

PackFlow Refresh 2023: Glass

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

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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; and
- 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
 - 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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J959 Glass Version 2.0

Executive Summary

Introduction

The PackFlow update reports (available here: [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, collections and recycling, and to assess potential compliance risks versus the packaging recycling targets.

The PackFlow Refresh 2023 project has two phases:

Phase 1

- Updates the baseline year to 2022 for estimates of packaging materials placed on the market (POM) collections, recycling, and end markets (from 2019 in the previous flow reports¹).

Phase 2

- Develop 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 report focuses on generating robust estimates of UK glass packaging POM² that are as accurate as is reasonably possible. The report also considers the quantities of glass packaging recycling, both in the UK and abroad, and provides insights into the end markets and products that are manufactured by packaging glass recyclers in the United Kingdom (UK).

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

Glass Packaging POM

This report estimates glass packaging POM in 2022 to be 2,562k tonnes (+/- 6%)^{3,4}: a decrease of 0.5% from the previous estimate in 2019.

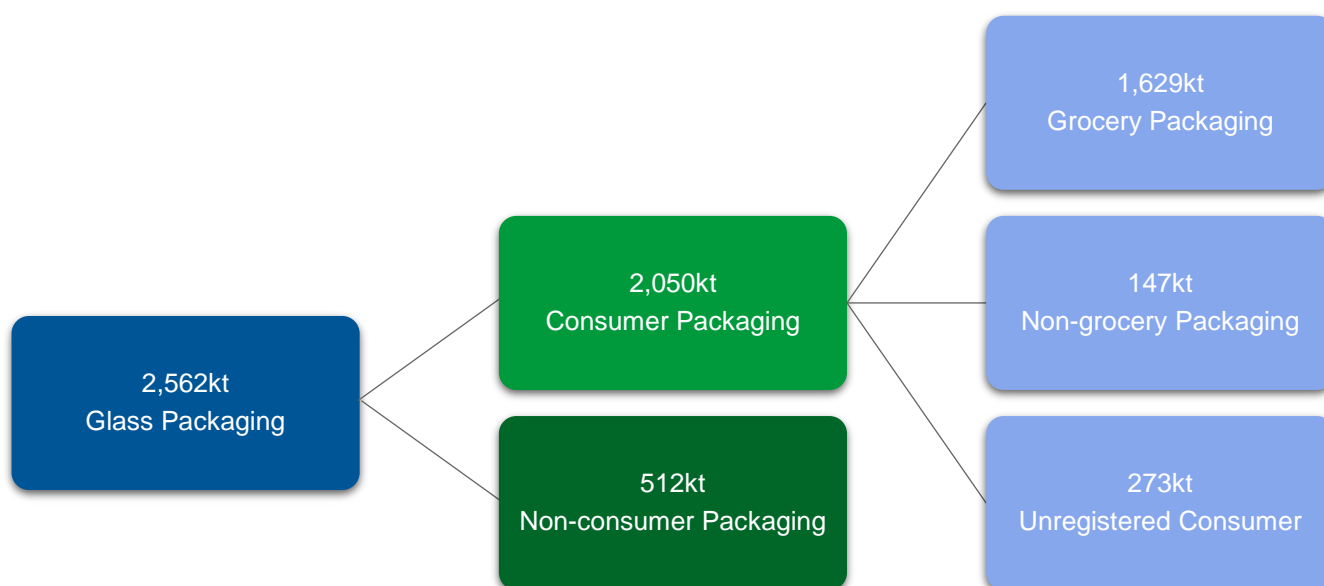
The glass packaging POM estimate is established using a methodology that identifies UK production of glass packaging, adds imports of glass packaging, and removes exports of glass packaging. Data from a variety of sources is used for each sector and the results combined. The POM figure is cross-checked with reported obligated data on National Packaging Waste Database (NPWD) and with this project's industry Steering Group.

¹ The previous packaging materials flow reports can be accessed here: <https://www.valpak.co.uk/more/material-flow-reports>.

² Glass packaging placed on the market means all household and non-household glass packaging used around products sold within the UK.

³ The error margins are assumed estimates based on the robustness assessment and are not the outputs of statistical calculation.

⁴ The error margin indicates that the two glass packaging POM figures are not substantially different.

Figure ES1: Glass Packaging POM by Sector, 2022 (k tonnes)⁶

The estimate for glass packaging POM in the consumer sector is 2,050k tonnes (+/- 5%).

The methodology for consumer POM is based on primary sales data from a sample of UK supermarkets 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 as such by industry.

The estimate for glass packaging POM in the non-consumer sector is 512k tonnes (+/- 15%).

Non-consumer glass packaging POM is derived by subtracting the consumer POM estimate from the total POM estimate for glass packaging. The estimates are reviewed and sense-checked by key industry stakeholders.

The non-obligated or unregistered flow estimate for glass packaging POM accounts for 11% of total POM in 2022 – this represents an increase of 2% from 2019.

The estimate of the unobligated/unreported tonnage (273k tonnes, 11%) in 2022 uses NPWD data to calculate a final net pack fill⁵ figure of 2,288k tonnes, which is then subtracted from the total glass packaging POM estimate of 2,562k tonnes. The unobligated proportion of 11% is an increase from the 9% identified in 2019.

The estimates of glass packaging POM by format type are: 2,116k tonnes (83%) glass bottles and 446k tonnes (17%) glass jars.

The format types for glass packaging are established primarily using information from Valpak's Environmental Product Information Centre (EPIC) database and sense-checked by key industry stakeholders including British Glass. Across glass packaging formats on the market, glass bottles make up the vast majority (by weight) of glass packaging.

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 /

⁵ 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))

household like') is 2,562kt, of which 2,302kt would remain in the Extended Producer Responsibility (EPR) system following the introduction of Deposit Return System (DRS) in Scotland and Wales.

Table 1: 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)
Glass - All	2,562	2,050	512	512	512	2,562
Glass - excluding DRS all nations	536	506	30	30	30	536
Glass - excluding DRS Scotland and Wales Only	2,302	1,852	450	450	450	2,302

Consumer Packaging in the Household Waste Stream

The total proportion of consumer glass packaging from grocery retailers that is disposed of in the household waste stream is 76%. The total proportion of consumer glass packaging from non-grocery retailers that is disposed of in the household waste stream is 77%. The remainder of glass is typically disposed in the work, gym, transport, educational and recreational facilities etc. This is based on the same sample of retailers as is used in the rest of this report and equates to 1,558kt (76%) of packaging in total across both grocery and non-grocery retail (consumer packaging).

Consumer Packaging in the 'Litterable' Categories

The total proportion of consumer glass packaging from grocery retailers that falls within the 'litterable' categories (as described in the material specific reports) is 74%. The total proportion of consumer glass packaging from non-grocery retailers that falls within the 'litterable' categories is 76%. This is based on the same sample of retailers as is used in the rest of this report and equates to 1,317kt (74%) of packaging in total.

Glass Packaging Recycling

The total quantity of UK glass packaging recycled is estimated to be 1,898k tonnes in 2022.

This includes NPWD reported glass packaging recycling (1,872k tonnes) and an estimate of unreported glass packaging recycling (26k tonnes). Based on the POM calculated as part of this project, this gives an overall glass packaging recycling rate of 74.1% in 2022, and an accredited recycling rate for glass packaging of 73.1%.

The total quantity of consumer⁶ UK glass packaging recycled is estimated to be 1,460k tonnes.

Based on WDF collection figures and the consumer POM calculated in this project, the consumer glass packaging recycling rate is estimated to be 71%.

The total quantity of non-consumer⁷ UK glass packaging recycled is estimated to be 438k tonnes.

Non-consumer glass packaging recycling is calculated by removing the consumer recycling tonnage from the figure for total glass packaging recycling. Based on the non-consumer POM estimate in this project, the non-consumer glass packaging recycling rate is 86% in 2022.

⁶ Consumer packaging is packaging consumed in the household.

⁷ Non-consumer packaging is packaging consumed in the commercial/industrial sector.

Of the total 664k tonnes of glass packaging not recycled, 531k tonnes (80%) is sent for energy recovery and 133k tonnes to landfill (20%) in 2022.

This is based on an estimated total of 590k tonnes of consumer glass packaging not being recycled and 74k tonnes of non-consumer not being recycled, estimated using WDF and published statistics on UK disposal routes for glass packaging.

End Markets

In 2022, 82% of glass collected was recycled in the UK.

In 2022, 82% of the recorded glass packaging recycling took place in the UK with the remaining 18% occurring overseas.

Glass is primarily recycled in remelt end markets in the UK.

Overall, 74% of the recorded glass packaging collected in the UK is recycled in remelt applications (UK and overseas). Of the glass packaging recycled in the UK, 68% went into remelt applications and 32% into 'other' applications.

Of the remelt fraction, industry suggests 15-20% is used to produce glass mineral wool and the remainder is used by the container industry. For non-remelt applications, typically glass is used as an aggregate substitute, which includes glass used in road construction, concrete products, as a shot blasting abrasive or filtration media.

The EU is the main export market for glass packaging exported from the UK.

Nearly all glass packaging exports in 2022 were destined for remelt applications with the container sector believed to take the majority. The key export destinations were Portugal (48%), Belgium (30%), Netherlands (9%), Spain (6%), Italy (5%), and Norway (1%).

Packaging Future Trends and Scenarios

Two EPR scenarios for each of the packaging materials are discussed in this summary (with further analysis available in the material specific report). The two 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); 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.

EPR Scenario 1

Glass POM tonnage is projected to reduce in 2023 compared to 2022, and while growth resumes from 2024 it remains below its 2022 level until 2028. Business targets are projected as constant at 2024 level of 82%. The POM projection is reflected in the projection of obligated tonnage for glass packaging, and (with assumed constant collection rates) the projection of accredited recycling. Based on this a surplus relative to the business target 2024 to 2028 is projected for glass packaging.

EPR Scenario 3

Glass POM tonnage is projected to reduce in 2023 compared to 2022, and while growth resumes from 2024 it remains below its 2022 level until 2026. Glass drinks containers in Scotland and Wales are removed from EPR POM from 2027 onwards (~260k tonnes). The business targets for the remaining material are projected as constant at 2024 level of 82%. The POM projection is reflected in the projection of obligated tonnage for glass packaging, and (with assumed constant collection rates) the projection of accredited recycling. Based on this a slight shortfall relative to the business target 2024 to 2026 is projected for glass packaging. The reduction in the recycling obligation relative to the projection for accredited recycling results in a surplus relative to the business target from 2027 onwards, which indicates that either the business target and/or the modelled collection rate could be adjusted downwards whilst still achieving the target.

Recommendations

Future updates of this work should revise the estimate of unaccredited glass recycling.

Future updates of this work should revise the estimate of unaccredited glass recycling for the glass recycled in the Ceramic, Stone, and Porcelain (CSP) output material from glass recycling facilities. Research conducted during this project indicated that going forward this will increasingly be recycled in accredited facilities and therefore will be captured in the published accredited recycling data.

Drinks containers, DRS in the nations and recycling of what remains.

At present, plans are that glass shall be included in a DRS in Wales, excluded from a DRS in England and Northern Ireland, and may be included or excluded from the DRS in Scotland. Furthermore, there has been some interest in and trials of various forms of Digital DRS, where each container is given a unique identity, which would help with fraud prevention but also unlocks the potential for deposits to be redeemed in locations other than a reverse vending machine, such as within kerbside recycling.

The inclusion of all or some glass drinks containers within the DRS will change the landscape for the compliance position for the glass packaging that remains within EPR. As such, further understanding of non-drinks glass packaging recycling rate, including glass jars and food bottles from the consumer sector (and how that differs from drinks), may be insightful for future EPR development and target setting, should some of the drinks containers be included in DRS.

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Appendix VI: UK Obligated Imports (Filled) Cross Reference

Appendix VII: POM Correlation Analysis

Appendix VIII: Supply Chain Where PRNs/PERNs Can Be Issued

Glossary

BBPA – British Beer and Pub Association

bn – Billion

C&I – Commercial and Industrial

Consumer Packaging – Packaging consumed in the household

CSP – Ceramics, Stones and Porcelain

Cullet – Crushed glass prepared for use in the glass remelt manufacturing process

DAERA – Department of Agriculture, Environment and Rural Affairs

DRS – Deposit Return System

EA – Environment Agency

EfW – Energy from Waste

EPIC – Environmental Product Information Centre

EPR – Extended Producer Responsibility

GDP – Gross Domestic Product

Glass Recycler / Reprocessor – Organisation which processes glass to prepare it for end markets such as remelt (container and fibreglass manufacturing), filtration, shotblasting, aggregates and export

Grocery Packaging – Packaging around products purchased in non-specialised retail stores with food, beverages or tobacco predominating

HMRC – His Majesty's Revenue and Customs

INCPEN – Industry Council for Packaging & the Environment

k – Thousand

kt – Thousand tonnes

LA – Local Authority

Non-consumer Packaging – Packaging consumed in the commercial/industrial sector (away from home or on the go in hotels, bars, restaurants and businesses)

Non-grocery Packaging – Packaging around products found in non-grocery retailers

NPWD – National Packaging Waste Database

ONS – Office of National Statistics

PERN – Packaging Export Recovery Note

POM – Placed on Market

PRN – Packaging Recovery Note

PRODCOM – "Production Communautaire" (Community Production)

RDF – Refuse Derived Fuel

SEPA – Scottish Environment Protection Agency

Unregistered Consumer Packaging – Packaging arising from organisations in the consumer sector that are below or unaware of the producer responsibility threshold

VDS – Valpak Data Solutions

WDF – WasteDataFlow

WRAP – Waste and Resources Action Programme

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- The Advisory Committee on Packaging (ACP)
- British Glass
- Industry Council for Packaging and the Environment (INCPEN)
- The Department of Agriculture, Environment and Rural Affairs (DAERA)
- The Department for Environment, Food and Rural Affairs (DEFRA)
- The Environment Agency (EA)
- Re-Gen Waste
- Sibelco
- The Scottish Government
- The Scottish Environment Protection Agency (SEPA)
- The Packaging Federation
- UK Hospitality
- URM
- Zero Waste Scotland (ZWS)

1. Introduction

1.1. Background

The PackFlow Refresh 2023 reports (available here: <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 flows of glass packaging in the UK in terms of material Placed on the Market (POM)⁸, collections and recycling, and to assess potential compliance risks versus the packaging targets.

The PackFlow Refresh 2023 project has two phases:

Phase 1

- Updates the baseline year to 2022 for estimates of packaging materials placed on the market (POM) collections, recycling and end markets (from 2019 in the previous flow reports⁹).

Phase 2

- Develop 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 other key industry stakeholders in their packaging policy work, Phase 1 of this report focused on generating robust estimates of UK glass packaging POM that are as accurate as is reasonably possible. The report also considers the quantities of glass packaging recycled, both in the UK and abroad, and provides insights into the end markets and products that are manufactured by glass packaging recyclers in the UK.

1.2. Phase 1 Objectives

The PackFlow Refresh 2023 project for glass packaging has the following key objectives for Phase 1:

- Provide updated (and cross-checked) baseline estimates of glass packaging placed on the UK market in 2022, by packaging format, sector, source, and nation:
 - Format (bottles, jars, other)
 - Sector (consumer, non-consumer)
 - Source (handled by obligated producers who are registered, non-obligated producers, or free riders)
 - Nation (England, Scotland, Wales, and Northern Ireland)
- Estimate the amount of packaging POM that could be disposed of within the Deposit Return System (DRS);
- Identify household (HH) and household-like (HH-like) categories;
- Identify commonly littered items;
- Estimate the quantities of glass packaging collected through kerbside and other collection types;
- Estimate the quantities of glass packaging recovered and recycled, sent for incineration with energy recovery, and sent to landfill for both UK and overseas end destinations; and
- Provide estimates of the quantities of glass packaging that is recycled (i.e., is recorded as accredited recycling) and glass packaging that is recycled but does not generate a Packaging Recovery Note (PRN) / Packaging Export Recovery Note (PERN) (i.e., is unrecorded or unaccredited).

⁸ Glass packaging placed on the market means all household and non-household plastic packaging used around products sold within the UK.

⁹ The previous packaging materials flow reports can be found at <https://www.valpak.co.uk/more/material-flow-reports>.

1.3. Methodology

1.3.1. POM

Glass packaging POM is estimated using the following methodology:

$$\text{Total UK Glass Packaging Consumption} = \text{Total Production} - \text{Exports (Empty)} - \text{Exports (Filled)} + \text{Imports (Empty)} + \text{Imports (Filled)}$$

This methodology references a variety of data sources of glass packaging products placed on the market combined with cross-checks where possible. The results of this method are cross-checked against an assessment of glass packaging POM reported on a variety of publicly available databases and sense-checked by the project's Steering Group. The baseline year for all data is 2022. Where 2022 data was not available, the most recent available data was used.

The details of the estimates for glass packaging POM and the results of the cross-checks that are performed are provided in Section 2 of this report.

Other methodologies were considered, such as using waste collection and composition data; however, this was not taken forward as this methodology has several significant limitations and is reliant on the composition of household waste, waste arisings from local authorities and similar data from the non-consumer sector, all of which will vary in terms of robustness. The justification of the use of POM data over alternatives is provided in full in section 1.3.1 of Glass Flow 2025¹⁰.

1.3.2. POM Cross-check (Net Pack Fill)

The cross-check used glass packaging data reported by obligated companies, which is publicly available on the National Packaging Waste database (NPWD). The net pack fill estimate is thought to capture the vast majority of obligated glass packaging but does omit glass packaging handled by non-obligated companies, free-riders¹¹ and packaging for internal company use (considered to be non-obligated packaging under the regulations).

To estimate the amount of glass packaging placed on the UK market by obligated companies, the net pack fill calculation set out below is applied. This calculation uses the total data reported by obligated packaging producers and is available on the NPWD website¹²:

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

1.3.3. Recycling

The NPWD is used as the source for accredited (recorded) recycling of glass packaging. The glass recycling industry, including those involved in producing cullet and exporting glass were consulted on the recycling of glass packaging that might not, for whatever reason, be reported on NPWD. The output of these discussions is used to estimate a figure for non-accredited (or unrecorded) recycling of glass packaging.

¹⁰ <https://www.valpak.co.uk/knowledge-hub-post/glassflow-2025/>

¹¹ Those companies who are above the packaging obligation threshold by having a turnover of £2 million and handling 50 tonnes of packaging or more but are not registered with the relevant agency.

¹² www.npwd.environment-agency.gov.uk

The total glass packaging recycling figure, consisting of recorded and unrecorded glass packaging recycling, is then split into consumer and non-consumer recycling. The Waste Data Flow (WDF) database is used as the source for the consumer recycling data. The difference between this and the figure for total recycling of glass packaging is assumed to be non-consumer glass packaging recycling.

1.3.4. Data Robustness

As there are levels of uncertainty around the data used to establish the various elements that are combined to estimate glass packaging POM, estimates are presented with error margins, providing an indicative range of uncertainty 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 relating to appropriate margins of error¹³, as shown in Table 2. The respective indicative margins of error are provided throughout the report.

Table 2: 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%
61%	to	65%	+/-	24%
56%	to	60%	+/-	27%

To calculate the 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).

¹³ These are assumed to be indicative estimates of error margins and not the outputs of a statistical calculation.

2. Phase 1: Glass Packaging POM

2.1. Introduction

This section of the report presents estimates for the total quantity of glass packaging POM in the UK in 2022. The POM figure is split between consumer and non-consumer; for the purposes of this report consumer glass packaging is defined as what is consumed in the home and non-consumer glass packaging is defined as glass packaging that is consumed in pubs, clubs, bars, and restaurants etc.

It is important to note that the report estimates consumer glass packaging consumption from supermarket grocery sales, i.e., as such all glass packaging around grocery products is counted as consumer glass packaging. This method will, in effect, include some products in glass that are purchased in supermarkets by some of the smaller pubs, clubs, restaurants, etc. for consumption on their premises (and not in the home).

This section includes (where possible) a series of sense checks against the data used. The details for the majority of these are included as appendices to this report.

The glass packaging recycling targets are currently based on a percentage requirement of what is flowing onto the market. The EU Packaging Waste Directive has set recycling targets of 70% of the total glass packaging waste arising in 2025 and 75% by 2030¹⁴. Although no longer part of the EU the UK government sets targets to meet and where possible exceed these targets. Companies in the UK that handle over 50 tonnes of packaging annually and have a turnover more than £2m are obligated to contribute to this overall objective, with the business recycling target set at 82% of the amount of glass placed on the market by obligated businesses in 2022. The same target remains in 2023¹⁵. Of the total amount of glass packaging recycled, an additional requirement is that 72% must be from re-melt.

2.2. UK Production

Historically, to identify how much glass packaging is produced in the UK, production data from UK glass manufacturers was provided by British Glass (2013 to 2017). The UK glass production data is publicly available from NPWD and British Glass provided a sense-check. In essence, due to the scale of the facility required to operate glass furnaces capable of producing glass packaging in any meaningful quantities, glass packaging manufacturers will be obligated and therefore included in NPWD. Therefore, in this report glass packaging production figures for 2019 to 2022 were derived from NPWD¹⁶.

As a sense check, in 2022 the British Glass and NPWD production figures were similar. British Glass believes any slight differences are because the data they collect is packed production rather than packaging supplied and placed on the market during a reporting year.

The UK glass packaging production estimates for 2019 to 2022 are provided in Table 3.

Table 3: UK Glass Container Production, 2019 - 2022 (k tonnes)

	2019	2020	2021	2022
Glass Container Production	2,419	2,281	2,470	2,473
% Change from prev. year	2%	-6%	8%	0.2%

Table 3 shows that over the period 2019 to 2022, UK glass container production increased by approximately 2% (or 54k tonnes).

¹⁴ <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A01994L0062-20180704> (Accessed 02/10/2023).

¹⁵ <https://www.gov.uk/guidance/packaging-producer-responsibilities> (Accessed 02/10/2023).

¹⁶ <http://npwd.environment-agency.gov.uk/Public/PublicSummaryData.aspx> (Accessed 30/01/2024).

Appendix II provides a sense check against data from PRODCOM¹⁷ (Eurostat statistics on the production of manufactured goods). It is important to note that the NPWD figures in which the 2022 glass production estimate is based are 'live'; i.e., they may change at any point until all submissions are finalised. Therefore, when NPWD data is used it is the latest available at the time of writing, but it is not believed the final NPWD data will vary significantly from the figures used in this report.

In this report, the NPWD figure 2473k (+/- 9%) is used for UK glass container production in 2022.

2.3. Exports (Empty)

Figures for exports of empty glass containers are taken from NPWD Table 2a conversion data are shown in Table 4. These were sense-checked by British Glass using data from their members.

Table 4: UK Empty Exports of Glass Packaging, 2019 - 2022 (k tonnes)

	2019	2020	2021	2022
Exports (empty) - Table 2a Conversion	200	184	201	240
% Change from prev. year	-1%	-8%	9%	19%

Table 4 shows there has been an oscillation between negative and positive annual growth between 2019 and 2022. However, over the whole period, empty glass packaging exports are up 40k tonnes (20%). Cross referencing the figures against HMRC beverage exports (detailed in Appendix III), shows a similar trend to the NPWD figures, therefore this report uses the NPWD data giving a figure for UK empty exports of glass packaging of 240k (+/- 9%) in 2022.

British Glass stated that their expectation is that there will be only minimal unregistered tonnage, as export of empty glass containers tends to be done only by the large glass packaging producers. This is because it is typically done to meet a particular demand within their group or to service their customers different sites.

¹⁷<https://www.ons.gov.uk/businessindustryandtrade/manufacturingandproductionindustry/datasets/ukmanufacturer-sales-by-product-prodcom> (Accessed 06/09/2023).

2.4. Exports (Filled)

Estimates for the export of filled glass packaging are taken from NPWD data Table 2b conversion and are shown in Table 5.

Table 5: UK Filled Exports of Glass Packaging, 2019 - 2022 (k tonnes)¹⁸

	2019	2020	2021	2022
Exports (Filled) – NPWD Table 2b Conversion	832	757	847	889
% Change from prev. year	2%	-9%	12%	5%

The Steering Group commented that these figures could exclude glass sourced in the UK that is subsequently exported to countries such as Eire or Gibraltar. Using Valpak member data submissions, it was possible to calculate a figure for this, shown in Table 6; however, as this only applies to Valpak members, it is considered a minimum figure.

Table 6: UK Filled Exports of Glass Packaging with Uplift, 2019 - 2022 (k tonnes)

	2019	2020	2021	2022
Exports (Filled) NPWD -Table 2b Conversion	832	757	847	889
Excluded EIRE/Gibraltar Exports	2	2	2	2
Exports (Filled)	833*	758*	848*	890*

* Figures do not exactly add up due to rounding.

The project Steering Group believed that there will be only minimal unregistered tonnage as exports (filled) will tend to be done by large producers. There is a cross referencing exercise against HMRC exports data (detailed in Appendix IV). This shows that the exports (filled) NPWD trend is generally supported by the HMRC trade data trend for beverage exports¹⁹. However, it is worth noting that this is only partly indicative as this includes beverages exported regardless of packaging types.

This method shows 890k tonnes (+/- 9%) of filled glass packaging was exported in 2022.

¹⁸ <http://npwd.environment-agency.gov.uk/Public/PublicSummaryData.aspx> (Accessed 30/01/2024). Only conversion data was used as the way the data form is submitted, based on Valpak experience, the numbers for raw material manufacture are the same as conversion.

¹⁹ www.uktradeinfo.com (Accessed 06/09/2023).

2.5. Imports (Empty)

NPWD data is used to estimate imports of empty glass packaging. British Glass advised that due to their membership not covering the full import/export supply chain, NPWD data is the preferred source of data on empty imports. The NPWD figures for empty import of glass packaging are shown in Table 7.

Table 7: UK Imports of Empty Glass Packaging, 2019 - 2022 (k tonnes)²⁰

	2019	2020	2021	2022
Imports (Empty) – NPWD Table 3a Pack / Fill	140	231	177	155
% Change from previous year	38%	65%	-23%	-13%

Table 7 shows that in 2022 there were 155k tonnes (+/- 9%) of glass packaging imported unfilled. Compared to 2019, this is an increase of 15k tonnes (11%). The Figure above also highlights that that the import/export of empty glass packaging is often done to meet particular demands and can fluctuate significantly. Empty imports/exports of glass containers are likely to be for the following reasons²¹:

- Multi-national glass manufacturers moving products around to meet demand;
- UK glass manufacturers selling glass containers outside of the UK. There are also imports of glass containers from European Union (EU) and non-EU countries to brand-owners and packer/fillers; and
- Glass container wholesalers in the UK that acquire glass containers from multiple glass manufacturers from around the EU and non-EU countries.

The project Steering Group believed that there will be only minimal unregistered tonnage as imports (empty) also tend to be done by the large producers. This is because they will typically be done in large quantities to meet a specific demand; it can be expensive as it is essentially transporting glass packaging with a lot of air/void space. The exception to this is that empty glass packaging will be imported by small-scale specialist packaging suppliers, but the tonnage is likely to be minimal.

These figures were cross referenced against HMRC import figures with the details shown in Appendix V.

2.6. Imports (Filled)

2.6.1. Introduction

The quantity of filled imports of glass packaging is more complicated to calculate. The estimate for this is based on the following calculation:

Imports (Filled)	=	Obligated Imports	+	Unobligated / Unregistered Imports	+	Cross Border Shopping
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2.6.2. Obligated Imports

As shown in the equation above, total filled imports comprise the obligated imports (those covered by the packaging regulations), unobligated/unregistered imports and cross border shopping.

²⁰ <http://npwd.environment-agency.gov.uk/Public/PublicSummaryData.aspx> (Accessed 30/01/2024).

²¹ British Glass correspondence, 02/10/2020.

Obligated (filled) imports are identified from information provided from NPWD: Table 3a: packaging imported into the UK for selling. This is shown in Table 8.

Table 8: UK Obligated Imports of Filled Glass Packaging, 2019 - 2022 (k tonnes)

	2019	2020	2021	2022
Imports (Filled) – NPWD Table 3a: Imported for Selling	995	1,081	1,028	1,036
% Change from prev. year	1%	9%	-5%	1%

Table 8 shows that obligated filled imports of glass packaging based on the NPWD data is 1,036k tonnes (+/- 9%) in 2022, a slight increase since 2019.

This data was checked against HMRC data, which is included in Appendix VI. This shows that the HMRC data increased from 2019 to 2022 and follows similar upward trend to the NPWD data.

2.6.3. Unobligated/Unregistered Imports

The unobligated importers are those that import filled glass packaging but fall below the packaging regulations threshold for turnover and packaging tonnage handled and are known as *de-minimis*. It is assumed that the majority of those that fall below the packaging regulations threshold are less likely to import filled glass packaging as they are not large enough to benefit from the economies of scale offered. However, the import of some specialist products supplied to local specialist shops for example will still occur. This could also include local wine clubs that import from specific vineyards etc. There are also those that are obligated under the regulations but that are not registered: free-riders. This will include those that do not register either through lack of knowledge of the regulations (where there is confusion around who the importer is, for example) and those that deliberately avoid the regulations.

Valpak made an estimate based on the estimated number of free-riders and their typical tonnages plus the number of *de-minimis* and their typical tonnage (based on internal Valpak knowledge regarding new registrations and the market not changing significantly over this period). This figure was estimated at 50k tonnes in 2012 and remained at this level in all previous updates; however, the Steering Group for this update identified that this may need revised. As such, further research was conducted, which identified that since Brexit the personal allowance of alcohol the public can bring into the country without paying tax has been significantly reduced²², which indicates there may be less unobligated/unregistered filled glass being packaging being imported. As such the Steering Group believed the previous estimate of 50k tonnes should be revised down to 25k tonnes (+/- 27%)²³. This estimate for unobligated/unregistered imports (filled) was sense checked by British Glass, which agreed this figure seemed sensible.

²² <https://www.gov.uk/bringing-goods-into-uk-personal-use/arriving-in-Great-Britain> (Accessed 06/09/2023).

²³ This is based on internal Valpak research. Due to the nature of this estimate i.e., it is unobligated/unregistered tonnage and is not recorded, it is difficult to provide a greater level of confidence and has therefore been given a large error margin.

2.6.4. Cross Border Shopping

The passenger numbers were taken from a variety of sources: air²⁴, sea²⁵, Eurostar²⁶ and Le Shuttle²⁷. As this is by full journeys (return trips), the passenger numbers were halved to determine all inbound journeys. The number of passengers buying alcohol was based on figures from Keynote²⁸ and it is assumed one glass bottle of alcohol purchased per buying passenger, with an average weight of 0.37kg. This is applied to the proportion of these alcoholic purchases that are packaged in glass, using the retail sales figures from the Valpak Data Solutions (VDS) database. The estimates depend on the assumptions set out above; therefore, there is some uncertainty around the quantities. However, they represent a relatively small proportion of the overall total compared with the more robust estimates of production, exports, etc. Table 9 summarises the estimate for cross border shopping.

Table 9: Cross Border Shopping, 2022

	Air	Sea	Rail - Eurostar	Rail - Le Shuttle	Total
Total Passengers (k)	221,856	20,651	8,300	7,889	258,697
Inbound Passengers (k)	110,928	10,326	4,150	3,945	129,348
Passenger Purchase Ratio	2%	40%	1%	54%	
Passengers Purchasing Duty Free (k)	2,219	4,130	42	2,130	8,520
Proportion Glass Purchases	82%	82%	82%	82%	82%
Av Bottle Weight (kg)	0.37	0.37	0.37	0.37	
Total Imported (k tonnes)	1	1	0	1	3

This shows that there were 3k tonnes (+/- 24%) of glass packaging POM from cross border shopping in 2022.

2.6.5. Total Imports (Filled)

Table 10 shows the total imports filled for glass packaging entering the UK.

Table 10: Total Imports of Filled Glass Packaging, 2022 (k tonnes)

	Obligated Imports	Unobligated / Unregistered Imports	Cross Border Shopping	Total
Imports (Filled)	1,036	25	3	1,064

This shows that there were 1,064k tonnes (+/- 8%) of imports (filled) of glass packaging in 2022.

²⁴ <https://www.caa.co.uk/Documents/Download/9116/47a460b2-0592-4ef7-b24b-aa5e27ccfce4/5636>

²⁵ <https://www.gov.uk/government/statistical-data-sets/sea-passenger-statistics-spas#all-uk-international-short-sea-long-sea-and-cruise-passengers> (Accessed 10/07/2023).

²⁶ https://mediacentre.eurostar.com/mc_view?language=&article_id=ka33z0000008h0qAAA (Accessed 10/07/2023).

²⁷ <https://www.getlinkgroup.com/uploadedFiles/assets-uk/Shareholders-Investors/Publication/Annual-Review> (Accessed 10/07/2023).

²⁸ KeyNote: Cross Border Shopping (2000).

2.7. Summary of Glass Packaging POM

Table 11 shows the total glass packaging POM in 2022.

Table 11: Total Glass Packaging POM, 2022 (k tonnes)

Category	Sub-Category	2022
UK Glass Packaging POM	Glass Packaging	2,562
Production	UK Production	2,473
	Total	2,473
Exports	Empty	240
Exports	Filled	890
	Total	1,130
Imports	Empty	155
	Filled - Obligated	1,036
	Filled - Unregistered	25
	Filled - Cross border selling	3
	Total	1,219

This report estimates a total of 2,562k tonnes (+/- 6%) of glass packaging POM in 2022. This represents a decrease in POM of 12k tonnes (0.5%) since 2019, however given the margin of error this represents little change. The following sections of the report provide further detail by breaking the POM down by sector, colour, and format.

2.8. Consumer POM

It is important for policy makers to understand where the glass is placed on the market; therefore, this section breaks down the total glass packing POM in the UK into consumer (packaging consumed in the household) and non-consumer (packaging consumed in the commercial/industrial sector i.e., away from home or on the go in hotels, bars, restaurants, and businesses) sectors.

For the purposes of this report, the consumer sector has been broken down into grocery and non-grocery. The addition of these two sub-sectors equates to the total consumer sector.

2.8.1. Consumer Type Glass Packaging

It is considered of interest to provide a POM estimate for glass packaging which could be defined as ‘consumer-type’. A review of all categories of glass packaging used within the Environmental Product Information Centre (EPIC²⁹) database for non-consumer glass packaging was conducted by Valpak and British Glass in 2019 to determine the split between ‘household-like’ and ‘non-household like’.

This concluded that all categories of glass packaging used could potentially be considered ‘consumer-type’, and although there may be the odd item that would be considered a novelty/specialist item of packaging, in terms of overall weight this would be negligible. Due to the short timeframe between the review and this work it is believed this will be unchanged.

Therefore, the full POM estimate of 2,562k tonnes (+/- 6%) is considered ‘consumer-type’.

2.8.2. Grocery Retail

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 glass packaging quantities reported in ‘Table 1 Selling’ from NPWD for 92% of UK grocery retailers³⁰. This data was scaled up to 100% of the UK grocery market and resulted in an estimated glass POM for 2019 of 1,629k tonnes (+/- 6%).

This estimate was cross referenced with EPIC, which was assessed to provide data on annual sales and packaging weights for all relevant products packaged in glass. This was taken from a selection of Valpak’s supermarket clients, representing a cross-section of grocery retailers in the UK.

Using volume market share information from Kantar World Panel for these supermarkets (representing 46% of the grocery retail market by sales volume for 2022), the resulting quantity of glass packaging was scaled up to represent an estimate for the UK grocery retail market. This method assumes that the glass packaging profile of the supermarkets in EPIC is representative of those not represented in EPIC. Based on this analysis, glass packaging in the grocery retail sector was estimated to be 1,685k tonnes in 2022 which is 56k³¹ tonnes (3%) lower than the estimate produced using the EA data. As with previous years this shows that EPIC and EA data is closely aligned.

In previous years EPIC data was used to estimate consumer POM due to it allowing for a greater level of interrogation of the data. However, based on the EA having higher market coverage the EA data was used to estimate consumer POM. The EPIC database was then used to further interrogate the breakdown of the consumer POM estimate product trends, colour, and format.

The final grocery retail glass packaging POM for 2022 of 1,629k tonnes (+/- 6%) was used. This is 4% higher than that identified for 2019³². Appendix I provides a detailed assessment of relative levels of confidence in the data.

2.8.3. 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 glass 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

²⁹ Valpak’s EPIC database holds sales data and packaging weights information for clients signed up for the fully managed service. It holds data for 34 million products and related packaging. 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).

³⁰ The figure does not include non-obligated or unregistered producers.

³¹ Due to rounding.

³² <http://www.valpak.co.uk/knowledge-hub/?category=flow-reports>

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)
 - 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
 - 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)
 - 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).

The method used assumes the packaging profile of those retailers within the Valpak 'non-grocery' sample is representative of those not in the sample and that turnover is a suitable scaling factor for packaging usage. Based on this method, total non-grocery glass POM is estimated at 147k tonnes (+/- 18%).

Adding the grocery and non-grocery estimates provides a consumer POM estimate of 1,776k tonnes (+/- 6%).

However, this is based on obligated producer packaging data and does not include the unobligated/unregistered tonnage. Discussions with the project Steering Group highlighted that they believe the unobligated/unregistered tonnage will most likely relate to small organisations in the consumer sector that are below or unaware of the producer responsibility threshold. Therefore, if the unobligated/unregistered tonnage of 273k (calculated by taking the obligated POM estimate away from the total POM) is added to the consumer grocery and non-grocery estimates, it provides a total for consumer packaging of 2,050k tonnes (+/- 5%). This estimate represents an increase of 8% in consumer POM since 2019.

2.9. Non-Consumer POM

The non-consumer glass packaging estimate can be derived from taking the consumer estimate from the total glass POM, as shown in Table 12.

Table 12: Non-consumer Glass Packaging, 2019 (k tonnes)

Non-consumer Packaging	=	Total POM	-	Consumer packaging
512	=	2,562	-	2,050

This shows that non-consumer packaging accounts for 512k tonnes (+/- 15%), which is a decrease of 24% since 2019. It also shows that consumer POM accounts for 80% and non-consumer accounts for 20% of the glass packaging POM.

2.10. Glass Packaging POM Formats

2.10.1. POM Composition by Colour

Using the Valpak EPIC database, the colour of glass packaging placed on the market could be identified for both the consumer and non-consumer sectors:

Consumer

- Clear (53%)
- Amber (18%)
- Green (29%³³)

Non-consumer

- Clear (51%)
- Amber (18%)
- Green (31%³⁴)

Both consumer and non-consumer splits were sense-checked by British Glass, Sibelco and Re-Gen Waste. In the UK clear glass packaging has traditionally made up a high proportion of glass manufacturing due to demand for products such as whisky. However due to the imports of products such as wine there is a higher proportion of green and amber glass within glass packaging collected for recycling. Using the splits above, Table 13 shows the quantity of glass packaging POM by colour.

³³ This includes 5% of other colours of glass, which are typically mixed or darker colours and would likely end up processed with green glass. This was identified using the EPIC database.

³⁴ This includes 7% of other colours of glass, which are typically mixed or darker colours and would likely end up processed with green glass. This was identified using the EPIC database.

Table 13: Glass Packaging POM by Colour, 2022 (k tonnes)

	Quantity
Total Consumption	2,562
Total Consumer Consumption	2,050
Clear	1,096
Amber	362
Green	529
Total Non-consumer Consumption	512
Clear	261
Amber	94
Green	156

2.10.2. POM Composition by Format

By using the EPIC database, the breakdown in format of glass POM can also be identified for consumer and non-consumer glass, then using these splits and applying them to the POM estimates for consumer and non-consumer POM, the quantity of glass by format can be derived as shown in Table 14. This was sense-checked by British Glass in 2022, which agreed the splits were in line with their estimates.

The total estimate of glass packaging POM by format type are: 2,116k tonnes (83%) glass bottles and 446k³⁵ tonnes (17%) glass jars.

³⁵ Figure differs from table due to rounding.

Table 14: Glass Packaging POM by Format, 2022 (k tonnes)

	Quantity
Total Consumption	2,562
Total Consumer Consumption	2,050
<i>Bottles</i>	1,619
<i>Jars</i>	430
<i>Other</i>	0
Total Non-consumer Consumption	512
<i>Bottles</i>	497
<i>Jars</i>	15
<i>Other</i>	0

This shows that bottles are the most used format of glass packaging POM in both the consumer and non-consumer sectors, accounting for 79% and 97% respectively. By further interrogating the EPIC database, the percentage of bottles that are beverage bottles can be identified and by applying this to the estimate for bottles POM, it is estimated that 1,544k tonnes of consumer bottles and 482k tonnes of non-consumer bottles are beverage containers.

It should be noted that where the format of glass packaging was not exactly a glass bottle or jar could be termed slightly differently based on subjective opinion i.e., a Douwe Egberts glass coffee jar lid or Gu glass dessert pot. These were included in the most relevant category i.e., jars. Any other formats were minimal.

2.11. Glass POM Cross-check (Net Pack Fill)

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

The 2022, UK flow of glass packaging was calculated using the packaging weights reported to the EA by registered producers, which is publicly available on the NPWD website. The calculation used is shown 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
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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 the Steering Group believe³⁶ that there would typically be fewer unobligated packers in comparison to unobligated sellers, due to the likely size of packers being larger than sellers. In addition, raw material manufacturing will include process losses, i.e., not everything manufactured will

³⁶ No evidence data is available to support this.

be converted or pack/filled, so it is expected that obligated tonnage is likely to decline as we move further down the supply chain.

Using this method, the total obligated glass POM in 2022 is 2,288k tonnes (as of 30 January 2024) shown in Table 15³⁷, which is lower than the 2,342k tonnes reported in 2019.

Table 15: Obligated Glass Packaging (Net Pack Fill), 2022 (k tonnes)

	Glass Packaging
Table 1 Pack/Fill (UK pack/filling)	2,221
Imports:	
3A Selling (filled imports)	1,036
3B (packaging removed from imports)	1
Total Imports	1,038*
Exports:	
2A P/F (direct exports)	839
2B P/F (third party exports)	131
Total Exports	971*
Net Pack Fill	2,288

* Figures do not exactly add up due to rounding.

This method does not account for glass packaging handled by 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, except through iteration.

However, it should be noted that at the time of writing the 2023 producer registrations were complete for 2022 data, and as such, the 2022 Net Pack Fill figure is unlikely to change unless errors in data submissions are identified.

An estimate of the unobligated/unregistered quantity has been made by subtracting the net pack fill figure of 2,288k tonnes from the project's final flow estimate of 2,562k tonnes. This leaves 273k tonnes, or an unobligated proportion of 11%.

³⁷ As reported by businesses in 2023.

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.

It should also be noted that the implementation of DRS may involve separate DRS systems being implemented in the UK. Although confirmation of which schemes will include glass, at the time of writing it is understood that there is the possibility of England and Northern Ireland not containing glass, whilst Scotland and Wales might. Packaging that falls into the scope of the DRS will be excluded from the Packaging Waste Regulations and the reformed system to incorporate EPR, therefore the options below consider these potential scenarios.

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 2,562kt, of which 2,302kt would remain in the EPR system following the introduction of DRS in Scotland and Wales.

Table 16: 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)
Glass - All	2,562	2,050	512	512	512	2,562
Glass - Excluding DRS All Nations	536	506	30	30	30	536
Glass - Excluding DRS Scotland and Wales Only	2,302	1,852	450	450	450	2,302

4. Consumer Packaging in the Household Waste Stream

4.1. Introduction

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.

4.2. 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 that 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.

4.3. 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.
 - This assumption is based on ONS data³⁸ ³⁹.
- 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.

4.4. 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.

³⁸ www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/families/datasets/householdsbyhouseholdsizeandregionsofenglandandukconstituentcountries

³⁹ www.gov.uk/government/statistics/non-domestic-rating-stock-of-properties-2020

4.5. 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?; and
23. **Beer/Cider** - Think about the last time you consumed beer or cider (with or without alcohol) bought from a supermarket, off licence or 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.

4.6. 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.

4.7. 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).

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

Based on the methodology detailed above, the total proportion of consumer glass packaging from grocery retailers that is disposed of in the household waste stream is 76%. The total proportion of consumer glass

packaging from non-grocery retailers that is disposed of in the household waste stream is 77%. The remainder of glass is typically disposed in the work, gym, transport, educational and recreational facilities etc. This is based on same sample of retailers as is used in the rest of this report and equates to 1,558kt (76%) of packaging in total across both grocery and non-grocery retail (consumer packaging).

The proportion of grocery glass packaging within the household waste stream is detailed in Table 17.

Table 17: Proportion of Glass Grocery Packaging Disposed of Within the Household Waste Stream

	Brown	Clear	Green	Other
Bottle	71%	74%	72%	73%
Jar	79%	87%	98%	87%

The proportion of non-grocery glass packaging within the household waste stream is detailed in Table 18.

Table 18: Proportion of Glass Non-Grocery Packaging Disposed of Within the Household Waste Stream

	Brown	Clear	Green	Other
Bottle	72%	74%	72%	73%
Jar	100%	93%	100%	93%

* Figures do not exactly add up due to rounding.

5. Consumer Packaging in the 'Litterable' Categories

5.1. Introduction

Under EPR there is the possibility of attaching additional costs to items that are commonly littered, therefore this section identifies the proportion of glass that is considered litterable.

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 report⁴⁰ 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 EPIC 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.

5.2. Proportion of Packaging that Falls Within the Litterable Categories

Based on the methodology detailed above, the total proportion of consumer glass packaging from grocery retailers within the 'litterable' categories detailed above is 74%. The total proportion of consumer glass packaging from non-grocery retailers within the 'litterable' categories is 76%. This is based on same sample of retailers as is used in the rest of this report and equates to 1,317kt (74%) of packaging in total.

The proportion of grocery glass packaging within the litterable categories is detailed in Table 19.

Table 19: Proportion of Glass Grocery Packaging that Falls Within the Litterable Categories

	Brown	Clear	Green	Other
Bottle	100%	91%	100%	100%
Jar	0%	0%	0%	0%

The proportion of non-grocery glass packaging within the litterable categories is detailed in Table 20 below.

Table 20: Proportion of Glass Non-Grocery Packaging that Falls Within the Litterable Categories

	Brown	Clear	Green	Other
Bottle	97%	100%	100%	100%
Jar	0%	0%	0%	0%

⁴⁰ www.keepbritaintidy.org/sites/default/files/resources/20200330%20KBT%20Litter%20Composition%20Report%20-%20FINAL.pdf

6. By Nation Reporting

6.1. 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.

6.2. 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.

6.2.1. Agriculture

Valpak considered national statistics for agriculture relating to employment⁴¹, income, the number of holdings and the total hectares⁴² in each of the nations as follows.

Table 21: 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 shown in Table 22.

⁴¹

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

⁴² https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1088518/AUK-Chapter2-14jul22.ods

Table 22: Proportion of Key Metrics Relating to Agriculture in 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%

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.

6.2.2. 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 23: Proportion of Population Living in Each Nations of the UK

	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%

6.2.3. Construction

Various factors were considered within construction sector, however, as is the case in agriculture, the total employment^{43 44} 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.

⁴³ GB data:

<https://www.ons.gov.uk/file?uri=/businessindustryandtrade/constructionindustry/datasets/constructionstatisticsannualtables/2021/constructionannualtables2021.xlsx>

⁴⁴ Northern Ireland Data: <https://www.nisra.gov.uk/system/files/statistics/2022q2soti.xlsx>

Table 24: Proportion of Employees Within the Construction Sector in Each Nation 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%

6.2.4. GDP

Those aspects of POM in the Non-Consumer (manufacturing) sectors were scaled by GDP⁴⁵ to represent manufacturing output.

Table 25: Proportion of Total UK GDP 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%

6.2.5. Hospitality

Data as to the relative size of the hospitality sector in each of the regions is available from Government statistics in terms of the number of establishments in 2017⁴⁶. 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.

⁴⁵ <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>

⁴⁶ https://assets.publishing.service.gov.uk/media/5d67a363ed915d53b4904899/Hospitality_and_Tourism_Workforce_Landscape.pdf

Table 26: 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%

6.3. Sector Scaling Factors Used

The scaling factors used for each sector in the by nation 2022 POM reporting is shown below in Table 27.

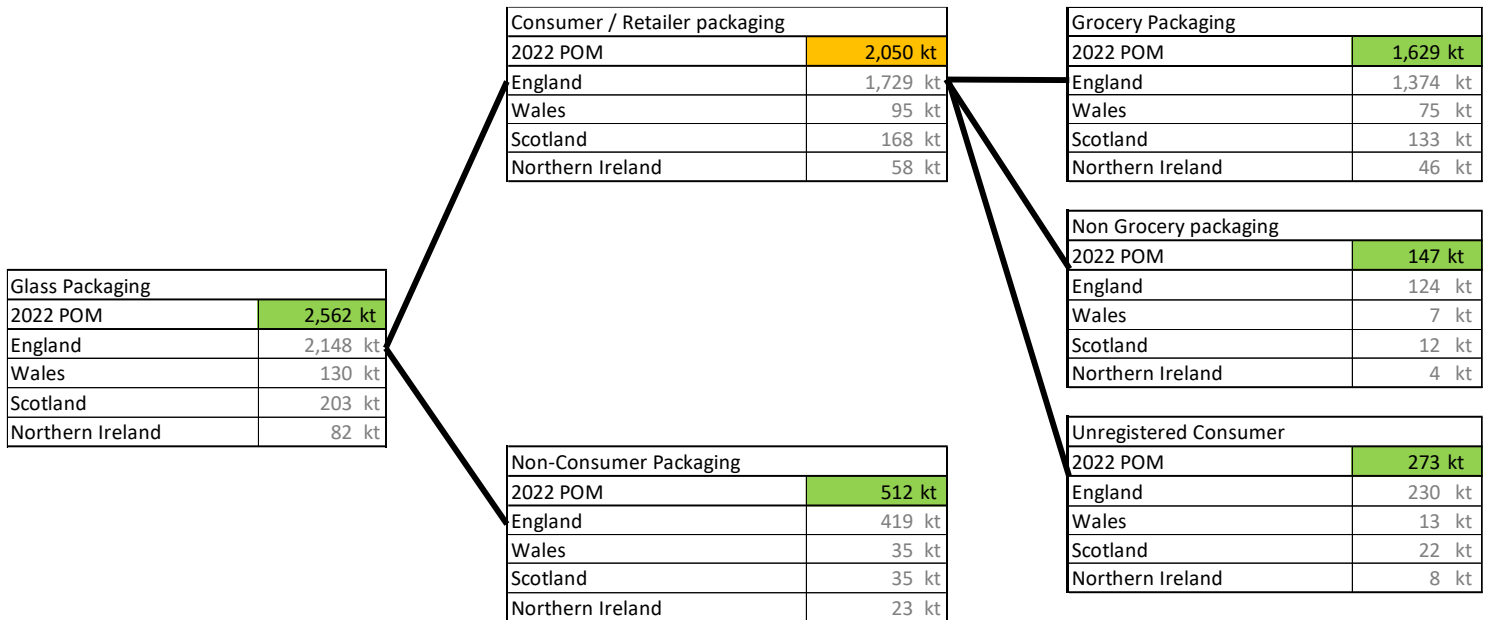
Table 27: Scaling Factors Used for Each Sector in the By-nation 2022 POM Reporting

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

6.4. POM by Nation – Glass

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

Figure 1: POM by Nation – Glass



7. Phase 1: Collection and Recycling of Glass Packaging

7.1. Accredited Recycling of Glass Packaging (Recorded)

The NPWD was used to identify the total accredited (recorded) recycling of glass packaging, both in the UK and of exports for recycling overseas. For 2022, this shows 1,872k tonnes of glass packaging were recycled, of which 1,534k tonnes (82%) took place in the UK.

Of the total (UK and exports), 1,380k tonnes (74%) relates to recycling for remelt applications (i.e., recycled into glass containers) and 492k tonnes (26%) to recycling for other (typically aggregate) applications. Most exports were for recycling in remelt applications, with only 3k tonnes (0.9%) of exports for other applications.

Based on the overall POM calculated in this report, the total recorded recycling figure of 1,872k tonnes gives a recorded recycling level of 73.1% in 2022.

PRNs and PERNs can be issued at various points of the supply chain depending on whether the glass is recycled in remelt or non-remelt applications, which was revised following the adoption of the EU End of Waste Regulation for Glass Cullet⁴⁷. Appendix VIII provides a diagram showing where in the supply chain PRNs and PERNs can be issued.

It should also be noted that key industry stakeholders for the project highlighted a potential difference between what percentage of material an exporter could claim for a PERN (Packaging Export Recovery Note) compared to the percentage a UK reprocessor could claim for a PRN (Packaging Recovery Note).

SEPA explained that exporter PERN claims tend to be based on sampling reports/outturns from the interim sites i.e., they don't necessarily claim 100% of the weight exported. For UK reprocessors/recyclers, it is the point where it is End of Waste (i.e., glass cullet for remelt) and is based on clean glass sent (outputs, 100%) to remelt facilities. Where the reprocessors are remelt facilities, the claim can be based on 'waste received'; which may involve deductions for any non-glass/contaminants as applicable.

7.2. Recycling of Glass Packaging (Unrecorded)

It is important to recognise that not all the recycling of glass packaging might be accredited and recorded on NPWD. To try and identify the scale of unrecorded recycling, discussions were held with the project Steering Group as well as UK recyclers and exporters handling recovered glass packaging.

For glass recycled into remelt applications, whether this occurs in the UK or overseas, the view of those consulted was that all of it is being captured on NPWD. The rationale for this conclusion is that glass recycling operations that prepare cullet for the remelt sector are large scale operations that are known to be accredited. For exports, the economic feasibility relies on the revenue generated from the PERNs and so shipments outside of the UK are unlikely to occur through unaccredited exporters. Therefore, the capture on NPWD of recycling for remelt was assumed to be 100%.

For recycling of glass packaging for use in non-remelt applications, it was believed that there is some loss in 2022 (and previous years), related to MRF glass fines used in aggregate applications. The payment of gate fees for glass fines and the potential to use relatively simple processing equipment to produce an aggregate (compared to that required to produce a furnace ready cullet) meant that some non-accredited recycling would likely happen. Following discussions with the key industry stakeholder group and other representatives from industry, it was assumed that 95% of the 'other' recycling (non-remelt) was captured on NPWD in 2022. Therefore the 5% that was not captured on NPWD equates to 26k tonnes.

During the production of glass cullet for remelt applications, ceramics, stones, and porcelain (CSP) must be removed. This is done using optical sorting equipment that removes this contamination with jets of air. This ejected fraction typically contains glass packaging that are removed along with the CSP. As this material is often used in aggregate applications, it is typically captured on NPWD. In previous PackFlow projects it was reported that most companies recycling this fraction were accredited, but that some may not be, therefore previously an unrecorded recycling figure for the recycling of this fraction where PRNs were not issued was applied. Since the

⁴⁷ <https://npwd.environment-agency.gov.uk/filedownload.aspx?fileid=edee7dc6-4249-4187-834e-88fb6a8b5bdd>

price of PRNs were higher in 2022 compared to 2019 (previous PackFlow), it is likely that all of this material was captured on NPWD.

In total, it is estimated that there were 26k tonnes of unrecorded glass packaging recycled in 2022, all from 'other' recycling not captured on NPWD.

7.3. Total Recycling (Recorded and Unrecorded)

The total glass packaging recycling can be calculated by combining the recorded recycling on NPWD with the estimate for unrecorded recycling:

$$\text{Total UK Glass Packaging Recycled} = \text{Total Recorded Recycling} + \text{Total Unrecorded Recycling}$$

This gives a total recycling figure for glass packaging of 1,898k tonnes. Based on the POM calculated in this report, this would be a recycling rate of 74.1%.

7.4. Consumer and Non-consumer Recycling

7.4.1. Consumer Recycling

Consumer recycling data was extracted from Waste Data Flow (WDF) and figures are reported based on the financial year 2021/22 (excluding Scotland where the data relates to 2021). This means there is some degree of inconsistency between the collection figures for April 2021 - March 2022 and the consumption figures for January 2022 - December 2022⁴⁸. A summary of the glass packaging collections is shown in Table 28.

Table 28: Glass Packaging Collection WDF Data, 2022 (k tonnes)

	Kerbside	Bring	HWRC	Total
Glass Packaging Collected	1,410	144	34	1,587

Adjustments were made to reflect the actual consumer glass recycling from the collection data reported in WDF by taking into consideration contamination.

Glass PRNs are issued at the point the cullet is produced and so will exclude any contamination, including caps, closures, and corks, etc. Exports need to account for contamination prior to reporting on NPWD. Estimates were made related to contamination in the WDF figures, so they better align with NPWD figures. It was assumed that local authorities (LAs) would report any glass that was separately collected from other materials based on vehicle delivery weights. WDF shows this to be 37% of the glass in 2022, either separately collected at the kerbside or in bring banks, including those at HWRCs. Where the glass is collected separately, a 3% loss is assumed for contamination (primarily caps and closures). Around 7-8% of the glass is ejected during the cullet making process whilst removing CSP (see above); however, this has not been deducted as it is assumed to be recycled as aggregates (recorded or unrecorded).

The remaining 63% of the glass is collected comingled with other materials. Here, the material will also contain caps and closures, but it is assumed that higher levels of other contamination will be present than for glass collected source separated. Glass is harder to sample at single stream MRFs than other materials due to the presence of small broken fragments that will fall through the sieve used to separate large items and fines during the sampling process. It is contamination in this fines fraction that may impact on contamination levels reported on WDF. If MRFs choose to allocate glass to suppliers based on outputs, then again, contamination will be

⁴⁸ The figure is approximate, as data is reported in different ways. Most is for the period April 2021 to March 2022; however, the SEPA data reviewed was for 2021. Also, some data was for household waste (used where available) and other data for municipal solid waste.

contained within it at higher levels than source separated glass. For the calculation, it is assumed that glass collected with other materials will be reported with 10% contamination levels.

It should be noted that an adjustment was also made in consumer glass recycling to account for any non-consumer glass that may be present. Non-consumer glass might arrive in the flow from several sources:

- Local authority collections of glass from licensed premises and offices;
- Licensed premises placing glass in bottle banks or domestic kerbside bins;
- Businesses and offices collecting glass and placing it in bottle banks or domestic kerbside bins; and
- Individuals purchasing drinks in glass bottles from small commercial outlets such as takeaways and sandwich shops that they then recycle at home.

The workings assume WDF kerbside to contain 0.5% C&I glass and WDF bring and CA to contain 2% C&I glass content.

Based on the above assumptions, it is estimated that the total glass collected as reported on WDF should be reduced by 128k tonnes to account for the presence of contamination (that would not be included in the NPWD figures). By making this reduction it means that 1,460k tonnes of consumer glass packaging was recycled in 2022. Based on the POM calculated in this report, this would give a consumer glass packaging recycling rate of 71%.

7.4.2. Non-consumer Recycling

Non-consumer recycling was estimated as shown in Table 29:

Table 29: Non-consumer Recycling Calculation (k tonnes)

Non-consumer Recycling	=	Total Recycling	-	Consumer Recycling
438	=	1,898	-	1,460

This gives a non-consumer recycling estimate for glass packaging of 438k tonnes in 2022. Based on this report's estimated non-consumer glass packaging POM, this gives a recycling rate of 86%.

7.5. Glass Packaging Not Recycled

By taking the consumer and non-consumer recycling totals from the respective POMs the non-recycled tonnages can be identified. This shows that 664k tonnes were not recycled in 2022, with 531k tonnes going to EfW and 133k tonnes to landfill.

For consumer glass packaging, the non-recycled total is 590k 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 (it should be noted that glass which ends up as Incinerator Bottom Ash (IBA) and is typically recycled to aggregates, however, unlike metals it does not count towards the glass recycling rate. Using these percentages, it is estimated that of the total consumer glass packaging not recycled, 472k tonnes was sent for energy recovery and 118k tonnes to landfill.

For non-consumer glass packaging, the non-recycled total is 74k tonnes. Here, an assumption was made that the glass content of C&I wastes entering EfW and RDF plants would be similar to that in MSW waste, therefore it was assumed that it 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, it is estimated that of the total non-consumer glass packaging not recycled, 59k tonnes was sent for energy recovery and 15k tonnes to landfill.

8. Glass Packaging End Markets

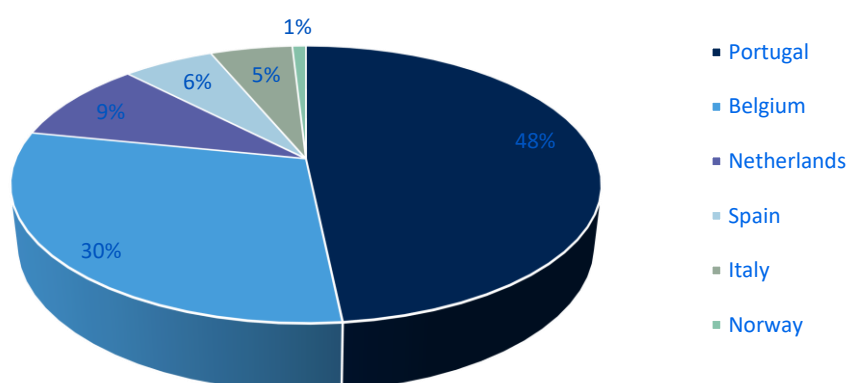
This section looks at the key uses for glass packaging collected in the UK for treatment by recycling. Based on NPWD figures for 2022, 82% of the recorded glass packaging recycling took place in the UK and 18% overseas. Of the glass packaging recycled in the UK, 1,045k tonnes (68%) went into remelt applications and 489k tonnes (32%) into 'other' applications.

Of the remelt fraction, input from industry suggests 10-15% is used to produce glass mineral wool and the remainder is used by the container industry. The 'other' category on NPWD is used for non-remelt applications, typically the use of glass in some form of aggregate substitute application. This includes glass used in road construction, concrete products, as a shot blasting abrasive or filtration media.

A Freedom of Information Act request was made to the Environment Agency for information on where UK waste packaging was exported to in 2022⁴⁹. It can be seen from the breakdown given below that it is all exported to other EU countries. Exports tend to be focused on either wine making regions, such as Portugal, or countries in Northwest Europe where logistics costs are relatively low, however it should be noted that some countries may not be the final destination of recycling and that glass, as a commodity, may be sold onwards. As mentioned earlier, nearly all the exports in 2022 were destined for remelt applications with the container sector believed to take the majority.

Table 30: Glass Packaging Export Destinations, 2022⁵⁰ (k tonnes)

Country	Export	% of Exports
Portugal	162	48%
Belgium	100	30%
Netherlands	32	9%
Spain	20	6%
Italy	18	5%
Norway	3	1%



⁴⁹ 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.

⁵⁰ Data source: UK Environment Agency. Freedom of Information request. Data Manipulation: Verde Research and Consulting Ltd. Contains public sector information licensed under the Open Government License v3.0. <http://www.nationalarchives.gov.uk/doc/open-government-licence/version/3/>

9. Phase 2: Packaging Future Trends and Scenarios

9.1. 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 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 reports⁵¹).

Phase 2

- Develop scenarios for packaging materials flow and recycling from 2022 to 2028⁵²; and
- Assess likely future recycling performance.

9.2. 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 2028² 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 trend.

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.

9.3. Methodology

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

9.3.1. Net Pack Fill

This report uses historic NPWD⁵³ 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).

⁵¹ The previous packaging materials flow reports can be found at <https://www.valpak.co.uk/more/material-flow-reports>.

⁵² The POM projections extend to 2040 but beyond 2028 should be regarded as highly uncertain.

⁵³ www.npwd.environment-agency.gov.uk

The net pack fill calculation applied in each year, to each packaging material type, 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
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10. Trends in Packaging POM by Material

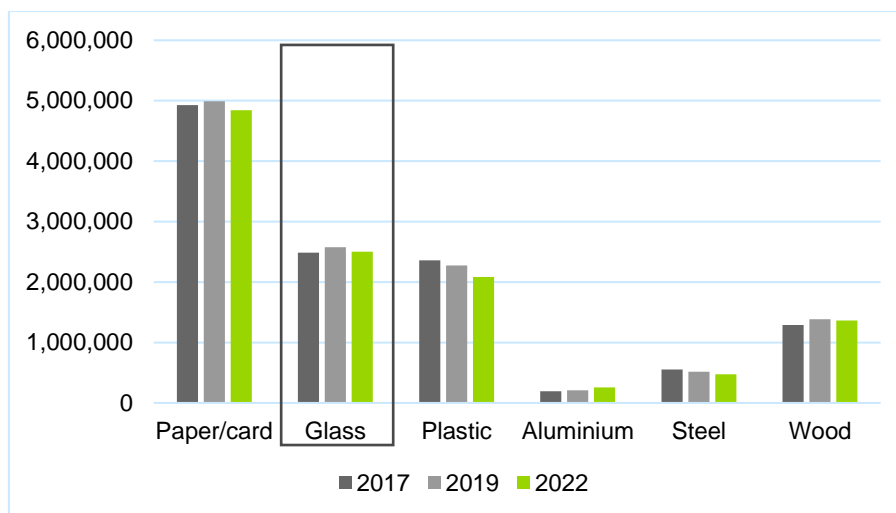
This section of the report uses NPWD time-series data on packaging handled by obligated producers, by type of packaging material, from 1998 to 2021 – this dataset represents the maximum number of annual observations available.

PackFlow's most recent quantifications of packaging POM are for 2017, 2019 and in the current project 2022 (Figure 2). The main takeaways from Figure 2 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 2: Packaging POM by Material, 2017, 2019 and 2022 (k tonnes)



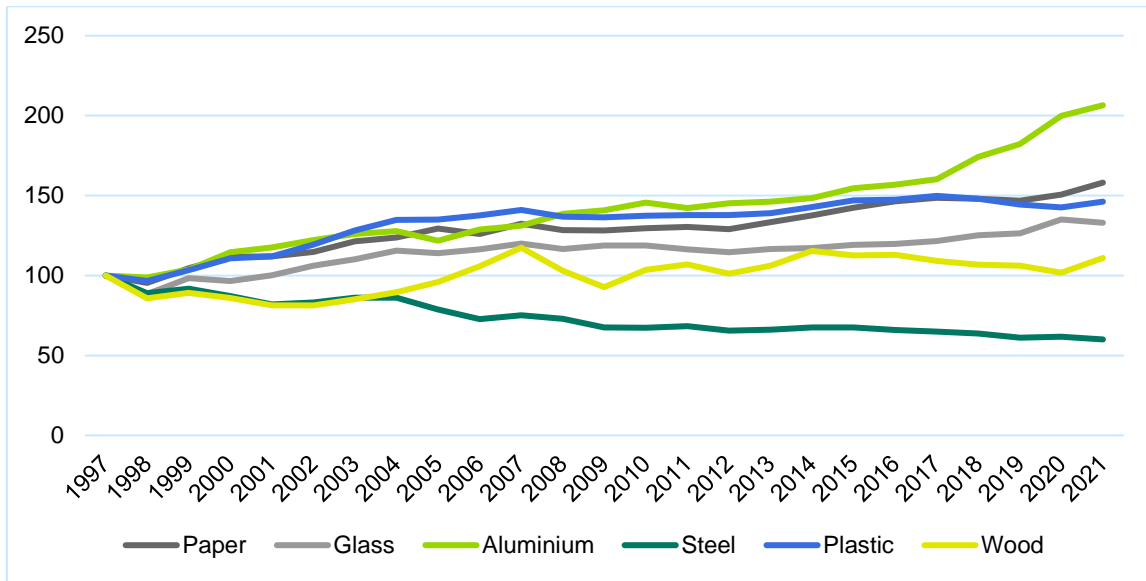
Instead, to inform trends by packaging material type the NPWD dataset is used to calculate the measure 'net pack fill' which is regarded as the best approximation or proxy to trends in POM by type of material.

Figure 3 shows the estimates of trend in packaging materials POM (by weight) by material type from 1997 to 2021. In general, POM⁵⁴ 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.

⁵⁴ 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.

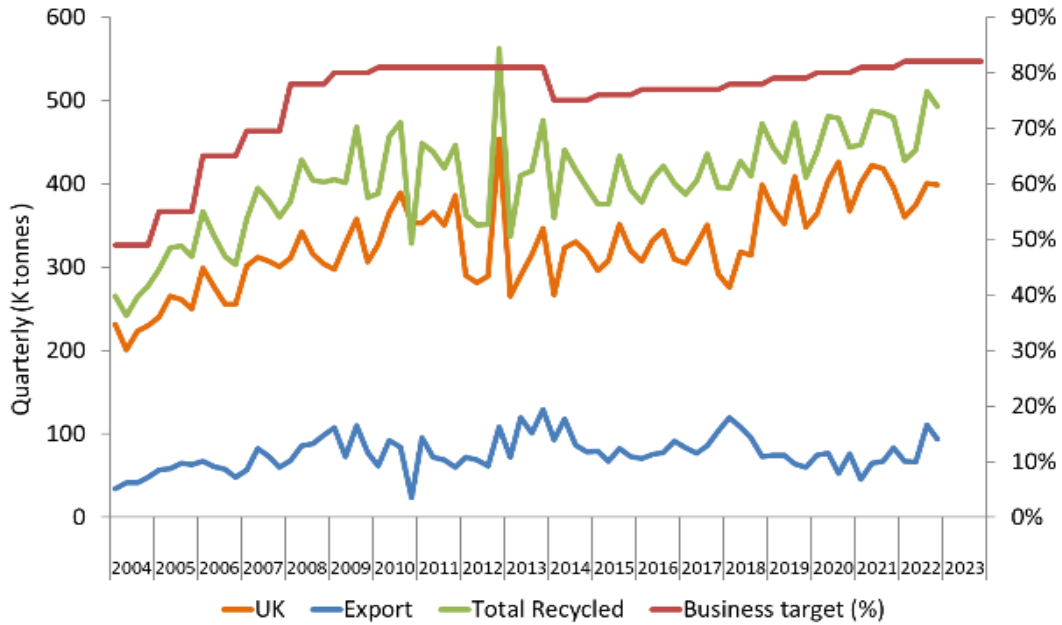
Figure 3: Packaging POM Trends by Material, 1997 - 2021 (Indexed 1997=100)



11. Packaging Recycling Trends

A key objective of this report is to provide an understanding of the trends in the recycling of glass packaging. 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 4 illustrates quarterly data on total⁵⁵ accredited recycling, UK domestic accredited recycling and accredited exports 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 chart,

Figure 4: Trends in Accredited Glass Packaging Recycling 2004 – 2023 (k tonnes)



The main driver of total glass packaging recycling is UK domestic recycling. UK domestic recycling trended upwards to around 2011 as the targets increased and was then broadly stable 2012 – 2018 (the glass target was reduced in 2014 following earlier fraudulent activity). Since then, the level of glass packaging recycling has risen steadily to meet the modest year-to-year increases in the targets. During the past five years, total glass packaging recycling has fluctuated in a range around 350 – 500k tonnes per quarter. The amounts of glass packaging waste exported are small in comparison to UK domestic recycling of glass packaging waste (around 17% of total recycling, on average), and there is no indication of a trend. Glass packaging recycling targets have flat-lined.

⁵⁵ In the tables reported by NPWD the quantity used here is referred to as ‘Packaging wastes accepted by UK recyclers or export’.

12. Glass Market Trends

Legislation

One of the most immediate changes to regulations regarding glass packaging is the setting of the packaging recycling targets for 2024, these targets will remain the same as 2022, with the exceptions of glass remelt (up from 72% to 75%), wood (up from 35% to 42%) and general recycling (up from 77% to 80%). This will increase the proportion of glass which is recycled in glass remelt markets compared to non-remelt markets.

There are several pieces of upcoming legislation that are due to be introduced, which will significantly impact the flow of glass packaging both on and off the UK market, these include Extended Producer Responsibility (EPR), Simpler Recycling, and Deposit Return Schemes (DRS).

Extended Producer Responsibility (EPR): This starts to be introduced in 2024 and 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 aim is to encourage greater engagement in the lifecycle of packaging products, from design to recycling⁵⁶. This has the potential to reduce packaging flowing onto the market as well as increase the quantity and quality of glass packaging collected for recycling.

Deposit Return Schemes (DRS): This 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.

DRS may involve separate DRS systems being implemented in the UK. Although confirmation of which schemes will include glass, at the time of writing it is understood that there is the possibility of England and Northern Ireland not containing glass, whilst Scotland and Wales might, which could increase the quantity and quality of glass packaging collected for recycling in those countries.

Simpler Recycling: The key aim is for all local authorities in England to collect an expanded and standardised list of recyclable materials from households (including glass bottles and jars). The implementation date for consistent collections from households is 1 April 2026. Simpler Recycling will also see businesses in England needing to ensure that same set of materials are recycled from their premises. This will affect businesses with more than ten FTEs from April 2025, and small business from April 2027. This should also increase the quantity and quality of glass packaging collected for recycling.

UK POM

The UK market for glass packaging is expected to see a Compound Annual Growth Rate (CAGR) of 3.5% during 2022-2027⁵⁷. However, discussions with key industry stakeholders have indicated this is based on the value of the sector rather than the production of glass packaging, and as such, when inflation is considered, this may represent a more modest growth rate (~1%) for the sector.

A factor which may affect the production of glass packaging is the cost-of-living crisis in the UK. It is estimated that approximately 50% of British consumers are planning on limiting their spending on alcohol due to financial pressures. According to research from British drinks brand Gunner Cocktails, the cost-of-living crisis is likely to be a "difficult period for many drinks brands in the UK as consumer confidence continues to reach historic lows"⁵⁸. This will decrease demand for glass packaging from alcohol producers.

Another initiative that could reduce glass packaging flowing on the UK market is lightweighting. An example of this is the Sustainable Wine Roundtable Bottle Weight Accord, which was set up by a group of international wine retailers (Laithwaites, Lidl GB, Naked Wines UK, Naked Wines USA, Sweden's Systembolaget AB, The Wine Society, Virgin Wines, Waitrose, and Whole Foods Market) which have committed to reduce the average weight of their bottles by around 25% in the next three years⁵⁹.

⁵⁶ [https://www.gov.uk/government/collections/extended-producer-responsibility-for-packaging-report-packaging-data#:~:text=Contents&text=New%20regulations%20apply%20to%20all,responsibility%20\(EPR\)%20for%20packaging](https://www.gov.uk/government/collections/extended-producer-responsibility-for-packaging-report-packaging-data#:~:text=Contents&text=New%20regulations%20apply%20to%20all,responsibility%20(EPR)%20for%20packaging)

⁵⁷ <https://www.mordorintelligence.com/market-analysis/glass-packaging>

⁵⁸ <https://drinksretailingnews.co.uk/consumers-cutting-down-on-alcohol-amid-cost-of-living-crisis/>

⁵⁹ <https://www.decanter.com/wine/swr-launches-ground-breaking-accord-on-reducing-glass-bottle-weight-513832/#:~:text=Under%20the%20SWR%20Bottle%20Weight,reporting%20progress%20to%20the%20SWR>

The UK market for glass bottles and containers is fragmented with various significant players such as Verallia UK Limited (Verallia Packaging SAS), Ciner Glass Ltd., O-I Glass, Inc., Ardagh Group, and more. Companies operating in the industry are focused on expanding their business through collaborations, investments, product innovations, and more. Recent examples are:

- May 2023 - Ardagh Glass Packaging (AGP) - United Kingdom announced the building of a highly sustainable, efficient furnace that is set to minimise greenhouse gas emissions from the glass production process; and
- July 2023 - Ciner Glass plans to build a new UK glass bottle manufacturing facility. Located in the Wales the facility will have the potential to produce millions of glass bottles each year. Ciner Glass aims to “play an integral role in the future prosperity of Wales by providing recyclable glass cullet to reduce the requirement for local, regional and national resources, helping bring carbon savings and contribute towards the country’s vision for a circular economy”⁶⁰. This will increase the production capacity for glass packaging in the UK as well as increase competition for glass cullet.

Waste Management

The key things that will impact the recycling trend for glass packaging going forward, other than any changes to the quantity of glass packaging placed on the market, include changes to recycling targets, EPR, DRS and Simpler Recycling, all of which should increase the quantity and quality of glass recycled.

Also, with Ciner glass opening its new plant in Wales it is likely to increase competition for glass cullet in the UK.

⁶⁰ <https://cinerglass.com/vision-for-south-wales/>

13. Projections and EPR Scenarios

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

13.1. POM Projections

The Phase 1 baseline data year for glass 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;
2. Medium term. The scenario projections link to growth projections to inform the scenario profiles 2024 to 2040. Official published economic projections to 2028 are used, namely the Office for Budget Responsibility (OBR)'s forecast published in November 2023 to accompany the Chancellor's Autumn 2023 Statement; and
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 are linked to indicators (and projections of these indicators). The indicators considered are selected through analysis of historical relationships with packaging POM. Therefore, they are (statistically) *a priori* deemed potentially useful in describing the evolution of packaging POM. The indicators shown in Table 31 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 31: 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 is reported in Appendix VII. A summary is shown in Table 32 and Table 33. In each of these the top three correlations are ranked.

Table 32: Levels Correlation Analysis of Glass Packaging and Indicator Measures, 1997 – 2021

Material	Highest Correlations	Suggested Activity Indicator to Link To
Glass	<ol style="list-style-type: none"> 1. Retail sales, all stores excl. automotive 2. Import of food products 3. GVA - manufacturing. 	Retail sales

Table 33: Growth Correlation Analysis of Glass Packaging and Indicator Measures, 1998 – 2021

Material	Highest correlations	Suggested Activity Indicator to Link To
Glass	<ol style="list-style-type: none"> 1. Retail sales, predominantly food stores 2. Population 3. Retail sales in household goods stores. 	Retail sales

The correlation analysis of trends in packaging materials POM supports developing a projection for glass 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 VII for further details.

Table 34: Summary of Linking Glass Packaging POM to Indicator Measures

Material	Levels analysis	Growth Analysis	Projection Based On
Glass	Retail sales	Retail sales	Retail sales

Table 35: Projected Growth in Indicator Measures, 2024 – 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

13.2. EPR Scenarios

Three EPR scenarios for each of the packaging materials covered in the Packflow Refresh 2023 were 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 (%), 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 2 for glass packaging. Only scenarios 1 and 3 are included from the list above.

13.3. 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 glass packaging.

Table 36: Glass Projection EPR Scenario 1

Glass	Units	2022	2023	2024	2025	2026	2027	2028
Business target	%	82%	82%	82%	82%	82%	82%	82%
POM	k tonnes	2,562	2,482	2,488	2,500	2,520	2,547	2,572
Obligated tonnage	k tonnes	2,187	2,217	2,223	2,234	2,251	2,275	2,298
Level of non-obligated tonnage	%	11%	11%	11%	11%	11%	11%	11%
Business target	k tonnes	1,793	1,818	1,822	1,832	1,846	1,866	1,884
Accredited recycling	k tonnes	1,872	1,879	1,970	1,980	1,996	2,017	2,037
Surplus (+) / shortfall (-)	k tonnes	79	61	148	149	150	151	153
Business recycling rate	%	86%	85%	89%	89%	89%	89%	89%
Recycling rate performance	%	73%	76%	79%	79%	79%	79%	79%
National recycling rate	%	70%	73%	73%	73%	73%	73%	73%

Glass POM tonnage is projected to reduce in 2023 compared to 2022, and while growth resumes from 2024 it remains below its 2022 level until 2028. Business targets are projected as constant at 2024 level of 82%. The POM projection is reflected in the projection of obligated tonnage for glass packaging, and (with assumed constant collection rates) the projection of accredited recycling. Based on this a surplus relative to the business target 2024 to 2028 is projected for glass packaging.

13.4. EPR Scenario 2

In this scenario in-scope DRS drinks containers are removed from EPR. Glass packaging is assumed not to be an in-scope DRS material and the projection in this scenario is not impacted by the removal of DRS drinks containers.

13.5. 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, the table below shows the results for glass packaging.

Glass POM tonnage is projected to reduce in 2023 compared to 2022, and while growth resumes from 2024 it remains below its 2022 level until 2026. Glass drinks containers in Scotland and Wales are removed from EPR POM from 2027 onwards (~260k tonnes). The business targets for the remaining material are projected as constant at 2024 level of 82%. The POM projection is reflected in the projection of obligated tonnage for glass packaging, and (with assumed constant collection rates) the projection of accredited recycling. Based on this a slight shortfall relative to the business target 2024 to 2026 is projected for glass packaging. The reduction in the recycling obligation relative to the projection for accredited recycling results in a surplus relative to the business target from 2027 onwards, which indicates that either the business target and/or the modelled collection rate could be adjusted downwards whilst still achieving the target.

Table 37: Glass Projection EPR Scenario 3

Glass	Units	2022	2023	2024	2025	2026	2027	2028
Business target	%	82%	82%	82%	82%	82%	82%	82%
POM	k tonnes	2,501	2,423	2,435	2,459	2,499	2,291	2,337
Obligated tonnage	k tonnes	2,343	2,187	2,356	2,379	2,417	2,217	2,261
Level of non-obligated tonnage	%	3%	3%	3%	3%	3%	3%	3%
Business target	k tonnes	1,921	1,793	1,932	1,951	1,982	1,818	1,854
Accredited recycling	k tonnes	1,872	1,879	1,928	1,948	1,979	2,020	2,061
Surplus (+) / shortfall (-)	k tonnes	-50	86	-3	-3	-3	203	207
Business recycling rate	%	80%	86%	82%	82%	82%	91%	91%
Recycling rate performance	%	75%	78%	79%	79%	79%	88%	88%
National recycling rate	%	77%	74%	79%	79%	79%	79%	79%

14. Conclusions

14.1. Conclusions: POM

There were 2,562k tonnes (+/- 6%) of glass packaging POM in 2022: a decrease of 0.5% from the previous estimate in 2019.

This has been derived using a methodology consisting of identifying UK production and adding imports and removing exports. Data was used from a variety of sources for each sector with the results combined. It has been cross-checked with reported obligated data on NPWD and with the project's Steering Group.

The estimate of glass packaging POM in the consumer sector is 2,050k tonnes (+/- 5%) in 2022.

The methodology for consumer POM is based on primary sales data from a sample of UK supermarkets 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 as such by industry.

The estimate for glass packaging POM in the non-consumer sector is 512k tonnes (+/- 15%) in 2022.

Non-consumer glass packaging POM is derived by subtracting the consumer POM estimate from the total POM estimate for glass packaging. The estimates are reviewed and sense-checked by key industry stakeholders.

Non-obligated or unregistered flow for glass packaging accounted for 11% of POM in 2022 – this represents an increase of 2% from 2019.

The estimate of the unobligated/unreported tonnage (273k tonnes, 11%) in 2022 uses NPWD data to calculate a final net pack fill figure of 2,288k tonnes, which is then subtracted from this the total glass packaging POM estimate of 2,562k tonnes. The unobligated proportion of 11% is an increase from the 9% identified in 2019.

The estimates of glass packaging POM by type are: 2,116k tonnes (83%) bottles and 446k tonnes (17%) jars.

The format types for glass packaging are established primarily using information from Valpak's EPIC database and sense-checked by key industry stakeholders including British Glass. Across glass packaging formats on the market, glass bottles make up the vast majority (by weight) of glass packaging.

14.2. Recycling

The total quantity of UK glass packaging recycled is estimated to be 1,898k tonnes in 2022.

This includes NPWD reported glass packaging recycling (1,872k tonnes) and an estimate of unreported glass packaging recycling (26k tonnes). Based on the POM calculated as part of this project, this gives an overall glass packaging recycling rate of 74.1% in 2022, and an accredited recycling rate for glass packaging of 73.1%.

The total quantity of consumer UK glass packaging recycled is estimated to be 1,460k tonnes in 2022.

Based on WDF collection figures and the consumer POM calculated in this project, the consumer glass packaging recycling rate is estimated to be 71%.

The total quantity of non-consumer UK glass packaging recycled is estimated to be 438k tonnes in 2022.

Non-consumer glass packaging recycling is calculated by removing the consumer recycling tonnage from the figure for total glass packaging recycling. Based on the non-consumer POM estimate in this project, the non-consumer glass packaging recycling rate is 86% in 2022.

Of the total 664k tonnes of glass packaging not recycled, 531k tonnes (80%) was sent to energy recovery and 133k tonnes (20%) was sent to landfill in 2022.

This is based on an estimated total of 590k tonnes of consumer glass packaging not being recycled and 74k tonnes of non-consumer not being recycled, estimated using WDF and published statistics on UK disposal routes for glass packaging.

14.3. End Markets

In 2022, 82% of glass collected was recycled in the UK.

In 2022, 82% of the recorded glass packaging recycling took place in the UK with the remaining 18% occurring overseas.

Glass is primarily recycled in remelt end markets in the UK.

Of the glass packaging recycled in the UK, 68% went into remelt applications and 32% into 'other' applications.

Of the remelt fraction, industry suggests 15-20% is used to produce glass mineral wool and the remainder is used by the container industry. For non-remelt applications, typically glass is used as an aggregate substitute, which includes glass used in road construction, concrete products, as a shot blasting abrasive or filtration media.

The EU is the main export market for glass packaging exported from the UK.

Nearly all glass packaging exports in 2022 were destined for remelt applications with the container sector believed to take the majority. The key export destinations were Portugal (48%), Belgium (30%), Netherlands (9%), Spain (6%), Italy (5%), and Norway (1%).

14.4. Projections and EPR Scenarios

EPR Scenario 1

Glass POM tonnage is projected to reduce in 2023 compared to 2022, and while growth resumes from 2024 it remains below its 2022 level until 2028. Business targets are projected as constant at 2024 level of 82%. The POM projection is reflected in the projection of obligated tonnage for glass packaging, and (with assumed constant collection rates) the projection of accredited recycling. Based on this a surplus relative to the business target 2024 to 2028 is projected for glass packaging.

EPR Scenario 3

Glass POM tonnage is projected to reduce in 2023 compared to 2022, and while growth resumes from 2024 it remains below its 2022 level until 2026. Glass drinks containers in Scotland and Wales are removed from EPR POM from 2027 onwards (~260k tonnes). The business targets for the remaining material are projected as constant at 2024 level of 82%. The POM projection is reflected in the projection of obligated tonnage for glass packaging, and (with assumed constant collection rates) the projection of accredited recycling. Based on this a slight shortfall relative to the business target 2024 to 2026 is projected for glass packaging. The reduction in the recycling obligation relative to the projection for accredited recycling results in a surplus relative to the business target from 2027 onwards, which indicates that either the business target and/or the modelled collection rate could be adjusted downwards whilst still achieving the target.

14.5. Recommendations for Further Work

Future updates of this work should revise the estimate of unaccredited glass recycling.

Future updates of this work should revise the estimate of unaccredited glass recycling for the glass recycled in the Ceramic, Stone, and Porcelain (CSP) output material from glass recycling facilities. Research conducted during this project indicated that going forward this will increasingly be recycled in accredited facilities and therefore will be captured in the published accredited recycling data.

Drinks containers, DRS in the nations and recycling of what remains.

At present, plans are that glass shall be included in a DRS in Wales, excluded from a DRS in England and Northern Ireland and may be included or excluded from the DRS in Scotland. Furthermore, there has been some interest in and trials of various forms of Digital DRS, where each container is given a unique identity, which would help with fraud prevention but also unlocks the potential for deposits to be redeemed in locations other than a reverse vending machine, such as within kerbside recycling.

The inclusion of all or some glass drinks containers within the DRS will change the landscape for the compliance position for the glass packaging that remains within EPR. As such, further understanding of non-drinks glass packaging recycling rate, including glass jars and food bottles from the consumer sector (and how

that differs from drinks), may be insightful for future EPR development and target setting, should some of the drinks containers be included in DRS, although this will be determined by what materials are included when DRS is implemented.

Investigate ways to ensure the material eligible for a PRN and PERN is consistent.

During the project concerns were raised regarding the quality of glass exported (and eligible for a PERN) to ensure the quality it is consistent with glass recycled in the UK (eligible for a PRN), or that the contamination proportion of material which is exported and is contamination is not eligible for a PERN.

There was debate around this subject with it suggested that exporters do not necessarily claim for 100% of the weight exported, and rather it is based on sampling reports/outturns from the interim sites.

However, it is clear that there must be greater understanding of the issue and transparency of what is happening. Another suggestion is that PRNs/PERNs are only allowed to be issued at the point of conversion to ensure the material is treated equally.

Appendix I

Data Robustness Assessment

A robustness analysis was completed on the key data sources used. This was developed to highlight the level of uncertainty for each data source by scoring them 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 5 (POM), 6 (Recycling) and a summary in 7 which has 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 it is answered 'No' then a score of 0 is given.

Figure 5: Data Robustness Assessment Results – POM

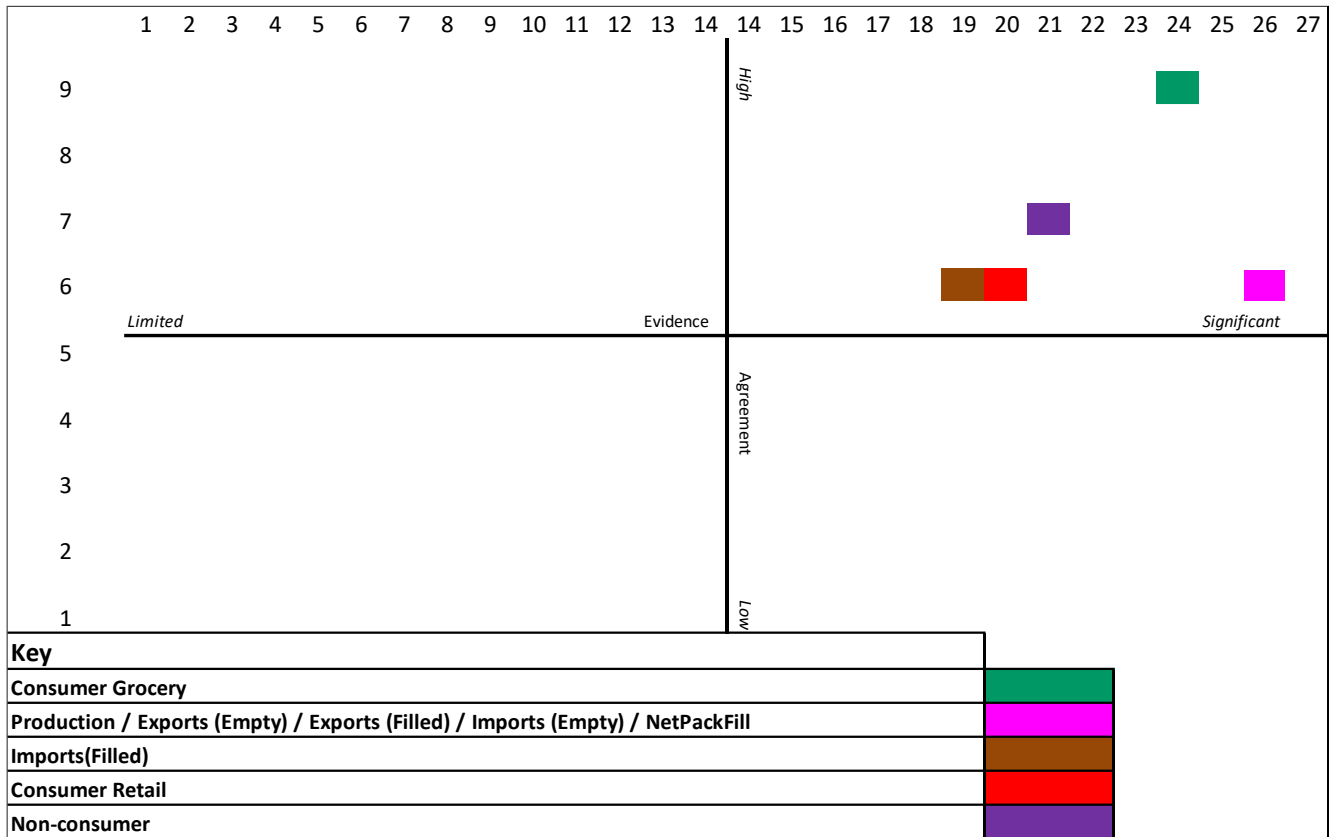


Figure 6: Data Robustness Assessment Results – Recycling

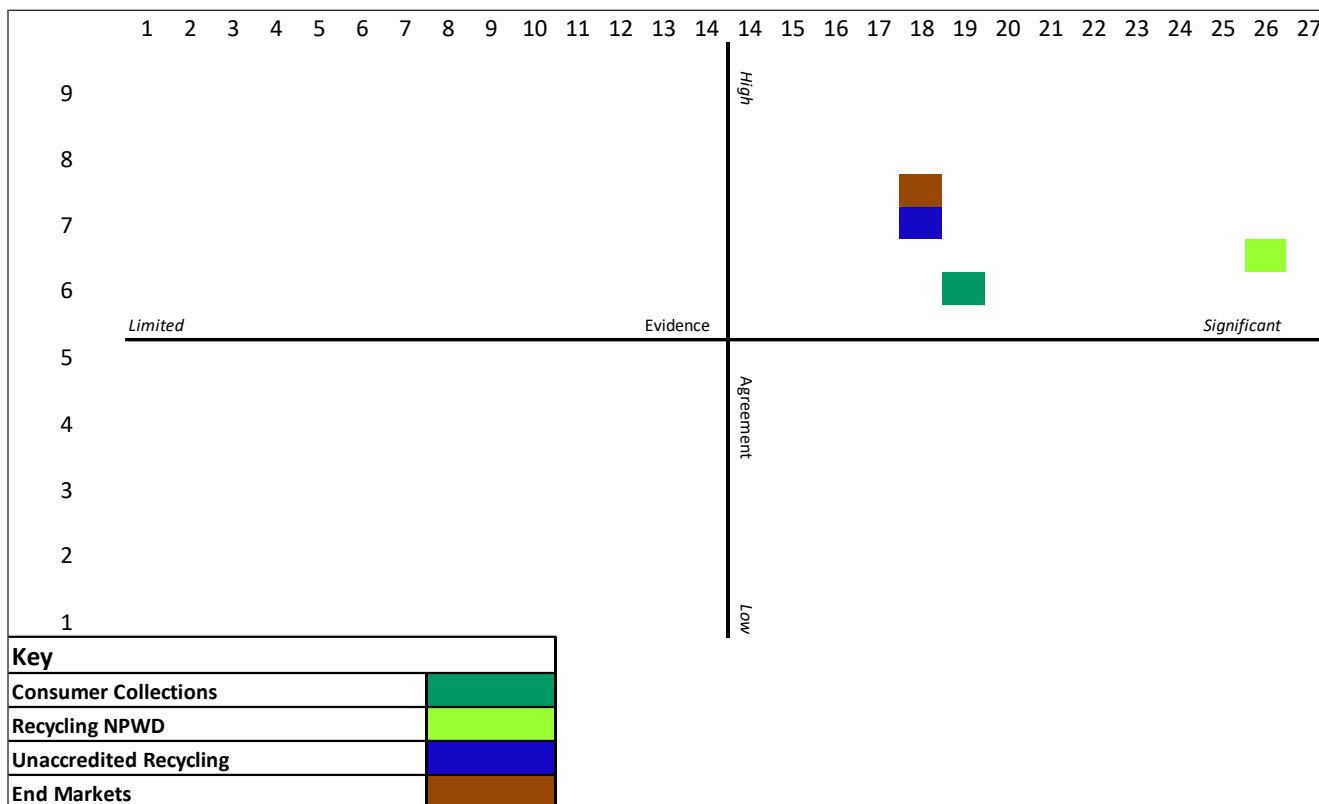


Figure 7: Data Robustness Assessment Results – Summary

Data & Source	Robustness Scores		Error Margin
	Evidence (Robustness and completeness, max 27):	Degree of agreement around the findings (max 9):	Error Margin (+/-)
1 NPWD Producer Data	26	6	9%
2 Valpak & British Glass - Imports (Filled) Unregistered	14	6	27%
3 Various Transport Data - Imports (Filled) Cross Border Selling	16	6	24%
4 Environment Agency Grocery Retailer Packaging Handled	24	9	6%
5 Valpak Turnover & Packaging Handled Data	20	6	18%
6 Valpak EPIC Data	22	6	15%
7 NPWD Recycling Data	26	6	9%
8 Verde Research and Consulting Ltd Survey of Recyclers and Exporters	18	7	21%
9 WDF	19	6	21%
10 Bricks & Mortar Retail	16	6	24%
11 Impact of Recession Analysis	15	6	27%

Figure 8: British Glass Production Data

Data
British Glass production data from UK glass manufacturers (members of British Glass)
Source
British Glass
Data Used In:
POM

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 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?	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		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

Scoring	Score
Yes	3
Yes with some reservations	2
More yes than no, but equivocal	1
No	0

Figure 9: NPWD Producer Data 2019

Data
NPWD Producer Data 2019
Source
NPWD
Data Used In:
Import, Export and POM Sense-check

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

Scoring	Score
Yes	3
Yes with some reservations	2
More yes than no, but equivocal	1
No	0

Figure 10: Valpak and British Glass - Imports (Filled) Unregistered

Data
Valpak & British Glass estimates based in internal analysis
Source
Valpak & British Glass
Data Used In:
Imports (Filled) Unregistered

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 with some reservations	2
Is the underlying data reasonably free from concerns (e.g. official data from the ONS)?	No	0
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 with some reservations	2
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)?	More yes than no, but equivocal	1
Total		14

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 with some reservations	2
Total		6

Scoring	Score
Yes	3
Yes with some reservations	2
More yes than no, but equivocal	1
No	0

Figure 11: Various Transport Data - Imports (Filled) Cross Border Selling

Data
Transport Data
Source
Various incl. Civil Aviation Authority, GOV Maritime Shipping Statistics and Eurostar
Data Used In:
Imports (Filled) Cross Border Shopping

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 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)?	Yes with some reservations	2
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)?	More yes than no, but equivocal	1
Total		16

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 with some reservations	2
Total		6

Scoring	Score
Yes	3
Yes with some reservations	2
More yes than no, but equivocal	1
No	0

Figure 12: Environment Agency – Grocery Retailer Packaging Handled

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

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

Scoring	Score
Yes	3
Yes with some reservations	2
More yes than no, but equivocal	1
No	0

Figure 13: Turnover and Packaging Handled Data

Data
Valpak Turnover & Packaging Handled Data
Source
Valpak
Data Used In:
Consumer POM

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

Scoring	Score
Yes	3
Yes with some reservations	2
More yes than no, but equivocal	1
No	0

Figure 14: Valpak – Hospitality EPIC Data

Data
Valpak Hospitality EPIC Data
Source
Valpak
Data Used In:
Non-consumer POM

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

Scoring	Score
Yes	3
Yes with some reservations	2
More yes than no, but equivocal	1
No	0

Figure 15: NPWD – Recycling Data 2019

Data
NPWD Recycling Data 2019
Source
NPWD
Data Used In:
Recycling and 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

Scoring	Score
Yes	3
Yes with some reservations	2
More yes than no, but equivocal	1
No	0

Figure 16: Verde Research and Consulting Ltd – Survey of Recyclers and Exporters 2020

Data
Survey of Recyclers and Exporters 2020
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

Scoring	Score
Yes	3
Yes with some reservations	2
More yes than no, but equivocal	1
No	0

Figure 17: WDF 2018/19

Data
WDF Local Authority Collection Data
Source
WDF 2016/17
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?	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 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		19

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

Scoring	Score
Yes	3
Yes with some reservations	2
More yes than no, but equivocal	1
No	0

Appendix II

Production Data Cross Reference

The production data was cross referenced with data from PRODCOM⁶¹ (Eurostat statistics on the production of manufactured goods).

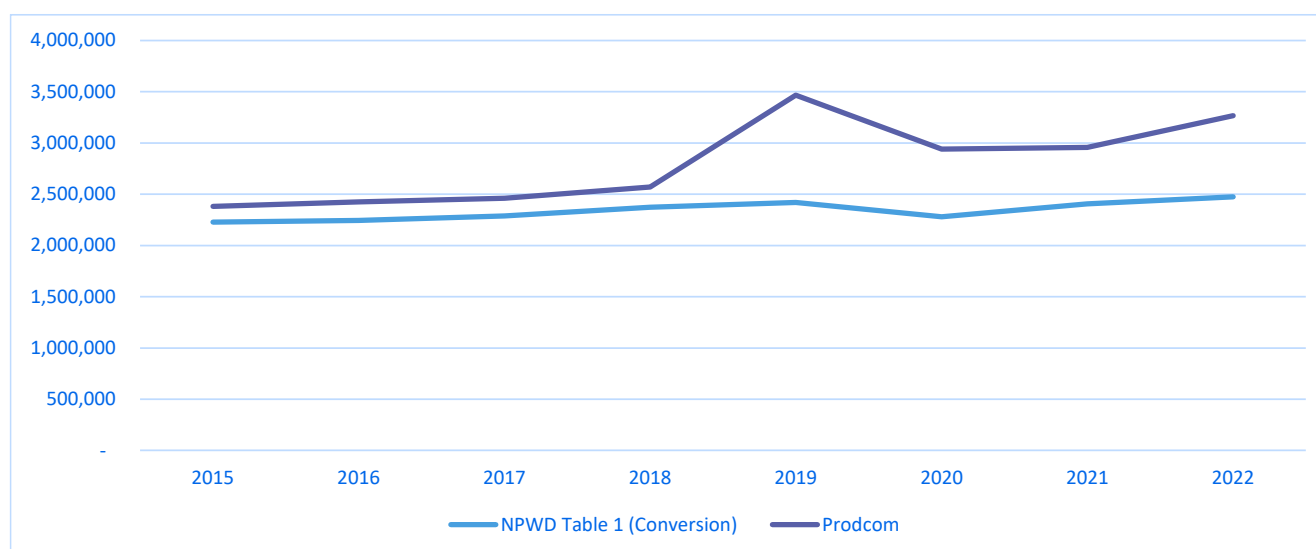
The latest available PRODCOM data is from 2022 (released 24/07/2023) and only gives the number of container units produced. Therefore, an average weight was applied to the number of units, and this was calculated using the average weight of glass packaging (taken from the Valpak Data Solutions database⁶²) which was 0.377kg. The PRODCOM data is summarised in Table 38. Previously British Glass provided estimates for UK production, however they believe that their estimates are in line with NPWD and as such NPWD data was used.

Table 38: PRODCOM and NPWD – UK Glass Container Production 2015 - 2022⁶³ (k tonnes)

	2015	2016	2017	2018	2019	2020	2021	2022
PRODCOM – No. of Items	6,435	6,551	6,645	6,818	9,195	7,795	7,839	8,666
Estimated Tonnage	2,382	2,424	2,459	2,570	3,466	2,939	2,955	3,267
NPWD - Table 1 Conversion	2,228	2,243	2,288	2,372	2,419	2,281	2,470	2,473

The NPWD and PRODCOM data are summarised in Figure 18 with a graphical representation of the trends.

Figure 18: UK Glass Container Production 2013 – 2022 (k tonnes)



⁶¹ <https://www.ons.gov.uk/businessindustryandtrade/retailindustry/datasets/poundsdatatotalretailsales> (Accessed 02/09/2023).

⁶² Valpak's Data Solutions database is one of the largest packaging databases in the country. Valpak work with over 70 companies including Tesco, Sainsbury's, Marks & Spencer and Mothercare and hold significant market coverage across many top retail sectors as well as distributors, brand owners and the retail supply chain. Data Solutions collect information direct from customers, suppliers as well as source information in house meaning that they hold 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 their bespoke innovative software Environmental Product Information Centre (EPIC).

⁶³ Data source: UK Environment Agency. Freedom of Information request. Data Manipulation: Verde Research and Consulting Ltd. Contains public sector information licensed under the Open Government License v3.0. <http://www.nationalarchives.gov.uk/doc/open-government-licence/version/3/>

This shows that PRODCOM has been a useful proxy for UK production estimates previously closely following NPWD estimates that there has been a sharp increase in the 2019 estimate that seems a departure from the historic trend.

Appendix III

Exports (Empty) Cross Reference

Previously the empty export figures were cross referenced against British Glass Exports (Empty) data, with the British Glass figures typically following a similar trend to NPWD. Following discussions with British Glass it was agreed NPWD data should be used as it is considered more complete in terms of the import/export supply chain. British Glass also stated that there will be only minimal unregistered tonnage, as Exports (Empty) tend to be done by large producers.

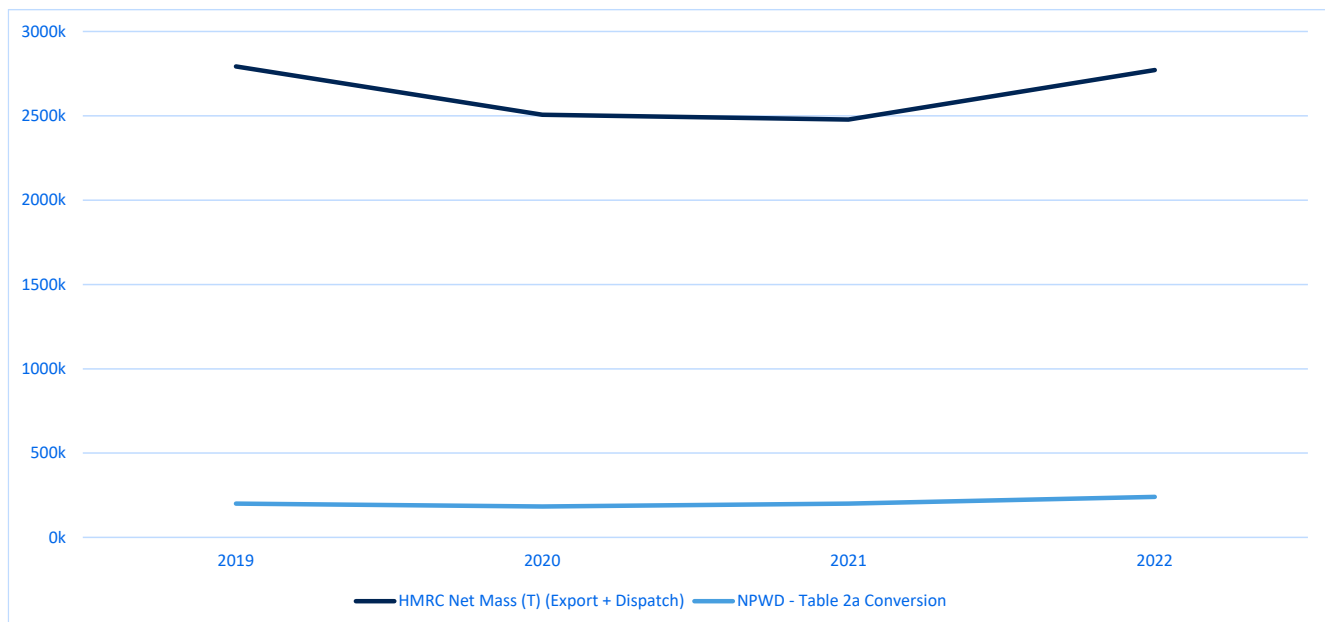
The export trends were checked against the HMRC trade data⁶⁴ for beverage exports, as shown in Table 39. It is worth noting that this is only partly indicative as it includes beverages exported regardless of packaging types, i.e., including beverages exported in glass bottles, but also cans, etc. This shows exports rising 12% in 2022 compared to NPWD, which had a 19% increase.

Table 39: HMRC – Beverage Exports 2019 – 2022⁶⁵ (k tonnes)

	2019	2020	2021	2022
Net Mass (Export + Dispatch)	2,794	2,506	2,478	2,771
% Change from previous year	-5%	-10%	-1%	12%

The HMRC and NPWD data is show in Figure 19 below and shows that HMRC export data loosely follows the NPWD data.

Figure 19: NPWD and HMRC Beverage Exports 2019 – 2022 (k tonnes)



Based on this and feedback from British Glass the NPWD data is considered the most robust for estimating exports of empty glass packaging.

⁶⁴ www.uktradeinfo.com (Accessed 06/09/2023).

⁶⁵ Data source: UK Environment Agency. Freedom of Information request. Data Manipulation: Verde Research and Consulting Ltd. Contains public sector information licensed under the Open Government License v3.0. <http://www.nationalarchives.gov.uk/doc/open-government-licence/version/3/>

Appendix IV

Exports (Filled) Cross Reference

For exports (filled) the NPWD Table 2b Conversion (with an uplift for glass sourced in the UK that is subsequently exported to countries) was used as shown in Table 40.

Table 40: UK Exports (Filled) 2019 – 2022 with Uplift (k tonnes)

	2019	2020	2021	2022
Exports (Filled) NPWD -Table 2b Conversion	832	757	847	889
Excluded EIRE/Gibraltar Exports	2	2	2	2
Exports (Filled)	833	758	848	890

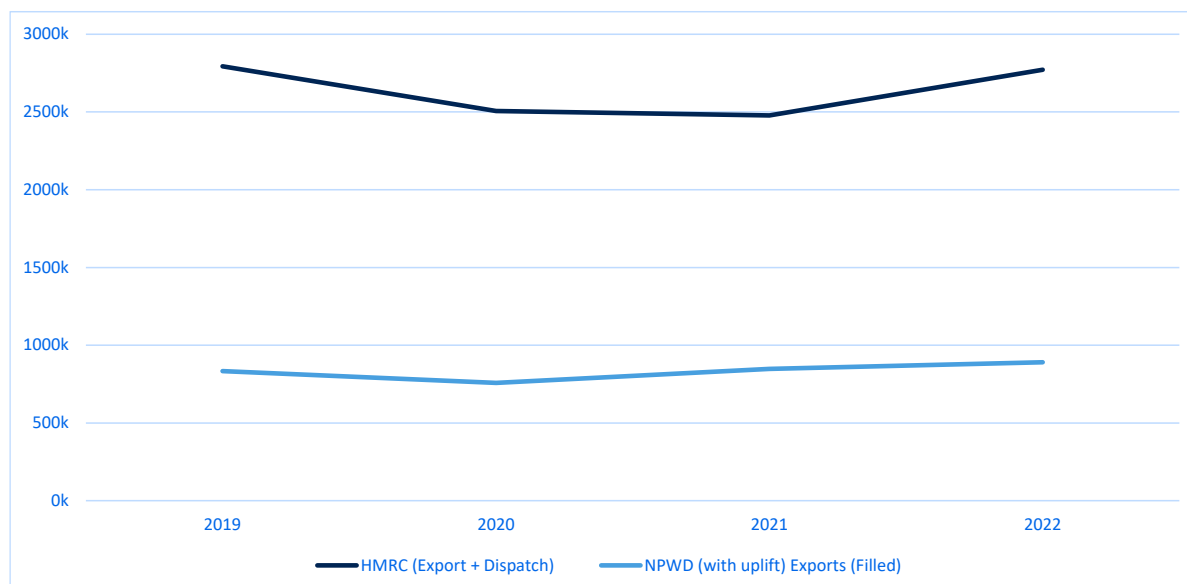
Exports (filled) data from the NPWD (with uplift) data was sense checked against HMRC trade data⁶⁶ for beverage exports shown in Table 41.

Table 41: HMRC – Beverage Exports 2019 – 2022 (k tonnes)

	2019	2020	2021	2022
Net Mass (Export + Dispatch)	2,794	2,506	2,478	2,771
% Change from prev. year	-5%	-10%	-1%	12%

Figure 20 shows a graphical representation of the data and trends.

Figure 20: NPWD (Filled with Uplift) and HMRC Beverage Exports 2019 – 2022 (k tonnes)



The exports (filled) NPWD trend is generally supported by the HMRC trade data trend for beverage exports⁶⁷, as shown in Figure 20. It is worth noting that this is only partly indicative as this includes beverages exported regardless of packaging types, i.e., including beverages exported in glass bottles, but also cans, etc.

⁶⁶ www.uktradeinfo.com (Accessed (Accessed 06/09/2023)).

⁶⁷ www.uktradeinfo.com (Accessed (Accessed 06/09/2023)).

Appendix V

Imports (Empty) Cross Reference

The obligated empty imports estimate was cross referenced against HMRC trade data⁶⁸; however, these figures are only used for a sense check as it is believed they are too broad and had potential consistency issues in terms of categorisation.

Table 42: UK Imports of Empty Glass Packaging, 2019 – 2022 (k tonnes)

	2019	2020	2021	2022
Imports (Empty) – NPWD Table 3a Pack / Fill	140	231	177	155

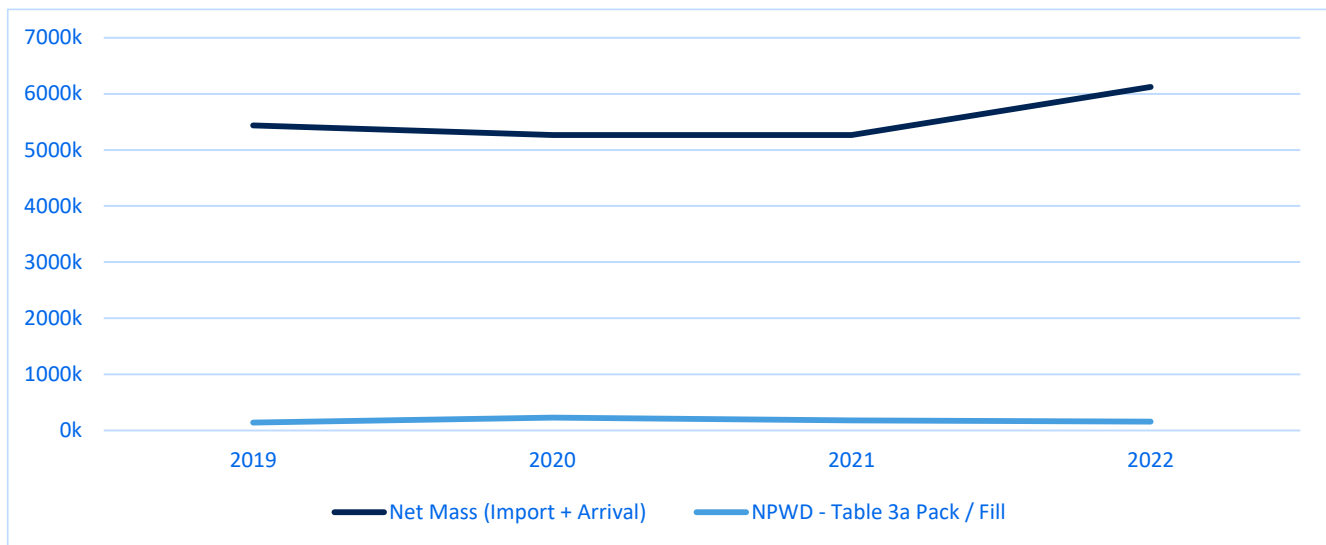
The HMRC beverage imports are shown below for the years 2019 to 2022.

Table 43: HMRC – Beverage Imports 2019 – 2022 (k tonnes)

	2019	2020	2021	2022
Net Mass (Import + Arrival)	5,435	5,263	5,268	6,123

This shows an overall increase from 2019 to 2022. Figure 21 shows the NPWD trend loosely follows the trend in imports of beverages as shown below.

Figure 21: HMRC – Beverage Imports and NPWD Empty Imports 2019 – 2022 (k tonnes)



⁶⁸ www.uktradeinfo.com (Accessed 06/09/2023).

Appendix VI

UK Imports (Filled) Cross Reference

The obligated filled imports estimate was cross referenced against HMRC trade data⁶⁹; however, these figures are only used for a sense check as it is believed they are too broad and had potential consistency issues in terms of categorisation. The HMRC beverage imports are shown below for the years 2019 to 2022 and shows an increase from 2019 to 2022.

Table 44: HMRC – Beverage Imports, 2019 – 2022 (k tonnes)

	2019	2020	2021	2022
Net Mass (Import + Arrival)	5,435	5,263	5,268	6,123

Using the methodology used for this project to estimate filled glass packaging imports, there is a slight decrease of 22k tonnes (2%) of filled imports of glass packaging from 2019 to 2022, which has largely been driven by the reduction of unobligated/unregistered imports (filled) from 50k tonnes to 25k tonnes, therefore taking this into account the HMRC data appears to loosely validate the approach of using NPWD supported by secondary research for unobligated/unregistered imports and cross border shopping. British Glass sense-checked this approach and recommended using the NPWD data and secondary research approach for filled imports of glass packaging.

⁶⁹ www.uktradeinfo.com (Accessed 06/09/2023).

Appendix VII

Technical Appendix

Technical Appendix

This short technical appendix details the methodology underlying the projections for glass packaging POM discussed in Section 13.1 of the report, and recycling discussed in Section 12 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 45, 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.

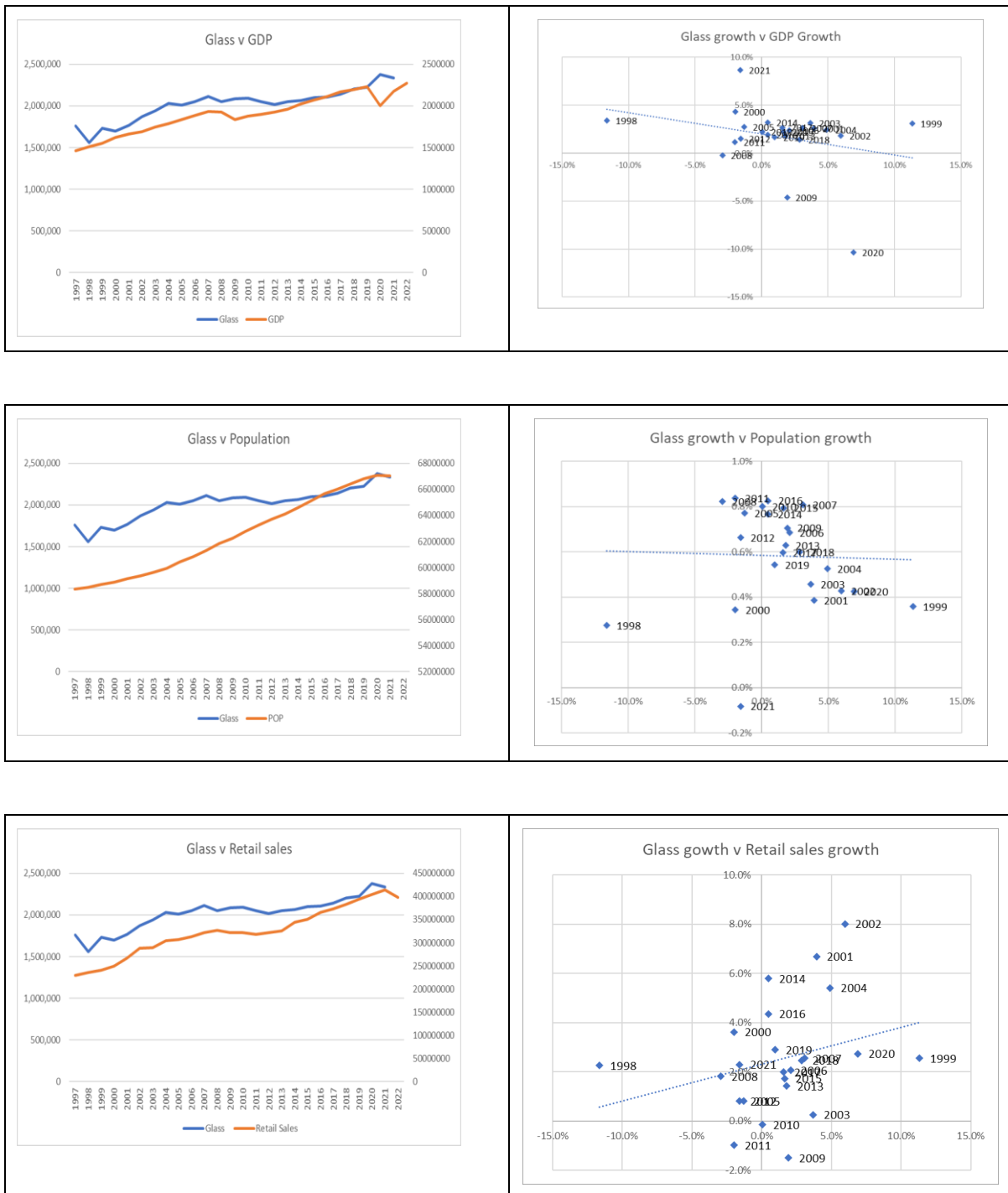
Table 45: A Selection of Indicators

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 glass packaging 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 by type of material - and GDP, population, and retail sales.

Figure 22: Glass 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 46: Correlation Analysis for Glass Packaging and Indicator Measures, Levels 1997 – 2021

Level		GLASS	Prob. t
Consumer spending	Household final consumption Expenditure CVM SA - £m	86.2%	0.00%
Consumer spending	Total goods : Total CVM NA Year SA £m	82.3%	0.00%
Gross Domestic Product	GDP	88.3%	0.00%
Retail sales	Retail in non-specialised stores IV2X	85.3%	0.00%
Retail sales	Retail in predominantly food stores IV36	95.3%	0.00%
Retail sales	Retail in non-food stores IV3I	91.0%	0.00%
Retail sales	Retail in other stores IW6U	92.2%	0.00%
Retail sales	Retail in textile, clothing and footwear stores IW6X	76.3%	0.00%
Retail sales	Retail in household goods stores IW6Y	61.7%	0.10%
Retail sales	Non-store retailing J58P	75.1%	0.00%
Retail sales	All retail excl. automotive	95.0%	0.00%
GVA	G46: Wholesale trade, except of motor vehicles and motorcycles	80.1%	0.00%
GVA	G47: Retail trade, Except of motor vehicles and motorcycles	52.4%	0.71%
GVA	G56: Food and beverage service activities	-22.8%	27.20%
GVA	A: Agriculture	49.7%	1.15%
GVA	B: Mining and quarrying	-85.7%	0.00%
GVA	C: Manufacturing	92.6%	0.00%
GVA	D: Electricity, gas, steam and air conditioning supply	-27.4%	18.49%
GVA	F: Construction	-31.3%	12.76%
GVA	G: Wholesale and retail trade and repair of motor vehicles and motorcycles	71.5%	0.01%
GVA	Total GVA	88.4%	0.00%
Construction	Public new housing	75.5%	0.00%
Construction	Private new housing	73.2%	0.00%
Construction	Total new housing	78.2%	0.00%
Imports	CPA 08:WW:IM: CVM:BOP:SA: C. Manufactured products	86.9%	0.00%
Imports	CPA 08:WW:IM: CVM:BOP:SA: 10. Food products	91.4%	0.00%
Population	POP	86.7%	0.00%

Table 47: Correlation Analysis for Glass Packaging and Indicator Measures, Growth 1998 – 2021

Growth		GLASS	Prob. t
Consumer spending	Household final consumption Expenditure CVM SA - £m	-0.237	27%
Consumer spending	Total goods :Total CVM NA Year SA £m	-0.350	9%
Gross Domestic Product	GDP	-0.279	19%
Retail sales	Retail in non-specialised stores IV2X	0.112	60%
Retail sales	Retail in predominantly food stores IV3G	0.313	14%
Retail sales	Retail in non-food stores IV3I	-0.017	94%
Retail sales	Retail in other stores IW6U	-0.055	80%
Retail sales	Retail in textile, clothing and footwear stores IW6X	-0.188	38%
Retail sales	Retail in household goods stores IW6Y	0.240	26%
Retail sales	Non-store retailing J58P	0.164	44%
Retail sales	All retail excl. automotive	-0.260	22%
GVA	G46: Wholesale trade, except of motor vehicles and motorcycles	-0.292	17%
GVA	G47: Retail trade, Except of motor vehicles and motorcycles	-0.283	18%
GVA	G56: Food and beverage service activities	-0.192	37%
GVA	A: Agriculture		23%
GVA	B: Mining and quarrying	0.057	79%
GVA	C: Manufacturing		15%
GVA	D: Electricity, gas, steam and air conditioning supply	-0.219	30%
GVA	F: Construction	-0.279	19%
GVA	G: Wholesale and retail trade and repair of motor vehicles and motorcycles	-0.287	17%
GVA	Total GVA	0.034	88%
Construction	Public new housing	-0.092	67%
Construction	Private new housing	-0.080	71%
Construction	Total new housing	-0.216	31%
Imports	CPA 08:WW:IM: CVM:BOP:SA: C. Manufactured products	0.219	30%
Imports	CPA 08:WW:IM: CVM:BOP:SA: 10. Food products	-0.032	88%
Population	POP	0.279	19%

From the tables above Table 48 and Table 49 list the top three correlations ranked in order from the highest correlation observed.

Table 48: Levels of Correlation Analysis of Glass Packaging and Indicator Measures, 1997 – 2021

Material	Highest correlations	Suggested Activity Indicator to Link To
Glass	<ol style="list-style-type: none"> 1. Retail sales, predominantly food stores 2. Retail sales, all stores excl. automotive 3. GVA - manufacturing 	Retail sales

Table 49: Growth Correlation Analysis of Glass Packaging and Indicator Measures, 1998 – 2021

Material	Highest correlations	Suggested Activity Indicator to Link To
Glass	<ol style="list-style-type: none"> 1. Retail sales, predominantly food stores 2. Population 3. Retail sales in household goods stores 	Retail sales

Based on the statistical correlation analysis above Table 50 provides a summary of the choice of indicator measure to link to for glass packaging. This supports developing a POM projection for glass by linking to projections of retail sales.

Table 50: Summary of Linking Glass Packaging POM to Indicator Measures

Material	Levels Analysis	Growth Analysis	Projection Based On
Glass	Retail sales	Retail sales	Retail sales

Table 51 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 51: 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

Compared to growth in retail sales, discussions with key glass packaging industry stakeholders indicated a more modest growth rate (~1%) for the sector, the glass POM projection is intended to reflect such a growth profile this but is otherwise arbitrary.

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 11 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 glass is projected as constant at their 2023 levels.

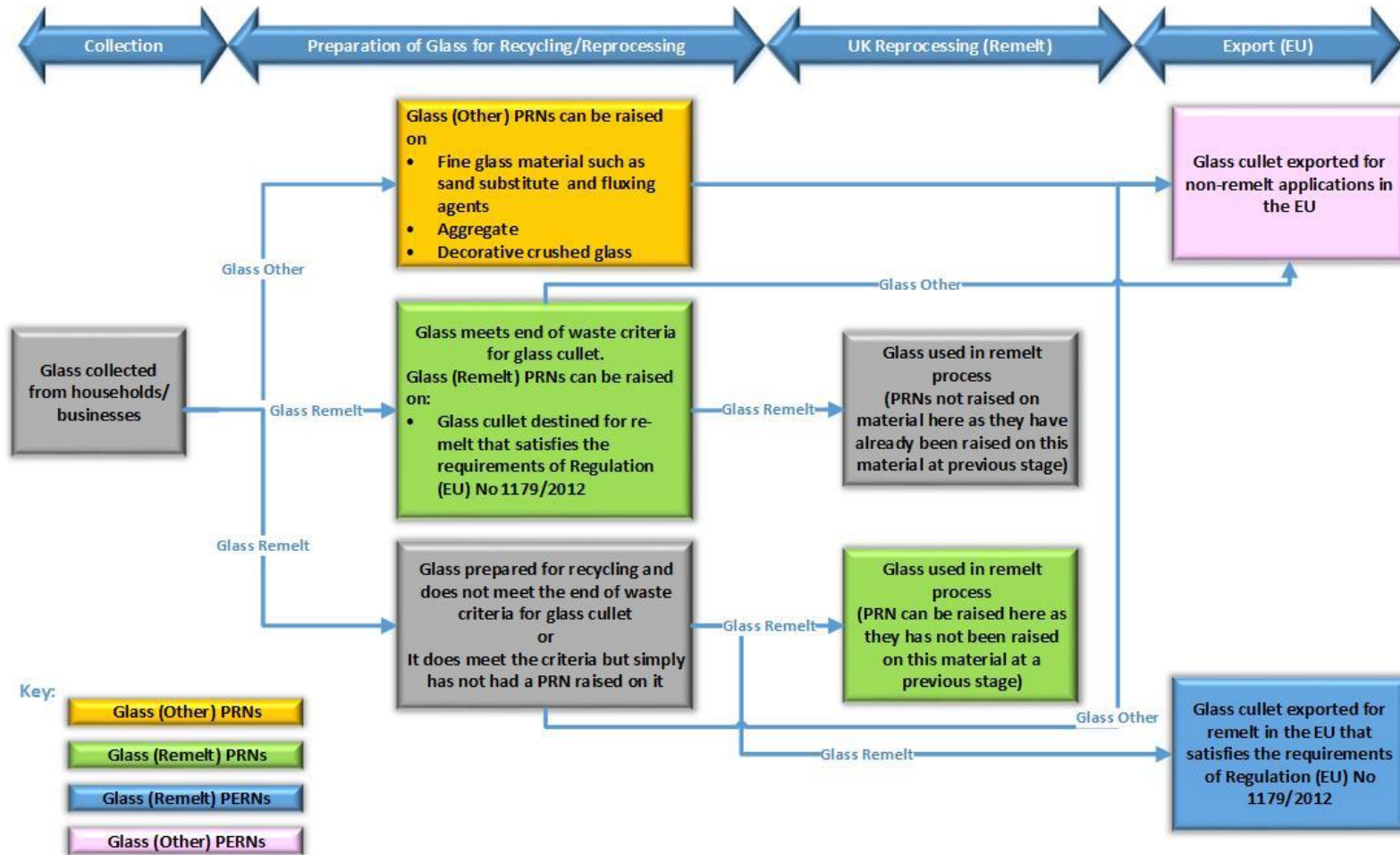
Export Recycling

Accredited exports for glass packaging are calculated as total accredited recycling less accredited UK domestic recycling.

Appendix VIII

Supply Chain Where PRNs/PERNs Can Be Issued

Figure 23: Supply Chain Where PRNs/PERNs Can Be Issued



Note:

Guidance and criteria required for when glass meets end of waste can be found here:
<https://npwd.environment-agency.gov.uk/filedownload.ashx?fileid=edee7dc6-4249-4187-834e-88fb6a8b5bdd>

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