022

Destination Country	Tonnage Exported (k tonnes)
Turkey	128
Germany	73
Netherlands	48
Belgium	34
Ireland	30
Spain	26
Vietnam	25
France	23
Poland	20
Italy	17

Source: The Environment Agency

11. Phase 2: Packaging Future Trends and Scenarios

11.1. Background

The PackFlow Refresh 2023 reports (https://www.valpak.co.uk/more/material-flow-reports) cover all packaging materials and have been produced to provide industry, governments, and other stakeholders with evidence to better understand packaging materials flows, packaging materials collection & recycling, and to assess likely future recycling performance.

The PackFlow Refresh 2023 project has two phases:

Phase 1

- Updates baseline data year to 2022 for estimates of packaging materials POM collections, recycling and end markets (from data years 2019 & 2017 in the previous PackFlow reports[108]).

Phase 2

- Develop scenarios for packaging materials flow and recycling from 2022 to 2028[109]; and
- Assess likely future recycling performance.

11.2. Phase 2 Objectives

The key objectives in Phase 2 are, for each of the packaging material types, to;

- Project packaging POM by year from 2022 to 2028[2] based on robust assumptions and techniques; and
- Estimate packaging recycling rates for 2022 for various scenarios based on robust assumptions and techniques, and provide a narrative up to 2028 focusing on recycling capacity, end markets, key outlets, and recycling rate trends.

To complement the above a trend analysis is undertaken comparing packaging POM data, by packaging material type, with a range of a priori suitable economic/ industry activity indicator data (e.g. consumer spending, growth in home shopping deliveries). The indicator measures are material-specific and linked to appropriate growth projections to provide plausible indications of future developments in packaging POM tonnages.

Key outputs of the Phase 2 analysis are; an updated analytical Excel-based tool enabling its users to easily make/present estimates of, and future projections of packaging POM quantities for the UK, and a report discussing the methodologies, results and conclusions.

11.3. Methodology

An overview of the approach to assess trends in packaging materials POM for this project is provided below.

11.3.1Net Pack Fill

This report uses historic NPWD[110] data - 'Packaging handled by activity' – from 1997 to 2023 submissions to represent trends in packaging materials POM by weight (more accurately this is trends in packaging materials POM reported by obligated producers).

The net pack fill calculation applied in each year, to each packaging material type, is set out below:

[108] *The previous packaging materials flow reports can be found at https://www.valpak.co.uk/more/material-flow-reports .*
[109] *The POM projections extend to 2040 but beyond 2028 should be regarded as highly uncertain.*
[110] *www.npwd.environment-agency.gov.uk*

Net Pack Fill	=	Packing/Filling Table 1 - pack/filling	+	Imports Table 3A - imported for selling	+	Imports Table 3B - packaging removed from around imports	-	Exports Table 2A + Table 2B – pack/filling

12. Trends in Packaging POM by material

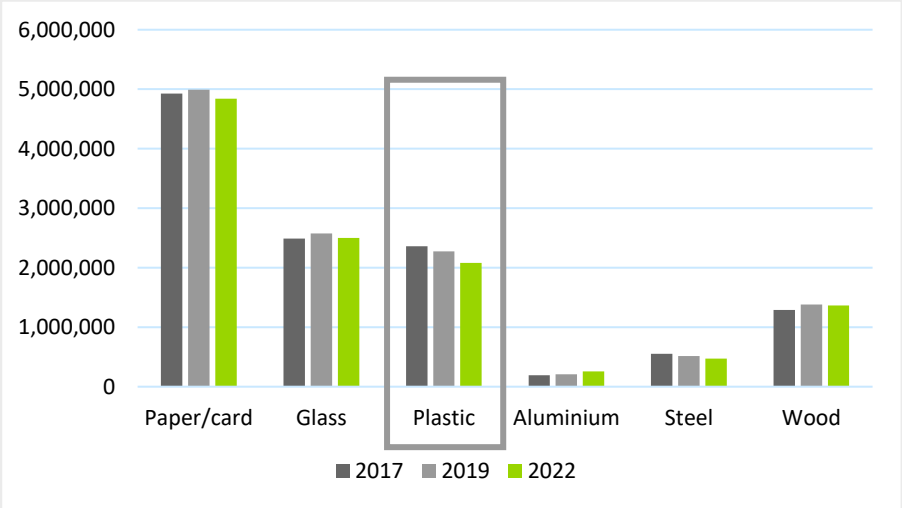
This section of the report uses NPWD time-series data on packaging handled by obligated producers, by type of packaging material, from 1998 to 2021 – this dataset represents the maximum number of annual observations available.

PackFlow's most recent quantifications of packaging POM are for 2017, 2019 and in the current project 2022 (Figure 1). The main takeaways from Figure 13 for packaging materials POM in 2022 compared to earlier years are;

- Paper and card has reduced compared to 2019 and 2017;
- Glass is down from 2019;
- Plastic is down from 2019 and 2017;
- Aluminium has increased compared to 2019 and 2017;
- Steel has reduced compared to 2019 and 2017; and
- Wood is stable between 2019 and 2022 but higher compared to 2017.

While these POM estimates are regarded by industry and Government as being the best available, they are not repeated on an annual basis, so there isn't a sufficiently long run of annual time-series observations available for a robust analysis of trends.

Figure 13: Packaging POM by Material, 2017, 2019 and 2022 (k tonnes)



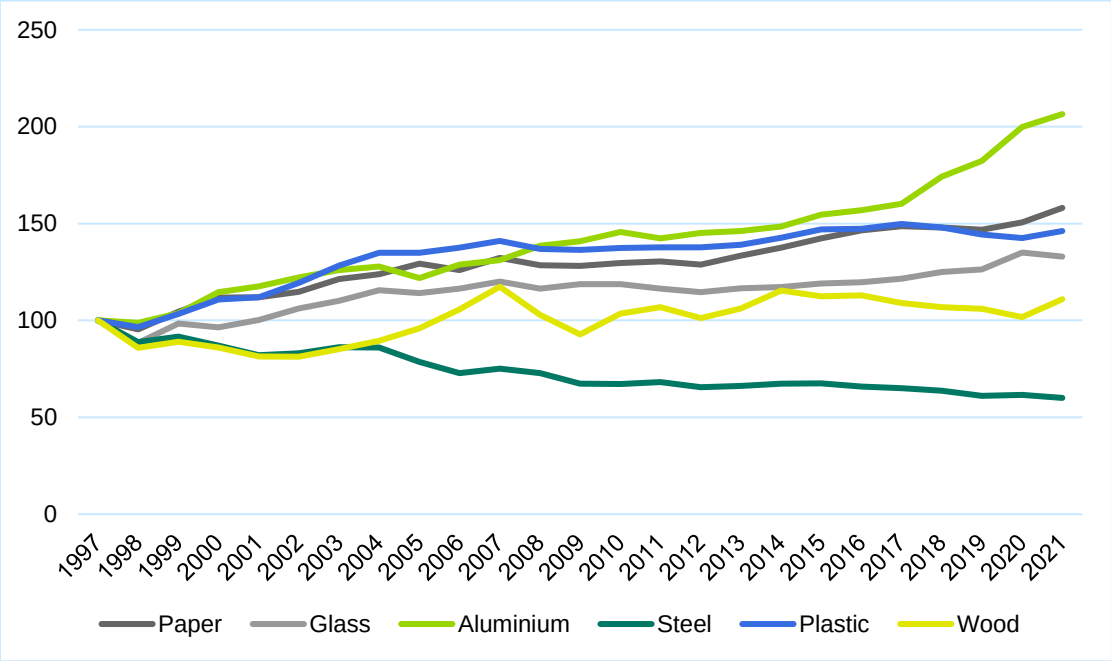
Instead, to inform trends by packaging material type the NPWD dataset is used to calculate the measure 'net pack fill' which is regarded as the best approximation or proxy to trends in POM by type of material.

Figure 14 shows the estimates of trend in packaging materials POM (by weight) by material type from 1997 to 2021. In general, POM[111] for all materials (apart from steel packaging) has increased though clearly there are year-to-year fluctuations. Aluminium packaging has grown the fastest, followed by paper, plastic and glass. Wood packaging has seen modest growth overall, and steel packaging has experienced year-on-year declines in most years over this period.

[111] Strictly speaking this is obligated POM as represented by the net pack fill measure. The % of total POM as measured by the PackFlow reports varies by material and over time.

Since 2017 growth in aluminium and glass packaging POM has picked up relative to trend and plastic packaging POM has reduced. Since 2019, paper packaging POM has increased relative to plastic packaging POM.

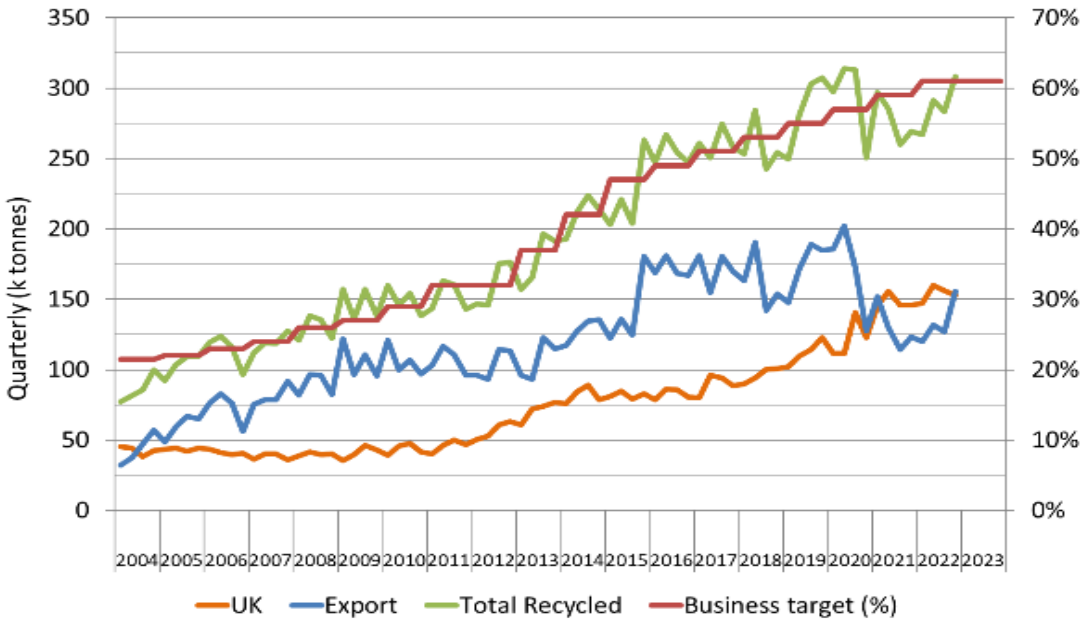
Figure 14: Packaging POM Trends by Material, 1997 – 2021 (indexed 1997=100)



13. Packaging Recycling

A key objective of this report is to provide an understanding of the trends in the recycling of packaging materials. To inform the recycling projections in the baseline scenario NPWD accredited recycling data (i.e.PRN/PERN) is used as a proxy for the assessment of recycling trends. Note that non-accredited recycling and export (i.e. tonnages not recorded by PRN/PERN) also takes place which has an impact on overall recycling performance. Figure 15 illustrates quarterly data on total accredited recycling, UK domestic accredited recycling and accredited exports for plastic packaging material from 2004 to 2023. A key driver of packaging recycling is the material specific business targets, which are shown on the left-hand-scale of the charts.

Figure 15: Trends in Accredited Plastic Packaging Recycling 2004 – 2023 (k tonnes)



The strong upward trend in the total amount of plastic packaging waste recycled over the period 2004 – 2022 was driven by increases in the recycling targets. Export of plastic packaging wastes has played a key role in meeting the targets over much of this period. UK domestic plastic packaging recycling was static at around 50k tonnes per quarter to 2011 but since then it has increased steadily, exceeding the amount of plastic waste exported for the first time in 2021. Plastic recycling targets have flat-lined.

14. Plastic Market trends

Legislation

Upcoming changes in legislation such as the Extended Producer Responsibility (EPR)" reforms[112] will make packaging producers responsible for more of the costs associated with packaging at the end of its life. It aims to ensure that greater quantities of recyclable materials are reprocessed into valuable, high quality secondary resources. The goal is to encourage greater engagement in the lifecycle of packaging products, from design to recycling[113]. The increase in compliance fees should encourage producers to increase the accuracy of reporting as well as reducing the amount of plastic POM.

The EPR reforms will also introduce eco-modulation, whereby the fees paid by producers are increased or decreased based on the recyclability of packaging; more easily recycled material will incur a lower fee than packaging deemed difficult to recycled[114].

The Plastic Packaging Tax was implemented in the UK on 1st April 2022. The tax is a levy imposed on plastic packaging that does not meet a minimum threshold of 30% recycled content on a per-component basis. The tax was originally set at £200 per tonne for imported or manufactured plastic packaging components. This rate has now been raised to £217.85 per tonne to algin within inflationary pressures[115].

The introduction of the UK Plastic Packaging Tax as well as the upcoming eco-modulation fees within EPR will encourage the use of "easier to recycle" material and the inclusion of recycled content.

Historically, weight-based recycling targets for organisations and local authorities have diverted the sectors focus towards heavier materials such as glass and metals over lighter materials like paper and plastic.

UK POM

Consumer plastic packaging has seen decreases year on year, with a 12% reduction between 2019 and 2022[116][117]. This trend is expected to continue due to the publics increase in awareness of issues surrounding plastic packaging and well as businesses striving to achieve voluntary commitments to reduce and simplify product packaging.

Sustainability has not been at the forefront of the packaging industry in the past with design trends including complex materials e.g. multi-layered films. Business have increasingly been changing their packaging to alternative materials or consistent polymers/colours to improve the ease of recyclability, for example coloured milk bottle caps being replaced by clear plastic[118].

Within the non-consumer C&I sector, target increases and decreasing POM in the HH sector may be offset by increasing arisings in the commercial sector[119]. Back of store packaging may see an increase in the future as primary packaging is lightweighted to ensure that the quality of product is preserves during transit.

The implementation of the single use plastic ban on cutlery, balloon sticks, polystyrene cups and food containers which came in to force on the 1st October 2023[120] in England, may reduce the amount of plastic packaging used within the hospitality sector due to the ban on polystyrene cups and food containers.

The PackFlow reports have not seen a significant change in the amount of plastic POM within the Agriculture and C&D sectors. There are no clear predictions on how this might change in the future. The working assumption is that the packaging POM within the agriculture and C&D sectors will remain consistent.

Waste Management

The Deposit Return Scheme is due to be implemented in the UK and aims to boost the recycling of single-use drinks containers by adding a deposit to in-scope products at the point of purchase. It is due to be implemented in 2025 and aims to collect 90% of the eligible containers placed on the respective national markets within three years of implementation.

[112] Extended producer responsibility for packaging: report packaging data - GOV.UK (www.gov.uk)
[113] Extended producer responsibility for packaging: report packaging data - GOV.UK (www.gov.uk)
[114] The importance of eco-modulation for EPR | Valpak Limited – News and Blogs
[115] News and Blogs – The UK's Plastic Packaging Tax | Valpak
[116] PackFlow 2023 Plastic Refresh Phase 1
[117] PackFlow Covid-19 Plastic Phase 1
[118] Tesco making major change to milk bottles in all of its stores - Wales Online
[119] PackFlow – Trends and Obligation Analysis 2022
[120] Coverage of the introduction of restrictions on a range of single-use plastics - Defra in the media (blog.gov.uk)

The UK's current recycling rates for drinks containers is 70% (~4 billion plastic bottles). A well-designed DRS could deliver recycling rates of 90% or higher. Initial consultations assessed that an "all-in" DRS could see annual litter clean-up savings of £86million by the third year of operation[121].

The UK requires significant investment in its current infrastructure to ensure that it can manage the changing waste streams that will be impacted by the introduction of EPR and DRS. EPR will bring about revised recycling targets that will incentivise the collection of more difficult to process packaging, specifically that which is not in-scope of DRS such as plastic pots, tubs and trays and plastic films and flexibles. DRS on the other hand will reduce the amount of PET drinks bottled from the kerbside waste stream[122].

Household recycling rates in in 2021/2022 have plateaued at around 42-44%. To encourage increased recycling rates, all local authorities within England must collect the same recyclable waste streams for recycling or composting from households by March 2026. These waste streams include plastic, paper and card, glass, metal, food waste, and garden waste. Additionally, non-household municipal premises in England must arrange for the same set of recyclable waste streams to be collected for recycling or composting[123].

The introduction of simpler recycling alongside mandatory recyclability labelling on packaging (introduced as part of the EPR) should make it easier for the public and organisations to know what materials can and cannot be recycled, potentially increasing the recycling rates of plastic as well as other materials.

[121] *Understanding the impacts of the Deposit Return Scheme (DRS) for Local Authorities | SLR Consulting*
[122] *uk-plastic-packaging-sorting-reprocessing-infrastructure-2022-update-full-v11-1667559372.pdf (recoup.org)*
[123] *Government response - GOV.UK (www.gov.uk)*

15. Projections and EPR scenarios

This section of the report discusses the projections for POM and recycling and three EPR scenarios for the quantity of plastic packaging material which differ by the amount of plastic packaging material removed from the POM quantity. The remaining POM material is assumed to be covered by EPR from 2025 and is available to be collected for recycling. The quantity of POM plastic packaging removed is assumed to be in scope of a DRS from 2027.

15.1. POM Projections

The Phase 1 baseline data year for plastic packaging POM is calendar year 2022. The projected tonnages from 2022 to 2040 are developed with the following considerations (note that the report tables show a summary of the scenarios to 2028);

1. Near term. Profile shaped based on market intelligence and datasets that are available for year to date in 2023. Typically, in the near term there's more information available on which to base projections, and make assumptions. For example, qualitative commentaries on current market conditions are used. The current cost of living crisis – energy bubble – is a key source of uncertainty distorting purchasing decisions and, to the extent that this is reflected in indicator data, it is built into the profile of the projections for packaging materials.
2. Medium term. The scenario projections link to growth projections to inform the scenario profiles 2024 to 2040 ('official' economic projections to 2028 are used, namely the OBR's forecast published in November 2023 that accompany the Chancellor's Autmn Statement).
3. Long term. As the projection horizon extends further out there's inevitably greater uncertainty. The scenario projections adopt a 'return to trend or steady state' growth approach.

The POM projections by material type are linked to indicators (and projections of these indicators). The indicators considered are selected through analysis of historical relationships with packaging materials POM. Therefore, they are (statistically) *a priori* deemed potentially useful in describing the evolution of packaging materials POM. The indicators shown in the Table 48 are grouped according to level/growth in; economic activity (GDP, GVA by sector, construction, imports), spending (consumer spending and retail sales), and population. Data for all indicators is sourced from the ONS and is adjusted by the ONS to remove the effects of changes in prices, so they are indicators of activity potentially related to the tonnage of packaging POM in real-terms.

Table 48: A Selection of Indicators

Indicator group	Indicator and data source
Consumer spending	Household final consumption expenditure : National concept CVM SA - £m
Consumer spending	Total goods :Total CVM NA Year SA £m
Gross Domestic Product	GDP
Retail sales	Retail in non-specialised stores IV2X
Retail sales	Retail in predominantly food stores IV3G
Retail sales	Retail in non-food stores IV3I
Retail sales	Retail in other stores IW6U
Retail sales	Retail in textile, clothing and footwear stores IW6X
Retail sales	Retail in household goods stores IW6Y
Retail sales	Non-store retailing J58P
Retail sales	All retail excl. automotive
GVA	G46: Wholesale trade, except of motor vehicles and motorcycles

GVA	G47: Retail trade, except of motor vehicles and motorcycles
GVA	G56: Food and beverage service activities
GVA	A: Agriculture
GVA	B: Mining and quarrying
GVA	C: Manufacturing
GVA	D: Electricity, gas, steam and air conditioning supply
GVA	F: Construction
GVA	G: Wholesale and retail trade and repair of motor vehicles and motorcycles
GVA	Total GVA
Construction	Public new housing
Construction	Private new housing
Construction	Total new housing
Imports	CPA 08:WW:IM:CVM:BOP:SA: C. Manufactured products
Imports	CPA 08 :WW :IM :CVM :BOP :SA : 10. Food products
Population	POP

A chart-based correlation analysis for a selection of these indicators versus POM by packaging material type and a detailed statistical correlation analysis is reported in Appendix II. A summary is shown in Table 49 and Table 50. In each of these the top three correlations are ranked.

Table 49: Levels Correlation Analysis of Packaging Materials and Indicator Measures, 1997 – 2021

Material	Highest correlations	Suggested activity indicator to link to
Plastic	1. Consumer spending 2. Retail in non-food stores 3. Import of food products.	Consumer spending

Table 50: Growth Correlation Analysis of Packaging Materials and Indicator Measures, 1998 – 2021

Material	Highest correlations	Suggested activity indicator to link to?
Plastic	1. Imports of manufactured goods 2. Retail sales in non-specialised stores 3. Retail sales in non-food stores.	Imports

The correlation analysis of trends in packaging materials POM supports developing a projection for plastic by linking to projections of retail sales. The POM was multiplied by the change over time in the selected correlated indicator to obtain the level for each subsequent year. See Appendix II for further details.

Table 51: Summary of Linking Packaging POM to Indicator Measures.

Material	Levels analysis	Growth analysis	Projection based on
Plastic	Consumer spending	Retail sales, goods imports	Retail sales

Table 52: Projected Growth in Indicator Measures, 2024 to 2028.

Indicator	2023	2024	2025	2026	2027	2028	Source	
Retail sales	-3.1%	0.5%	1.0%	1.6%	2.1%	2.0%	ONS latest data: Jan – Oct 2023	OBR forecast Nov 2023: Consumer spending

15.2. EPR Scenarios

Three EPR scenarios for each of the packaging materials covered in the Packflow Refresh 2023 where developed and are discussed in the following sections. The three scenarios are:

- EPR scenario 1: All packaging materials subject to recycling obligations under 2007 Regulations for 2024 and under new EPR regulations from 2025 onwards (all packaging is in scope of current producer responsibility obligations from 2022 to 2025);
- EPR scenario 2: DRS drinks containers *excluding* glass removed from recycling obligations under EPR in 2027 onwards; and
- EPR scenario 3: DRS drinks containers *including* glass containers for Scotland and Wales, and *excluding* glass drinks containers in England and Northern Ireland, are removed from EPR POM tonnages from 2027.

In the context of scenarios 2 and 3 'removing DRS drinks containers', (glass as above) from EPR' means removing these materials from EPR recycling obligations. The policy is that they are not subject to disposal cost fees in the period between the new EPR regulations coming into force (from 2025) and DRS 'going live' (from 2027). Note that glass packaging is the *only* material impacted in scenario *3*.

The scenarios provide an assessment of likely recycling performance, in each year, to 2028 (note the projections extend to 2040 but data to 2028 is shown as a summary). In each scenario packaging materials are assumed to be under EPR from 2025 and the tables below show (to 2028) the tonnages of packaging placed on the market which would be under EPR. Also shown are the business targets (%, k tonnes), obligated packaging tonnages, the level (%) of non-obligated packaging, accredited packaging recycling (k tonnes), the projected surplus/shortfall of recycling relative to the business target, and a summary of the recycling rate performance over the scenario horizon.

The scenarios calculate the tonnage of accredited recycling based on the amount of packaging POM and an assumed collection rate. The scenarios assume the collection of EPR packaging material is separated from the DRS collection system and no other loss i.e. 100k tonnes of EPR packaging POM equates to 100k tonnes of EPR packaging available to be collected for accredited recycling. In reality there will be loss to residual streams and in handling/sorting, and DRS materials not captured by a DRS could end up in the recycling waste stream collected for accredited recycling.

Please note there is no EPR Scenario 3 for plastic packaging. Only scenarios 1 and 2 are included from the list above.

15.3. EPR scenario 1

In this scenario all packaging materials are subject to recycling obligations under 2007 Regulations for 2024 and under new EPR regulations from 2025 onwards (all packaging is in scope of current producer responsibility obligations from 2022 to 2025). The table below shows the scenario 1 results for plastic packaging.

Table 53: Plastic Projection EPR Scenario 1

Plastic	Units	2022	2023	2024	2025	2026	2027	2028
Business target	%	61%	61%	61%	62%	63%	64%	65%
POM	k tonnes	2,082	2,017	2,027	2,047	2,080	2,123	2,166
Obligated tonnage	k tonnes	1,985	1,883	1,885	1,903	1,934	1,975	2,014
Level of non-obligated tonnage	%	5%	7%	7%	7%	7%	7%	7%
Business target	k tonnes	1,211	1,149	1,150	1,180	1,218	1,264	1,309
Accredited recycling	k tonnes	1,150	1,232	1,471	1,486	1,510	1,542	1,572
Surplus (+) / shortfall (-)	k tonnes	-61	83	322	306	291	278	263
Business recycling rate	%	58%	65%	78%	78%	78%	78%	78%
Recycling rate performance	%	55%	61%	73%	73%	73%	73%	73%
National recycling rate	%	58%	57%	57%	58%	59%	60%	60%

Plastic POM tonnage is projected to reduce in 2023 compared to 2022, and while growth resumes it is projected to be below its 2022 level until 2027. Business targets are projected to increase by 1% point per annum and reach 65% in 2028. The POM projection is reflected in the projection of obligated tonnage for plastic packaging, and (with assumed constant collection rates) the projection of accredited recycling. Based on this plastic packaging is projected to be in a surplus relative to the business target 2023 to 2028.

15.4. EPR Scenario 2

In this scenario in-scope DRS drinks containers excluding glass drinks containers are removed from EPR POM quantities from 2027 onwards. In this context ‘removing DRS drinks containers from EPR’ means removing these materials from recycling obligations. The policy is that they are not subject to disposal cost fees in the period between the new EPR regulations coming into force (from 2025) and DRS ‘going live’ (from 2027). The table below shows the scenario 2 results for plastic packaging.

Table 54: Plastic Projection EPR Scenario 2

Plastic	Units	2022	2023	2024	2025	2026	2027	2028
Business target	%	61%	61%	61%	61%	61%	61%	61%
POM	k tonnes	2,082	2,017	2,027	2,047	2,080	1,724	1,759
Obligated tonnage	k tonnes	1,985	1,883	1,885	1,903	1,934	1,603	1,635
Level of non-obligated tonnage	%	5%	7%	7%	7%	7%	7%	7%

Business target	k tonnes	1,211	1,149	1,150	1,161	1,180	978	998
Accredited recycling	k tonnes	1,150	1,232	1,471	1,486	1,510	1,542	1,572
Surplus (+) / shortfall (-)	k tonnes	-61	83	322	325	330	563	575
Business recycling rate	%	58%	65%	78%	78%	78%	96%	96%
Recycling rate performance	%	55%	61%	73%	73%	73%	89%	89%
National recycling rate	%	58%	57%	57%	57%	57%	57%	57%

Plastic POM tonnage is projected to reduce in 2023 compared to 2022, and while growth resumes from 2024 it remains below its 2022 to 2026. Plastic drinks containers (PET Bottles) are removed from EPR from 2027 onwards (~399k tonnes). The business targets for the remaining material are projected as constant at 2024 level of 61%. The POM projection is reflected in the projection of obligated tonnage for plastic packaging, and (with assumed constant collection rates) the projection of accredited recycling. Based on this a surplus relative to the business target 2024 to 2026 is projected for plastic packaging. The reduction in the recycling obligation relative to the projection for accredited recycling results in a larger surplus relative to the business target from 2027 onwards.

15.5. EPR Scenario 3

In EPR scenario 3 in-scope DRS drinks containers including glass containers for Scotland and Wales, and excluding glass drinks containers in England and Northern Ireland, are removed from EPR POM tonnages from 2027. In this context ‘removing DRS drinks containers’, (glass as above) from EPR’ means removing these materials from recycling obligations. The policy is that they are not subject to disposal cost fees in the period between the new EPR regulations coming into force (from 2025) and DRS ‘going live’ (from 2027). Compared to EPR scenario 2 glass packaging is the only material impacted in this scenario.

16. Conclusions & Recommendations for Further Work

This section details the conclusions of the project and details the main areas recommended for further work.

16.1. Conclusions: POM

This project's estimate of UK plastic packaging POM for 2022 is 2,082k tonnes +/- 6%: a decrease of 208k tonnes[124] from the previous estimated figure for 2019.

This is the most robust estimate that can be derived using a variety of the most authoritative methods, including industry estimates, Valpak data and publicly available data and is regarded as such by industry.

The estimate of plastic packaging POM in the consumer sector is 1,267k tonnes +/- 6% in 2022.

This method is based on primary data alongside reliable market share data. No other method was used for deriving consumer data as this method is considered the most robust there is available and is accepted as such by industry.

The estimate of plastic packaging POM in the non-consumer sector is 815k tonnes +/- 13% in 2022.

For film, this method is based on a combination of primary (survey) data and secondary research. For rigids, this is based on the findings of the WRAP/Valpak report into rigid packaging in the C&I sector and on secondary research.

It is likely that any increase in sales of products using plastic packaging have been offset by light-weighting and a shift towards other packaging materials between 2017 and 2022.

The plastics packaging industry has believed for some time that packaging producer activity to light-weight plastic packaging[125] has negated any potential growth in consumption and the results of this work would seem to support this assumption.

Plastic drinks packaging is estimated to account for 390k tonnes (or 18%) of total plastic packaging POM in 2022. 229k tonnes of plastic drinks packaging is considered in scope of the DRS.

Valpak EPIC data and additional market data suggests that 81% of this tonnage is sold via the retail or consumer market and 19% via the non-consumer or hospitality sector, with 100k tonnes being HDPE, 279k tonnes PET and 11k tonnes other polymers. These figures have been cross-checked with industry and published industry data.

16.2. Conclusions: Recycling

Estimating the plastic packaging recycling rate for the UK in 2022

The waste plastic packaging delivered to recyclers as a percentage of POM is estimated to be 62% (1,285kt). The recycled plastic exiting recyclers as a percentage of POM is 44% (925kt). When adjusting the waste into recyclers to deduct non target material, as is done prior to PRN / PERN issuing, a recycling rate of 57% is achieved.

Estimating the consumer plastic packaging recycling rate for the UK in 2022

The consumer waste plastic packaging delivered to recyclers as a percentage of POM is estimated to be 48% (606kt). The recycled plastic exiting recyclers as a percentage of POM is 32% (400kt). When adjusting the waste into recyclers to deduct non target material, as is done prior to PRN / PERN issuing, a recycling rate of 44% is achieved. This uses the average difference between waste received / export and PRNs / PERNs issued on NPWD.

Estimating the non-consumer plastic packaging recycling rate for the UK in 2022

The non-consumer waste plastic packaging delivered to recyclers as a percentage of POM is estimated to be 83% (679kt). The recycled plastic exiting recyclers as a percentage of POM is 65% (525kt). When adjusting the

[124] *208k tonnes is a` decrease of 10%. As the error margin around the total plastic POM figure is 6%, this indicates that there has been a reduction in the amount of plastic POM in 2022.*
[125] *Including down-gauging activity.*

waste into recyclers to deduct non target material, as is done prior to PRN / PERN issuing, a recycling rate of 78% is achieved. This uses the average difference between waste received / export and PRNs / PERNs issued on NPWD.

The estimated non-consumer plastic packaging film recycling rate for the UK in 2022 is too high.

The figures for non-consumer film are too high. The recycled plastic into recyclers as a percentage of POM is likely to be particularly high due the percentage of non-target material in some grades of film. The recycling out figure is also higher than is likely to be the case. This could be due to a number of factors. Firstly, a high-level assumption has had to be made on the split of film and rigid C&I packaging exported due to the lack of data in this area. A second factor is that some of the film exported may not in fact be packaging. This could be a due the difficulties in separating packaging and non-packaging film but may also be due to miss-issuing of PRNs / PERNs on non-packaging material.

Of the total 1,156k tonnes of plastic packaging not recycled and lost during the recycling process, 997k tonnes (80%) is sent for energy recovery and 159k tonnes to landfill (20%) in 2022.

This is based on an estimated total of 867k tonnes of consumer plastic packaging not being recycled and 289k tonnes of non-consumer not being recycled, estimated using WDF and published statistics on UK disposal routes for plastic packaging.

16.3. Conclusions: End Markets

The main application for UK recycled PET is in food and non-food bottles.

Approximately 70% of UK recycled PET is used within food and non-food bottles. The majority of PET not used in this way is used within sheet manufacture to make products such as thermoform trays.

UK recycled HDPE is used comprehensively in a variety of applications, such as packaging, construction and horticultural.

Approximately 50% of UK recycled HDPE is used in the packaging sector, a further 30% in the construction sector, 10% in horticultural and 5% in household items. The remainder is used in a variety of products such railway sleepers, garden furniture and boxes.

UK recycled PP is predominantly used to make automotive products and packaging.

Approximately 40% of UK recycled PP is used in automotive products and a further 40% in packaging.

UK recycled LDPE is mainly used to make new films for construction, bags, sacks and agriculture.

Approximately 40% of UK recycled LDPE is used for construction films, 25% for plastic bags & sacks and around 10% for agricultural films. The remainder is used in other applications such as packaging and the production of plastic wood.

16.4. Projections and EPR Scenarios

EPR Scenario 1

Plastic POM tonnage is projected to reduce in 2023 compared to 2022, and while growth resumes it is projected to be below its 2022 level until 2027. Business targets are projected to increase by 1% point per annum and reach 65% in 2028. The POM projection is reflected in the projection of obligated tonnage for plastic packaging, and (with assumed constant collection rates) the projection of accredited recycling. Based on this plastic packaging is projected to be in a surplus relative to the business target 2023 to 2028.

EPR Scenario 2

Plastic POM tonnage is projected to reduce in 2023 compared to 2022, and while growth resumes from 2024 it remains below its 2022 to 2026. Plastic drinks containers (PET Bottles) are removed from EPR from 2027 onwards (~399k tonnes). The business targets for the remaining material are projected as constant at 2024 level of 61%. The POM projection is reflected in the projection of obligated tonnage for plastic packaging, and (with assumed constant collection rates) the projection of accredited recycling. Based on this a surplus relative to the business target 2024 to 2026 is projected for plastic packaging. The reduction in the recycling obligation relative to the projection for accredited recycling results in a larger surplus relative to the business target from 2027 onwards.

16.5. Recommendations for Further Work

Recyclability of Packaging

This report recommends that more research be carried out to quantifying the recyclability of packaging.

Quantification of Stretch wrap

It is currently difficult to accurately calculate the amount of stretch wrap used in transit packaging. This report recommends further work in to quantifying films used for delivery/transport packaging.

C&I plastic packaging film/rigids

The estimate of C&I film packaging appears low in comparison to the rigids figure. Furthermore, non-consumer film POM as a whole appears low when used to calculate non-consumer film recycling rates. This report recommends further work in this area to improve data accuracy.

Agricultural Films

This report recommends further work on the definition of agricultural films – for example, what is classified as a packaging application e.g., bale wrap. And what is not e.g., silage wrap/poly tunnels.

Non-consumer film being allocated PRN/PERNs

In 2022 the recycling rates for was non-consumer film were too high: this may be due to the incorrect allocation of PRN/PERNs to non-packing films or non-UK packaging film. This report recommends further work in this area to improve data accuracy.

Appendix I

Data Robustness Assessment

A robustness analysis was completed on the data sources used. This was developed to highlight the level of uncertainty for each data source by scoring the data sources on the evidence and agreement level from stakeholders. Questions were asked relating to the evidence and agreement levels of the data used (see the tables later in this section for details) and then the data were scored on each axis. The results are shown in Figure 16 (POM) and Figure 17 (Recycling). They have been constructed based on analysis completed for each project estimate.

The tables thereafter provide a full breakdown for each project estimate. If the question is answered 'Yes' then a score of 3 is given, if 'No' then a score of 0.

Figure 16: Data Robustness Assessment Results – POM

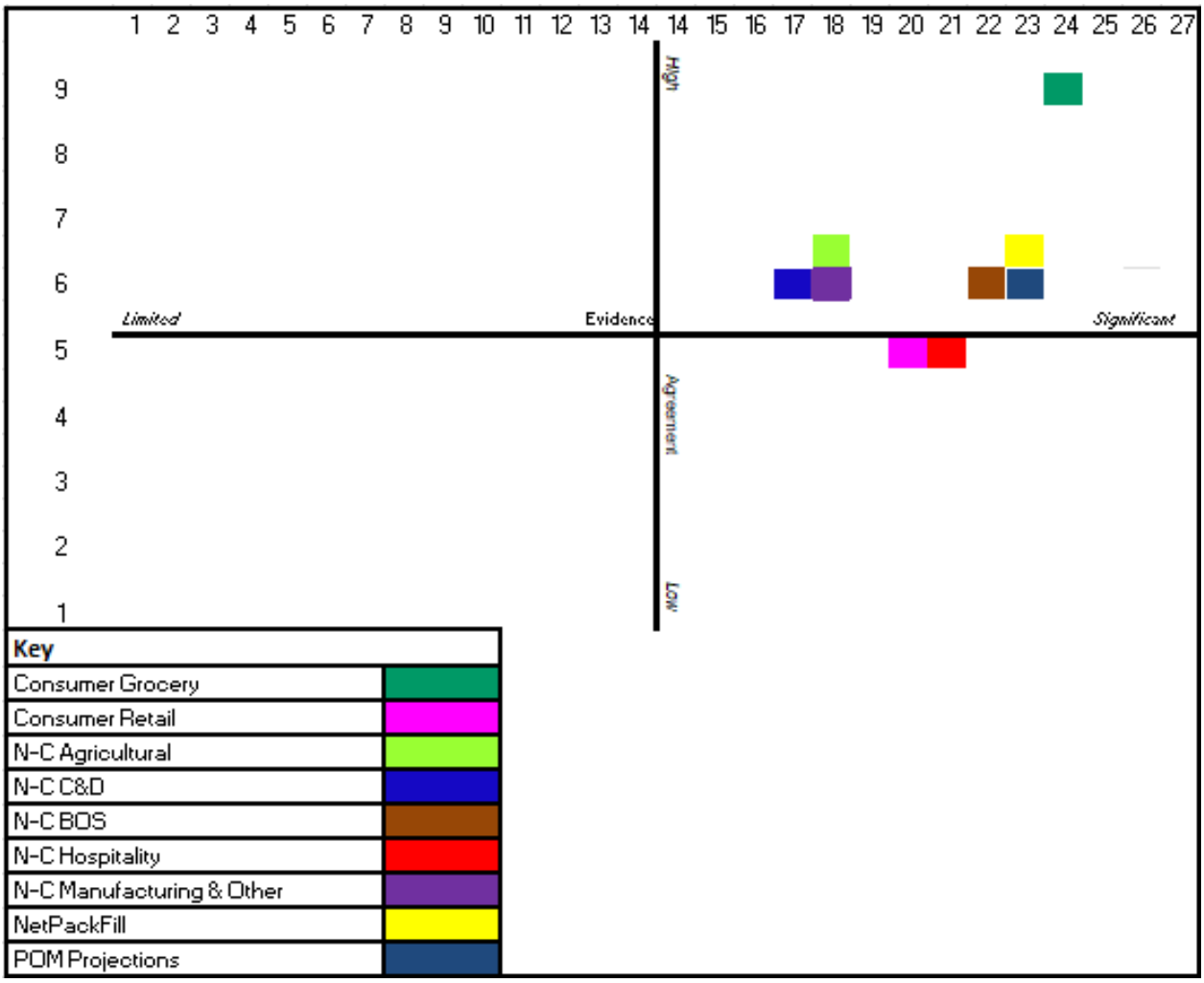
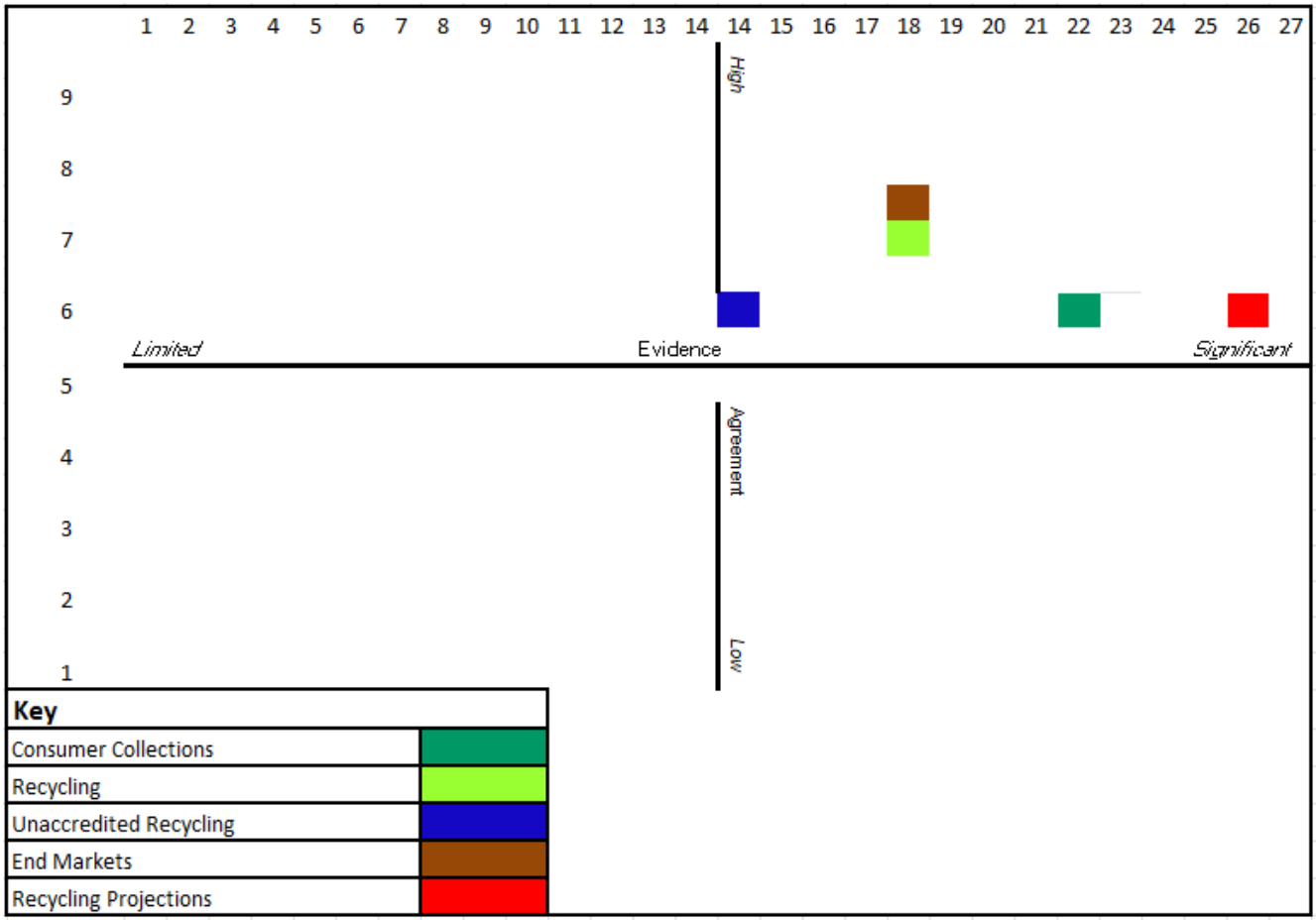


Figure 17: Data Robustness Assessment Results – Recycling



To convert scores to a percentage that could be used to relate to an appropriate error margin[126], the evidence and agreement levels scores were added and the percentage of the total possible score taken.

[126] *These are assumed to be indicative estimates of error margin and not the outputs of a statistical calculation*

Figure 18: Data Robustness Assessment Results – Summary

Data & Source	Robustness Scores	
	Evidence (Robustness and completeness, max 27):	Degree of agreement around the findings (max 9):
Environment Agency Grocery Retailer Packaging Handled	24	9
Valpak Turnover & Packaging Handled Data	20	6
The White Paper Dairy UK 2017	20	3
UK Soft Drinks Report 2020	20	4
Survey of Grocery Retailers 2022	22	6
Valpak Hospitality EPIC Data	22	6
The Skills Construction Needs - Five year Outlook 2022-2026	18	6
Survey of Construction Companies (2014)	16	6
BRE Smartwaste Portal	18	6
Internal research by the Green Construction Board, 2009	15	6
Primary Research by the C&I Rigid Plastic Packaging Report Team, 2014	17	6
UK Statistics on Waste 2020	18	6
UK AWP Waste Arisings, Defra/Valpak 2007	17	6
Agriculture in the UK Data Sets	18	6
NPWD + Valpak estimate of final 2020 obligation/NPF	23	6
Recoup Survey 2022	22	6
Verde Research and Consulting Ltd Survey of Recyclers and Exporters 2022	18	7
Letsrecycle PRN Values 2008-22	14	6
NPWD Recycling Data 2022	26	6

Table 55: Environment Agency Grocery

Data
Environment Agency Grocery Retailer Packaging Handled
Source
Environment Agency Data
Data Used In:
Consumer Grocery

Evidence (Robustness and completeness, max 27):	Scoring (Max 27)	
Does the data cover the correct time-frame?	Yes	3
Does the data provide complete coverage?	Yes with some reservations	2
Has the data been sourced from credible, up-to-date sources?	Yes	3
Is the underlying data reasonably free from concerns (e.g. official data from the ONS)?	Yes	3
Have the findings been independently peer-reviewed?	Yes with some reservations	2
Is the methodology/calculation reasonably free from concerns?	Yes with some reservations	2
Have the methodology/calculations been independently checked (internally or externally)?	Yes	3
Is the quantitative evidence well rooted in a wider qualitative understanding of the issue?	Yes	3
Have the findings been sense-checked against credible alternative sources (incl. inconclusively)?	Yes	3
Total		**24**

Degree of agreement around the findings (max 9):	Scoring (Max 09)	
Does more than one data source confirm the findings (within +/- 5%)?	Yes	3
Do the key stakeholders/experts actively agree with the findings?	Yes	3
Has feedback from the key stakeholders been incorporated in the reporting of findings?	Yes	3
Total		**9**

Table 56: Valpak Turnover & Packaging Handled Data

Data
Valpak Turnover & Packaging Handled Data
Source
Valpak
Data Used In:
Consumer Non-grocery

Evidence (Robustness and completeness, max 27):	Scoring (Max 27)	
Does the data cover the correct time-frame?	Yes	3
Does the data provide complete coverage?	Yes with some reservations	2
Has the data been sourced from credible, up-to-date sources?	Yes	3
Is the underlying data reasonably free from concerns (e.g. official data from the ONS)?	Yes	3
Have the findings been independently peer-reviewed?	No	0
Is the methodology/calculation reasonably free from concerns?	Yes	3
Have the methodology/calculations been independently checked (internally or externally)?	Yes	3
Is the quantitative evidence well rooted in a wider qualitative understanding of the issue?	Yes	3
Have the findings been sense-checked against credible alternative sources (incl. inconclusively)?	No	0
Total		**20**

Degree of agreement around the findings (max 9):	Scoring (Max 09)	
Does more than one data source confirm the findings (within +/- 5%)?	No	0
Do the key stakeholders/experts actively agree with the findings?	Yes	3
Has feedback from the key stakeholders been incorporated in the reporting of findings?	Yes	3
Total		**6**

Table 57: The White Paper Dairy UK 2017

Data Used In:
The White Paper Dairy UK 2017
Source
Dairy UK
Data Used In:
Drinks calculations

Evidence (Robustness and completeness, max 27):	Scoring (Max 27)	
Does the data cover the correct time-frame?	Yes with some reservations	2
Does the data provide complete coverage?	Yes with some reservations	2
Has the data been sourced from credible, up-to-date sources?	Yes	3
Is the underlying data reasonably free from concerns (e.g. official data from the ONS)?	Yes	3
Have the findings been independently peer-reviewed?	Yes with some reservations	2
Is the methodology/calculation reasonably free from concerns?	Yes with some reservations	2
Have the methodology/calculations been independently checked (internally or externally)?	Yes	3
Is the quantitative evidence well rooted in a wider qualitative understanding of the issue?	Yes	3
Have the findings been sense-checked against credible alternative sources (incl. inconclusively)?	No	0
Total		**20**

Degree of agreement around the findings (max 9):	Scoring (Max 09)	
Does more than one data source confirm the findings (within +/- 5%)?	No	0
Do the key stakeholders/experts actively agree with the findings?	Yes	3
Has feedback from the key stakeholders been incorporated in the reporting of findings?	No	0
Total		**3**

Table 58: UK Soft Drinks Report 2020

Data
UK Soft Drinks Report 2020
Source
British Soft Drinks Association
Data Used In:
Drinks calculations

Evidence (Robustness and completeness, max 27):	Scoring (Max 27)	
Does the data cover the correct time-frame?	Yes	3
Does the data provide complete coverage?	Yes with some reservations	2
Has the data been sourced from credible, up-to-date sources?	Yes	3
Is the underlying data reasonably free from concerns (e.g. official data from the ONS)?	Yes with some reservations	2
Have the findings been independently peer-reviewed?	More yes than no, but equivocal	1
Is the methodology/calculation reasonably free from concerns?	More yes than no, but equivocal	1
Have the methodology/calculations been independently checked (internally or externally)?	Yes	3
Is the quantitative evidence well rooted in a wider qualitative understanding of the issue?	Yes	3
Have the findings been sense-checked against credible alternative sources (incl. inconclusively)?	Yes with some reservations	2
Total		**20**

Degree of agreement around the findings (max 9):	Scoring (Max 09)	
Does more than one data source confirm the findings (within +/- 5%)?	No	0
Do the key stakeholders/experts actively agree with the findings?	Yes with some reservations	2
Has feedback from the key stakeholders been incorporated in the reporting of findings?	Yes	3
Total		**5**

Table 59: Survey of Grocery Retailers 2022

Data
Survey of Grocery Retailers 2022
Source
Valpak
Data Used In:
C&I Back of Store

Evidence (Robustness and completeness, max 27):	Scoring (Max 27)	
Does the data cover the correct time-frame?	Yes	3
Does the data provide complete coverage?	Yes with some reservations	2
Has the data been sourced from credible, up-to-date sources?	Yes	3
Is the underlying data reasonably free from concerns (e.g. official data from the ONS)?	Yes	3
Have the findings been independently peer-reviewed?	No	0
Is the methodology/calculation reasonably free from concerns?	Yes	3
Have the methodology/calculations been independently checked (internally or externally)?	Yes	3
Is the quantitative evidence well rooted in a wider qualitative understanding of the issue?	Yes	3
Have the findings been sense-checked against credible alternative sources (incl. inconclusively)?	Yes with some reservations	2
Total		**22**

Degree of agreement around the findings (max 9):	Scoring (Max 09)	
Does more than one data source confirm the findings (within +/- 5%)?	No	0
Do the key stakeholders/experts actively agree with the findings?	Yes	3
Has feedback from the key stakeholders been incorporated in the reporting of findings?	Yes	3
Total		**6**

Table 60: Valpak Hospitality EPIC Data

Data
Valpak Hospitality EPIC Data
Source
Valpak
Data Used In:
Hospitality

Evidence (Robustness and completeness, max 27):	Scoring (Max 27)	
Does the data cover the correct time-frame?	Yes	3
Does the data provide complete coverage?	Yes with some reservations	2
Has the data been sourced from credible, up-to-date sources?	Yes	3
Is the underlying data reasonably free from concerns (e.g. official data from the ONS)?	Yes	3
Have the findings been independently peer-reviewed?	No	0
Is the methodology/calculation reasonably free from concerns?	Yes	3
Have the methodology/calculations been independently checked (internally or externally)?	Yes	3
Is the quantitative evidence well rooted in a wider qualitative understanding of the issue?	Yes	3
Have the findings been sense-checked against credible alternative sources (incl. inconclusively)?	Yes with some reservations	2
Total		**22**

Degree of agreement around the findings (max 9):	Scoring (Max 09)	
Does more than one data source confirm the findings (within +/- 5%)?	No	0
Do the key stakeholders/experts actively agree with the findings?	Yes	3
Has feedback from the key stakeholders been incorporated in the reporting of findings?	Yes	3
Total		**6**

Table 61: The Skills Construction Needs – Five Year Outlook 2022-2026

Data
The Skills Construction Needs - Five year Outlook 2022-2026
Source
CITB
Data Used In:
C&D

Evidence (Robustness and completeness, max 27):	Scoring (Max 27)	
Does the data cover the correct time-frame?	Yes with some reservations	2
Does the data provide complete coverage?	More yes than no, but equivocal	1
Has the data been sourced from credible, up-to-date sources?	Yes	3
Is the underlying data reasonably free from concerns (e.g. official data from the ONS)?	Yes	3
Have the findings been independently peer-reviewed?	No	0
Is the methodology/calculation reasonably free from concerns?	Yes	3
Have the methodology/calculations been independently checked (internally or externally)?	Yes	3
Is the quantitative evidence well rooted in a wider qualitative understanding of the issue?	Yes	3
Have the findings been sense-checked against credible alternative sources (incl. inconclusively)?	No	0
Total		**18**

Degree of agreement around the findings (max 9):	Scoring (Max 09)	
Does more than one data source confirm the findings (within +/- 5%)?	No	0
Do the key stakeholders/experts actively agree with the findings?	Yes	3
Has feedback from the key stakeholders been incorporated in the reporting of findings?	Yes	3
Total		**6**

Table 62: Survey of Construction Companies (2014)

Data
Survey of Construction Companies (2014)
Source
WRAP
Data Used In:
C&D

Evidence (Robustness and completeness, max 27):	Scoring (Max 27)	
Does the data cover the correct time-frame?	More yes than no, but equivocal	1
Does the data provide complete coverage?	Yes with some reservations	2
Has the data been sourced from credible, up-to-date sources?	Yes	3
Is the underlying data reasonably free from concerns (e.g. official data from the ONS)?	More yes than no, but equivocal	1
Have the findings been independently peer-reviewed?	No	0
Is the methodology/calculation reasonably free from concerns?	Yes	3
Have the methodology/calculations been independently checked (internally or externally)?	Yes	3
Is the quantitative evidence well rooted in a wider qualitative understanding of the issue?	Yes	3
Have the findings been sense-checked against credible alternative sources (incl. inconclusively)?	No	0
Total		**16**

Degree of agreement around the findings (max 9):	Scoring (Max 09)	
Does more than one data source confirm the findings (within +/- 5%)?	No	0
Do the key stakeholders/experts actively agree with the findings?	Yes	3
Has feedback from the key stakeholders been incorporated in the reporting of findings?	Yes	3
Total		**6**

Table 63: Internal Research by the Green Construction Board 2009

Data
Internal research by the Green Construction Board, 2009
Source
Green Construction Board
Data Used In:
C&D

Evidence (Robustness and completeness, max 27):	Scoring (Max 27)	
Does the data cover the correct time-frame?	More yes than no, but equivocal	1
Does the data provide complete coverage?	More yes than no, but equivocal	1
Has the data been sourced from credible, up-to-date sources?	More yes than no, but equivocal	1
Is the underlying data reasonably free from concerns (e.g. official data from the ONS)?	Yes with some reservations	2
Have the findings been independently peer-reviewed?	No	0
Is the methodology/calculation reasonably free from concerns?	Yes with some reservations	2
Have the methodology/calculations been independently checked (internally or externally)?	Yes	3
Is the quantitative evidence well rooted in a wider qualitative understanding of the issue?	Yes	3
Have the findings been sense-checked against credible alternative sources (incl. inconclusively)?	Yes with some reservations	2
Total		**15**

Degree of agreement around the findings (max 9):	Scoring (Max 09)	
Does more than one data source confirm the findings (within +/- 5%)?	No	0
Do the key stakeholders/experts actively agree with the findings?	Yes	3
Has feedback from the key stakeholders been incorporated in the reporting of findings?	Yes	3
Total		**6**

Table 64: BRE Smartwaste Portal 2014

Data
BRE Smartwaste Portal, 2014
Source
BRE Smartwaste Portal
Data Used In:
C&D

Evidence (Robustness and completeness, max 27):	Scoring (Max 27)	
Does the data cover the correct time-frame?	More yes than no, but equivocal	1
Does the data provide complete coverage?	More yes than no, but equivocal	1
Has the data been sourced from credible, up-to-date sources?	Yes	3
Is the underlying data reasonably free from concerns (e.g. official data from the ONS)?	Yes with some reservations	2
Have the findings been independently peer-reviewed?	No	0
Is the methodology/calculation reasonably free from concerns?	Yes	3
Have the methodology/calculations been independently checked (internally or externally)?	Yes	3
Is the quantitative evidence well rooted in a wider qualitative understanding of the issue?	Yes	3
Have the findings been sense-checked against credible alternative sources (incl. inconclusively)?	Yes with some reservations	2
Total		**18**

Degree of agreement around the findings (max 9):	Scoring (Max 09)	
Does more than one data source confirm the findings (within +/- 5%)?	No	0
Do the key stakeholders/experts actively agree with the findings?	Yes	3
Has feedback from the key stakeholders been incorporated in the reporting of findings?	Yes	3
Total		**6**

Table 65: Primary Research by the C&I Rigid Plastic Packaging Report Team 2014

Data
Primary Research by the C&I Rigid Plastic Packaging Report Team, 2014
Source
C&I Rigid Plastic Packaging Report Team, 2014
Data Used In:
C&I Manufacturing

Evidence (Robustness and completeness, max 27):	Scoring (Max 27)	
Does the data cover the correct time-frame?	Yes with some reservations	2
Does the data provide complete coverage?	Yes with some reservations	2
Has the data been sourced from credible, up-to-date sources?	Yes	3
Is the underlying data reasonably free from concerns (e.g. official data from the ONS)?	Yes with some reservations	2
Have the findings been independently peer-reviewed?	No	0
Is the methodology/calculation reasonably free from concerns?	Yes with some reservations	2
Have the methodology/calculations been independently checked (internally or externally)?	No	0
Is the quantitative evidence well rooted in a wider qualitative understanding of the issue?	Yes	3
Have the findings been sense-checked against credible alternative sources (incl. inconclusively)?	Yes	3
Total		**17**

Degree of agreement around the findings (max 9):	Scoring (Max 09)	
Does more than one data source confirm the findings (within +/- 5%)?	No	0
Do the key stakeholders/experts actively agree with the findings?	Yes	3
Has feedback from the key stakeholders been incorporated in the reporting of findings?	Yes	3
Total		**6**

Table 66: UK Statistics of Waste 2020

Data
UK Statistics on Waste 2020
Source
DEFRA
Data Used In:
C&I Manufacturing

Evidence (Robustness and completeness, max 27):	Scoring (Max 27)	
Does the data cover the correct time-frame?	Yes with some reservations	2
Does the data provide complete coverage?	Yes with some reservations	2
Has the data been sourced from credible, up-to-date sources?	Yes	3
Is the underlying data reasonably free from concerns (e.g. official data from the ONS)?	Yes with some reservations	3
Have the findings been independently peer-reviewed?	No	0
Is the methodology/calculation reasonably free from concerns?	Yes with some reservations	2
Have the methodology/calculations been independently checked (internally or externally)?	No	0
Is the quantitative evidence well rooted in a wider qualitative understanding of the issue?	Yes	3
Have the findings been sense-checked against credible alternative sources (incl. inconclusively)?	Yes	3
Total		**18**

Degree of agreement around the findings (max 9):	Scoring (Max 09)	
Does more than one data source confirm the findings (within +/- 5%)?	No	0
Do the key stakeholders/experts actively agree with the findings?	Yes	3
Has feedback from the key stakeholders been incorporated in the reporting of findings?	Yes	3
Total		**6**

Table 67: UK AWP Waste Arisings, Defra/ Valpak 2007

Data
UK AWP Waste Arisings, Defra/Valpak 2007
Source
Defra/Valpak 2007
Data Used In:
Agriculture

Evidence (Robustness and completeness, max 27):	Scoring (Max 27)	
Does the data cover the correct time-frame?	More yes than no, but equivoca	1
Does the data provide complete coverage?	Yes	3
Has the data been sourced from credible, up-to-date sources?	More yes than no, but equivoca	1
Is the underlying data reasonably free from concerns (e.g. official data from the ONS)?	Yes	3
Have the findings been independently peer-reviewed?	No	0
Is the methodology/calculation reasonably free from concerns?	Yes	3
Have the methodology/calculations been independently checked (internally or externally)?	Yes	3
Is the quantitative evidence well rooted in a wider qualitative understanding of the issue?	Yes	3
Have the findings been sense-checked against credible alternative sources (incl. inconclusively)?	No	0
Total		**17**

Degree of agreement around the findings (max 9):	Scoring (Max 09)	
Does more than one data source confirm the findings (within +/- 5%)?	No	0
Do the key stakeholders/experts actively agree with the findings?	Yes	3
Has feedback from the key stakeholders been incorporated in the reporting of findings?	Yes	3
Total		**6**

Table 68: Agriculture in the UK Data Sets

Data
Agriculture in the UK Data Sets
Source
Defra
Data Used In:
Agriculture

Evidence (Robustness and completeness, max 27):	Scoring (Max 27)	
Does the data cover the correct time-frame?	Yes	3
Does the data provide complete coverage?	More yes than no, but equivoca	1
Has the data been sourced from credible, up-to-date sources?	Yes	3
Is the underlying data reasonably free from concerns (e.g. official data from the ONS)?	Yes	3
Have the findings been independently peer-reviewed?	No	0
Is the methodology/calculation reasonably free from concerns?	Yes with some reservations	2
Have the methodology/calculations been independently checked (internally or externally)?	Yes	3
Is the quantitative evidence well rooted in a wider qualitative understanding of the issue?	Yes	3
Have the findings been sense-checked against credible alternative sources (incl. inconclusively)?	No	0
Total		**18**

Degree of agreement around the findings (max 9):	Scoring (Max 09)	
Does more than one data source confirm the findings (within +/- 5%)?	No	0
Do the key stakeholders/experts actively agree with the findings?	Yes	3
Has feedback from the key stakeholders been incorporated in the reporting of findings?	Yes	3
Total		**6**

Table 69: NPWD Producer Data 2023

Data
NPWD Producer Data 2023 (2022 submission)
Source
NPWD + Valpak estimate of final 2022 obligation/NPF
Data Used In:
POM crosscheck & unobligated tonnage

Evidence (Robustness and completeness, max 27):	Scoring (Max 27)	
Does the data cover the correct time-frame?	Yes with some reservations	2
Does the data provide complete coverage?	More yes than no, but equivocal	1
Has the data been sourced from credible, up-to-date sources?	Yes with some reservations	2
Is the underlying data reasonably free from concerns (e.g. official data from the ONS)?	Yes	3
Have the findings been independently peer-reviewed?	Yes	3
Is the methodology/calculation reasonably free from concerns?	Yes	3
Have the methodology/calculations been independently checked (internally or externally)?	Yes	3
Is the quantitative evidence well rooted in a wider qualitative understanding of the issue?	Yes	3
Have the findings been sense-checked against credible alternative sources (incl. inconclusively)?	Yes	3
Total		**23**

Degree of agreement around the findings (max 9):	Scoring (Max 09)	
Does more than one data source confirm the findings (within +/- 5%)?	No	0
Do the key stakeholders/experts actively agree with the findings?	Yes	3
Has feedback from the key stakeholders been incorporated in the reporting of findings?	Yes	3
Total		**6**

Table 70: RECOUP Consumer Collections

Data
RECOUP Consumer Collections
Source
RECOUP Survey 2019
Data Used In:
Consumer Recycling

Evidence (Robustness and completeness, max 27):	Scoring (Max 27)	
Does the data cover the correct time-frame?	Yes with some reservations	2
Does the data provide complete coverage?	Yes with some reservations	2
Has the data been sourced from credible, up-to-date sources?	Yes	3
Is the underlying data reasonably free from concerns (e.g. official data from the ONS)?	Yes with some reservations	2
Have the findings been independently peer-reviewed?	Yes with some reservations	2
Is the methodology/calculation reasonably free from concerns?	Yes	3
Have the methodology/calculations been independently checked (internally or externally)?	Yes with some reservations	2
Is the quantitative evidence well rooted in a wider qualitative understanding of the issue?	Yes	3
Have the findings been sense-checked against credible alternative sources (incl. inconclusively)?	Yes	3
Total		**22**

Degree of agreement around the findings (max 9):		
Does more than one data source confirm the findings (within +/- 5%)?	No	0
Do the key stakeholders/experts actively agree with the findings?	Yes	3
Has feedback from the key stakeholders been incorporated in the reporting of findings?	Yes	3
Total		**6**

Table 71: Survey of Recyclers and Exporters 2022

Data
Survey of Recyclers and Exporters 2022
Source
Verde Research and Consulting Ltd
Data Used In:
Recycling and End Markets

Evidence (Robustness and completeness, max 27):	Scoring (Max 27)	
Does the data cover the correct time-frame?	Yes	3
Does the data provide complete coverage?	Yes with some reservations	2
Has the data been sourced from credible, up-to-date sources?	Yes	3
Is the underlying data reasonably free from concerns (e.g. official data from the ONS)?	More yes than no, but equivocal	1
Have the findings been independently peer-reviewed?	No	0
Is the methodology/calculation reasonably free from concerns?	Yes with some reservations	2
Have the methodology/calculations been independently checked (internally or externally)?	Yes	3
Is the quantitative evidence well rooted in a wider qualitative understanding of the issue?	Yes	3
Have the findings been sense-checked against credible alternative sources (incl. inconclusively)?	More yes than no, but equivocal	1
Total		**18**

Degree of agreement around the findings (max 9):	Scoring (Max 09)	
Does more than one data source confirm the findings (within +/- 5%)?	Yes with some reservations	2
Do the key stakeholders/experts actively agree with the findings?	Yes with some reservations	2
Has feedback from the key stakeholders been incorporated in the reporting of findings?	Yes	3
Total		**7**

Table 72: Letsrecycle PRN Values 2008-2022

Data
Letsrecycle PRN Values 2008-22
Source
Letsrecycle
Data Used In:
Unaccredited Recycling

Evidence (Robustness and completeness, max 27):	Scoring (Max 27)	
Does the data cover the correct time-frame?	Yes	3
Does the data provide complete coverage?	No	0
Has the data been sourced from credible, up-to-date sources?	Yes with some reservations	2
Is the underlying data reasonably free from concerns (e.g. official data from the ONS)?	Yes with some reservations	2
Have the findings been independently peer-reviewed?	More yes than no, but equivocal	1
Is the methodology/calculation reasonably free from concerns?	More yes than no, but equivocal	1
Have the methodology/calculations been independently checked (internally or externally)?	More yes than no, but equivocal	1
Is the quantitative evidence well rooted in a wider qualitative understanding of the issue?	Yes with some reservations	2
Have the findings been sense-checked against credible alternative sources (incl. inconclusively)?	Yes with some reservations	2
Total		**14**

Degree of agreement around the findings (max 9):	Scoring (Max 09)	
Does more than one data source confirm the findings (within +/- 5%)?	No	0
Do the key stakeholders/experts actively agree with the findings?	Yes	3
Has feedback from the key stakeholders been incorporated in the reporting of findings?	Yes	3
Total		**6**

Table 73: NPWD Recycling Data 2022

Data
NPWD Recycling Data 2022
Source
NPWD
Data Used In:
Recycling Projections

Evidence (Robustness and completeness, max 27):	Scoring (Max 27)	
Does the data cover the correct time-frame?	Yes	3
Does the data provide complete coverage?	Yes with some reservations	2
Has the data been sourced from credible, up-to-date sources?	Yes	3
Is the underlying data reasonably free from concerns (e.g. official data from the ONS)?	Yes	3
Have the findings been independently peer-reviewed?	Yes	3
Is the methodology/calculation reasonably free from concerns?	Yes	3
Have the methodology/calculations been independently checked (internally or externally)?	Yes	3
Is the quantitative evidence well rooted in a wider qualitative understanding of the issue?	Yes	3
Have the findings been sense-checked against credible alternative sources (incl. inconclusively)?	Yes	3
Total		**26**

Degree of agreement around the findings (max 9):	Scoring (Max 09)	
Does more than one data source confirm the findings (within +/- 5%)?	No	0
Do the key stakeholders/experts actively agree with the findings?	Yes	3
Has feedback from the key stakeholders been incorporated in the reporting of findings?	Yes	3
Total		**6**

Appendix II
Technical Appendix

Technical appendix

This short technical appendix details the methodology underlying the projections for packaging materials POM discussed in section 15.1 of the report, and recycling discussed in section 14 of the report.

POM projections

In this methodology, the POM projections by material type are linked to selected indicators, and to projections of these indicators. The indicators considered, through analysis of historical relationships with packaging materials POM, are (statistically) a priori deemed potentially useful in describing the evolution of POM quantities for each of the packaging materials. The list of potential indicators, as shown in the Table 74, are grouped according to level/growth in; economic activity (GDP, GVA by sector, construction, imports), spending (consumer spending and retail sales), and population. Time series data for all indicators is sourced from the ONS and is adjusted by the ONS to remove the effects of changes in prices, so they are indicators of activity potentially related to the tonnage of packaging POM in real-terms.

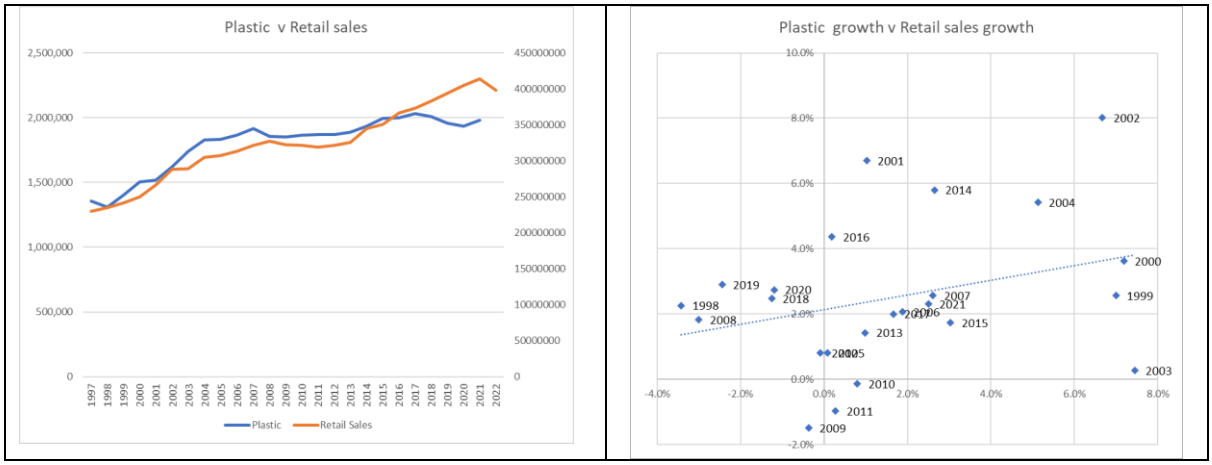
Table 74: A Selection of Indicators

Indicator group	Indicator and data source
Consumer spending	Household final consumption expenditure: National concept CVM SA - £m
Consumer spending	Total goods :Total CVM NA Year SA £m
Gross Domestic Product	GDP
Retail sales	Retail in non-specialised stores IV2X
Retail sales	Retail in predominantly food stores IV3G
Retail sales	Retail in non-food stores IV3I
Retail sales	Retail in other stores IW6U
Retail sales	Retail in textile, clothing and footwear stores IW6X
Retail sales	Retail in household goods stores IW6Y
Retail sales	Non-store retailing J58P
Retail sales	All retail excl. automotive
GVA	G46: Wholesale trade, except of motor vehicles and motorcycles
GVA	G47: Retail trade, except of motor vehicles and motorcycles
GVA	G56: Food and beverage service activities
GVA	A: Agriculture
GVA	B: Mining and quarrying
GVA	C: Manufacturing
GVA	D: Electricity, gas, steam and air conditioning supply
GVA	F: Construction
GVA	G: Wholesale and retail trade and repair of motor vehicles and motorcycles
GVA	Total GVA
Construction	Public new housing
Construction	Private new housing
Construction	Total new housing
Imports	CPA 08:WW:IM:CVM:BOP:SA: C. Manufactured products

Imports	CPA 08:WW:IM:CVM:BOP:SA: 10. Food products
Population	POP

A chart-based correlation analysis for a selection of these indicators (GDP, population and retail sales) versus POM for the plastic material type is shown below. The figures illustrate from 1997/98 to 2022 the (univariate) relationship, separately for both the levels and growth (annual % change), between the net pack fill measure - which serves as the best approximation to POM - and GDP, population and retail sales.

Figure 19: Plastic Packaging



These charts only provide a visual assessment of the degree of association between POM and a selection of indicators. Therefore, the tables below summarise the results of a more detailed statistical (univariate) correlation analysis across a broader range of possible indicators including alternative measures of consumer spending, detailed market segments for retail sales, GVA measures by industry sector, and imports for goods.

The correlations between the trends in each of the activity measures and trends in packaging materials are shown and the strength of the correlation is denoted by the statistical significance of the t-statistic derived (Prob. t). in each case the top three correlations are highlighted.

Table 75: Correlation Analysis for Packaging Materials and Indicator Measures, Levels 1997 – 2021

Level		PLASTIC	Prob. t
Consumer spending	Household final consumption Expenditure CVM SA - £m	93.9%	0.00%
Consumer spending	Total goods :Total CVM NA Year SA £m	81.3%	0.00%
Gross Domestic Product	GDP	93.7%	0.00%
Retail sales	Retail in non-specialised stores IV2X	87.9%	0.00%
Retail sales	Retail in predominantly food stores IV3G	92.7%	0.00%
Retail sales	Retail in non-food stores IV3I	95.7%	0.00%
Retail sales	Retail in other stores IW6U	90.7%	0.00%
Retail sales	Retail in textile, clothing and footwear stores IW6X	87.6%	0.00%

Retail sales	Retail in household goods stores IW6Y	64.6%	0.05%
Retail sales	Non-store retailing J58P	56.1%	0.35%
Retail sales	All retail excl. automotive	90.3%	0.00%
GVA	G46: Wholesale trade, except of motor vehicles and motorcycles	87.3%	0.00%
GVA	G47: Retail trade, Except of motor vehicles and motorcycles	64.2%	0.05%
GVA	G56: Food and beverage service activities	6.1%	77.08%
GVA	A: Agriculture	64.8%	0.05%
GVA	B: Mining and quarrying	-92.1%	0.00%
GVA	C: Manufacturing	92.3%	0.00%
GVA	D: Electricity, gas, steam and air conditioning supply	-27.8%	17.90%
GVA	F: Construction	-22.8%	27.40%
GVA	G: Wholesale and retail trade and repair of motor vehicles and motorcycles	84.8%	0.00%
GVA	Total GVA	93.4%	0.00%
Construction	Public new housing	82.8%	0.00%
Construction	Private new housing	70.4%	0.01%
Construction	Total new housing	77.2%	0.00%
Imports	CPA 08:WW:IM: CVM:BOP:SA: C. Manufactured products	92.5%	0.00%
Imports	CPA 08:WW:IM: CVM:BOP:SA: 10. Food products	94.2%	0.00%

Population	POP	84.0%	0.00%

Table 76: Correlation Analysis for Packaging Materials and Indicator Measures, Growth 1998 – 2021

Growth		PLASTIC	Prob. t
Consumer spending	Household final consumption Expenditure CVM SA - £m	0.389	6%
Consumer spending	Total goods :Total CVM NA Year SA £m	-0.236	27%
Gross Domestic Product	GDP	0.364	8%
Retail sales	Retail in non-specialised stores IV2X	0.486	2%
Retail sales	Retail in predominantly food stores IV3G	0.080	71%
Retail sales	Retail in non-food stores IV3I	0.481	2%
Retail sales	Retail in other stores IW6U	0.221	30%
Retail sales	Retail in textile, clothing and footwear stores IW6X	0.393	6%
Retail sales	Retail in household goods stores IW6Y	0.362	8%
Retail sales	Non-store retailing J58P	-0.340	10%
Retail sales	All retail excl. automotive	0.257	23%
GVA	G46: Wholesale trade, except of motor vehicles and motorcycles	0.306	15%
GVA	G47: Retail trade, Except of motor vehicles	0.197	36%

	and motorcycles		
GVA	G56: Food and beverage service activities	-0.015	95%
GVA	A: Agriculture	-0.012	96%
GVA	B: Mining and quarrying	0.293	16%
GVA	C: Manufacturing	-0.021	92%
GVA	D: Electricity, gas, steam and air conditioning supply	0.206	34%
GVA	F: Construction	0.310	14%
GVA	G: Wholesale and retail trade and repair of motor vehicles and motorcycles	0.353	9%
GVA	Total GVA	0.340	10%
Construction	Public new housing	0.435	3%
Construction	Private new housing	0.435	3%
Construction	Total new housing	0.302	15%
Imports	CPA 08:WW:IM: CVM:BOP:SA: C. Manufactured products	0.507	1%
Imports	CPA 08:WW:IM: CVM:BOP:SA: 10. Food products	-0.277	19%
Population	POP	0.309	14%

From the tables above Table 77 and Table 78 list the top three correlations ranked in order from the highest correlation observed.

Table 77: Levels Correlation Analysis of Packaging Materials and Indicator Measures, 1997 – 2021

Material	Highest correlations	Suggested activity indicator to link to
Plastic	1. Retail in non-food stores 2. Import of food products 3. Consumer spending	Consumer spending

Table 78: Growth Correlation Analysis of Packaging Materials and Indicator Measures, 1998 – 2021

Material	Highest correlations	Suggested activity indicator to link to?
Plastic	1. Imports of manufactured goods 2. Retail sales in non-specialised stores 3. Retail sales in non-food stores.	Imports

Based on the statistical correlation analysis above Table 79 provides a summary of the choice of indicator measure to link to by packaging material type. This supports developing a POM projection for by linking to projections of retail sales.

Table 79: Summary of Linking Packaging POM to Indicator Measures

Material	Levels analysis	Growth analysis	Projection based on
Plastic	Consumer spending	Retail sales, goods imports	Retail sales

Table 80 shows the projected growth rates for the indicators discussed above. The POM was multiplied by the change over time in the selected correlated indicator to obtain the level for each subsequent year.

Table 80: Projected Growth in Indicator Measures, 2024 to 2028.

Indicator	2023	2024	2025	2026	2027	2028	Source	
Retail sales	-3.1%	0.5%	1.0%	1.6%	2.1%	2.0%	2023 annual based on ONS latest data: Jan - Oct 2023	OBR forecast Nov 2023: Consumer spending

Recycling projections

In this methodology, the projections for total accredited recycling depend on the POM projection and the projection of the collection rate (assumed to be constant), apart from 2023 where NPWD data for 2023Q1 to Q3 is used to approximate a full year figure for 2023.

UK Domestic Recycling

The projections for accredited UK domestic recycling are extrapolated from observed trends (or absence of trends) in historic NPWD data (see section 14 of the report for a discussion). For 2023 NPWD data for 2023Q1 to Q3 is used to approximate a full year figure for 2023.

- Accredited UK domestic recycling of plastic packaging is projected to grow at its 2018 to 2022 CAGR of 12.5% per annum.

Export Recycling

- Accredited exports for plastic packaging are calculated as total accredited recycling *less* accredited UK domestic recycling.