EUROPEAN COMMISSION
EUROSTAT

Directorate E: Sectoral and regional statistics
Unit E-2: Environmental statistics and accounts; sustainable development

Guidance for the compilation and reporting of data on packaging and packaging waste according to Decision 2005/270/EC

(Note: The Commission Delegated Decision on average loss rates is currently being finalised, future versions of this guidance will contain further details on the published legal act.)

Version of 22 May 2024

Note on the guidance document

This document is provided to the Member States[1] as guidance for fulfilling their reporting obligations resulting from Council Directive 94/62/EC following the reporting requirements in Commission Decision 2005/270/EC. Please note that specific reporting is also required for the plastic based own resource in accordance to Council Decision 2020/2053 on the system of own resources, Council Regulation 2021/768 laying down implementing measures for the system of own resources of the European Union and other derived legislation and Council Regulation 2021/770 on the calculation of the own resource based on plastic packaging waste that is not recycled.

[1] As Decision 2005/270/EC and Directive 94/62/EC are incorporated into the EEA Agreement, this guidance note also applies to Iceland, Liechtenstein and Norway.

Contents

Glossary of Abbreviations

ALR	Average loss rate
APCR	Air pollution control residues
AR	Authorised Representative
BAT	Best Available Techniques
DRS	Deposit return scheme
EEE	Electronic and electrical equipment
EPR	Extended producer responsibility
EU	European Union
IBA	Incinerator bottom ash
OECD	Organisation for Economic Co-operation and Development
MRF	Material recovery facility
MSWI	Municipal Solid Waste Incinerator
PPWD	Packaging and Packaging Waste Directive
PAYT	Pay-as-you-throw
PoM	Placed on market
PRO	Producer responsibility organisation
WEEE	Waste electronic and electrical equipment
WFD	Waste Framework Directive
WTO	World Trade Organisation

1 Introduction

The purpose of this document is to provide guidance to Member States on the reporting of packaging waste data, pursuant to the requirements laid down in Commission Decision 2005/270/EC.[2] In particular, this guidance highlights important considerations relating to the calculation of packaging waste generated and recycled. Guidance is also provided to support Member States in the completion of the quality check report (hereafter referred to as the 'quality report').

The following changes have been introduced to the guidance document:

- Minor clarifications and more clear structure of the Annex A.2.1.1 on recycling of plastic packaging
- Minor clarifications for Annex 3.3.1 on the differentiation between preparation for reuse and reuse of wooden packaging
- Starting from reference year 2022, the Excel questionnaire only contains the data section. The quality report has been aligned with Eurostat's standard form for national metadata, and must be submitted via the ESS Metadata Handler. Previous references to the quality report in the Excel form are now adjusted and refer to the ESS Metadata Handler.

This guidance document will be further improved and expanded as more experience becomes available with data collection and reporting. For revised versions of this guidance document, please check https://ec.europa.eu/eurostat/web/waste/methodology.

[2] Commission Decision 2005/270/EC as amended by Implementing Decision (EU) 2019/665 establishing the formats relating to the database system pursuant to European Parliament and Council Directive 94/62/EC on packaging and packaging waste [referred to in this document as Decision 2005/270]. For the consolidated version see https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1583325017136&uri=CELEX:02005D0270-20190426

2 Scope, definitions and due dates

2.1 Scope and definitions

The reporting obligation is based on the implementing decisions for Directive 94/62/EC, as described in the introduction.

Packaging is defined in Article 3(1) of Directive 94/62/EC on packaging and packaging waste (hereafter: the Directive)[3], as last amended by Directive 2018/852[4], as:

> *"all products made of any materials of any nature to be used for the containment, protection, handling, delivery and presentation of goods, from raw materials to processed goods, from the producer to the user or the consumer. 'Non-returnable' items used for the same purposes shall also be considered to constitute packaging."*

Packaging therefore consists of sales packaging (primary packaging), grouped packaging (secondary packaging), and transport packaging (tertiary packaging) (as set out in Article 3).

Article 3(1) of the Directive further clarifies that items as per the above definition shall constitute packaging:

> *"unless the item is an integral part of a product and it is necessary to contain, support or preserve that product throughout its lifetime and all elements are intended to be used, consumed or disposed of together", including "items designed and intended to be filled at the point of sale and 'disposable' items sold, filled or designed and intended to be filled at the point of sale" as well as "packaging components and ancillary elements integrated into packaging".*

The Directive further defines packaging waste in Article 3(2) as:

"any packaging or packaging material covered by the definition of waste laid down in Article 3 of Directive 2008/98/EC, excluding production residues".

Article 3(1) of the Directive also provides criteria for when items are not considered packaging, with Annex I of the Directive then providing illustrative examples of these special cases. An item is not considered packaging if it is "*an integral part of a product and it is necessary to contain, support or preserve that product throughout its lifetime and all elements are intended to be used, consumed or disposed of together*".

[3] OJ L 365, 31.12.1994, p. 10; for the consolidated version see https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:01994L0062-20180704&from=EN

[4] OJ L 150, 14.6.2018, p. 141

A non-exhaustive list of items considered to be packaging / non-packaging can be found in Annex I of Directive 94/62/EC. Some PROs have lists with examples of packaging / non packaging items on their websites[5]

For the specific case of reusable packaging, examples of packaging which should not be reported on are included in Appendix A.3.4.3.

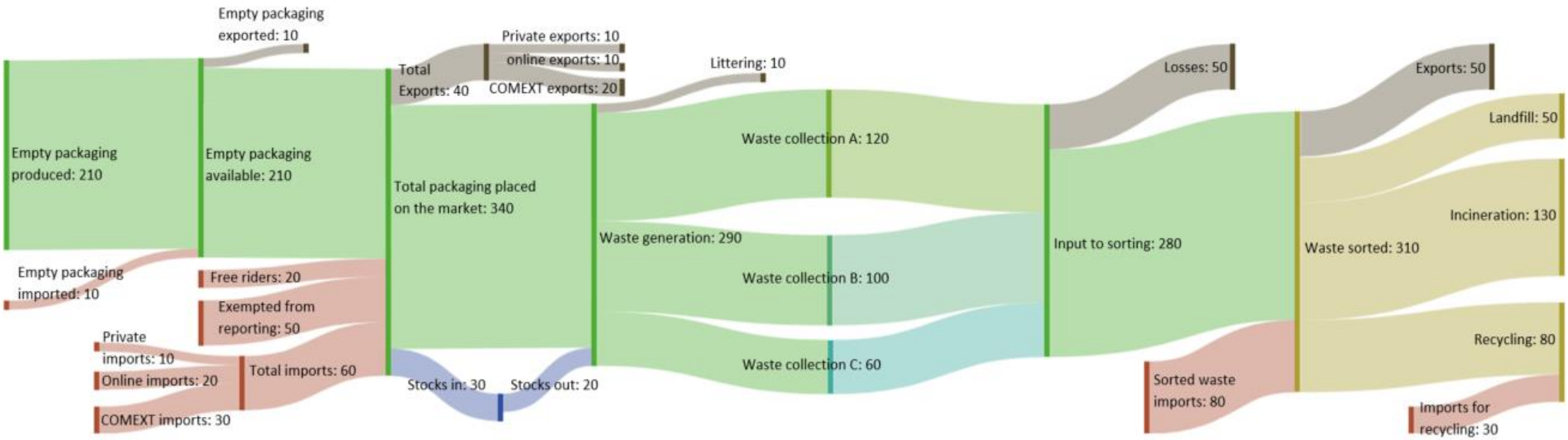
The scope of the packaging supply chain and waste management activities to be considered when reporting data are illustrated in Figure 1.

[5] Compliance with Annex I of Directive 94/62/EC not checked:

Valorlux in Luxembourg: https://www.valorlux.lu/media/616952feab731_list-of-packaging-non-packaging.pdf

Fost Plus in Belgium: https://www.fostplus.be/fr/media/575/download; page 70 ff.

Figure 1: Illustrative Flows of Packaging and Packaging Waste



2.2 Due date for data submission and application of the stricter compilation rules

Data must be reported by 30 June for the year n-2.

The Directive sets out new recycling targets (Article 6(1), points (f) to (i)), which are required to be met no later than 31 December 2025 (with additional, higher targets set for 2030). These targets are accompanied by new calculation rules to account for their attainment. These new calculation rules are mandatory since the reporting for the reference year 2020. These new and clearer calculation rules are set, in particular, in provisions of Article 6a of the Directive as well as in new Articles 6a to 6d and Article 6f of Decision 2005/270.

However, the old targets, as set out in Article 6(1), points (a) to (e), of the Directive are still in force until these are superseded by the new targets in 2025. The old calculation rules for these targets are described in particular in Articles 3 to 6 of Decision 2005/270, as last amended.

Reporting of data on reusable packaging has also been mandatory since the reporting for the reference year 2020.

In addition, Article 12(3b) of the Directive states:

> *"3b. The data reported by Member States in accordance with this Article shall be accompanied by a quality check report and a report on the measures taken pursuant to Article 6a(3) and (8), including detailed information about the average loss rates where applicable."*

Member States must thus accompany their report with a quality check report as set out in Decision 2005/270.

Member States must continue showing compliance with the old targets as set out in Article 6(1), points (a) to (e), of the Directive until they have to change to showing compliance with the new targets as laid down in Article 6(1) points (f) and (g) starting on 31 December 2025.

Any Member State that wishes to show **attainment of the old targets based upon the old calculation rules** must fill in a separate table. This means completing Table 1a *in addition* to Table 1.

This follows from Decision 2005/270:

- Article 6e:

  > *"For the purposes of calculating and verifying attainment of the targets set in points (a) to (e) of Article 6(1) of Directive 94/62/EC [i.e. the old targets], Member States may apply the calculation rules laid down in Articles 6a to 6d" [i.e. the new calculation rules]."*

- Article 9(5):

  > *"5. Where, for the purposes of verifying compliance with the targets set in points (a) to (e) of Article 6(1) of Directive 94/62/EC [i.e. the old targets], a*

Member State does not apply the calculation rules laid down in Articles 6a to 6d [i.e. a Member State decides not to use the new calculation rules], that Member State shall submit the data for verifying compliance with the targets set in points (a) to (e) of Article 6(1) of Directive 94/62/EC separately by using the format laid down in Table 1 of the Annex."

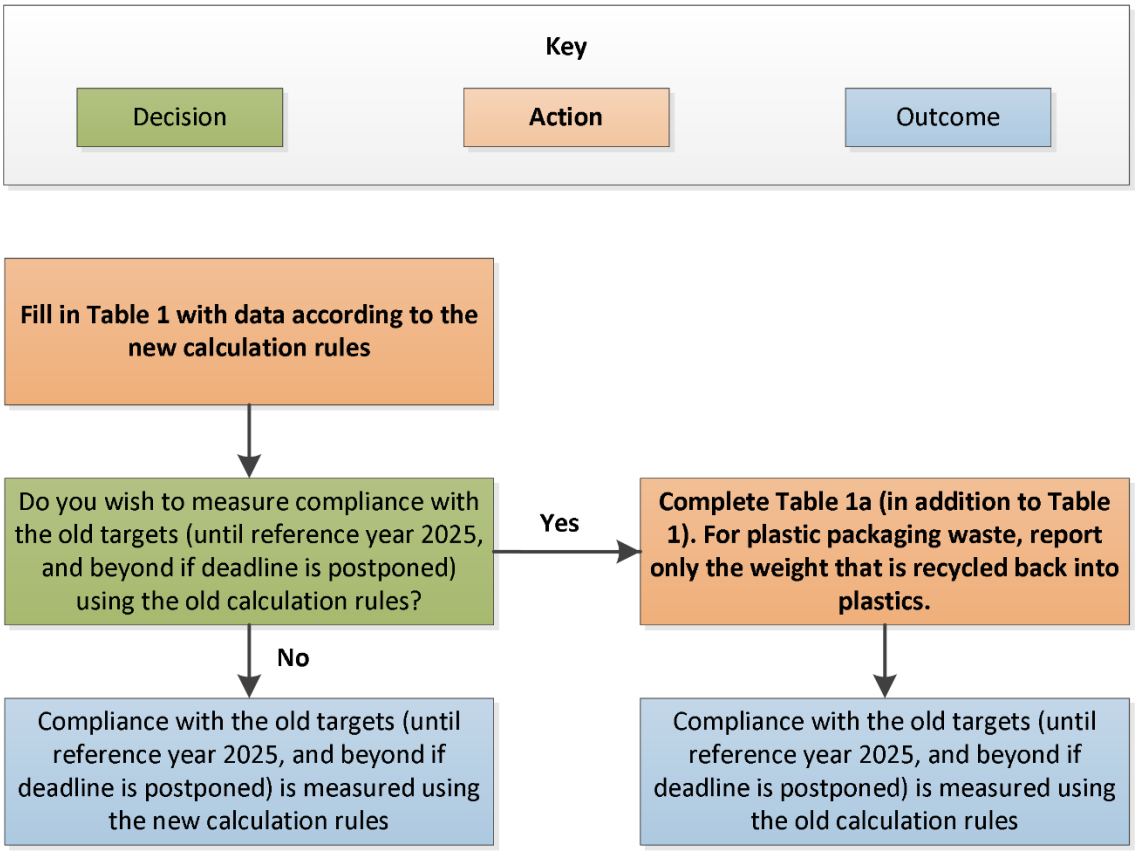
For that purpose, Eurostat offers a simplified Table 1a in the questionnaire (see Section 4.2).

Member States should only use Table 1a if they still wish to continue reporting on the attainment of the old targets until 2025 (inclusive), based on the old calculation rules. In such cases, for plastic materials contained in packaging waste, it is only possible to report the material that is recycled back into plastics.

Member States should use the flow chart presented in Figure 2 to help guide them through the process of completing Table 1, and Table 1a where appropriate. It presents the decisions that Member States need to make around reporting, and the required actions that follow from these decisions, in terms of which tables they should complete; it also presents the outcomes in terms of how compliance will be measured.

Finally, the reporting of data on reusable packaging is covered by Article 12(3)(a) of the Directive. Member States must report data on reusable packaging **from the reference year 2020 onwards, at the latest 18 months after the end of the respective year (by 30 June).**

Figure 2: Flow Chart Guide to Completing Table 1 and Table 1a where appropriate



3 Guidance for the preparation of data for reporting

This section of the guidance will assist Member States in collecting and preparing the data required to complete the reporting tables in the Excel questionnaire.

3.1 Waste Generation

This section sets out the main approaches used for the collection, calculation and verification of waste generation data. It relates to reporting according to Decision 2005/270, Annex I Tables 1, 1a, 2 and 3 and the quality report according to Decision 2005/270, Annex IV. The aspects regarding the generation of packaging waste are addressed under section 18 of the national ESMS metadata file.

Exhaustive and accurate estimation of packaging waste generation is particularly important in the context of comparability of performance against recycling targets between Member States. Overestimating generation could put targets out of reach, and underestimating could result in a significant drop in the level of performance required to meet a given target.

One method of obtaining waste generation data is based on the collection of data on the amount of packaging waste placed on the market (PoM). As stated in Article 6a of the Directive:

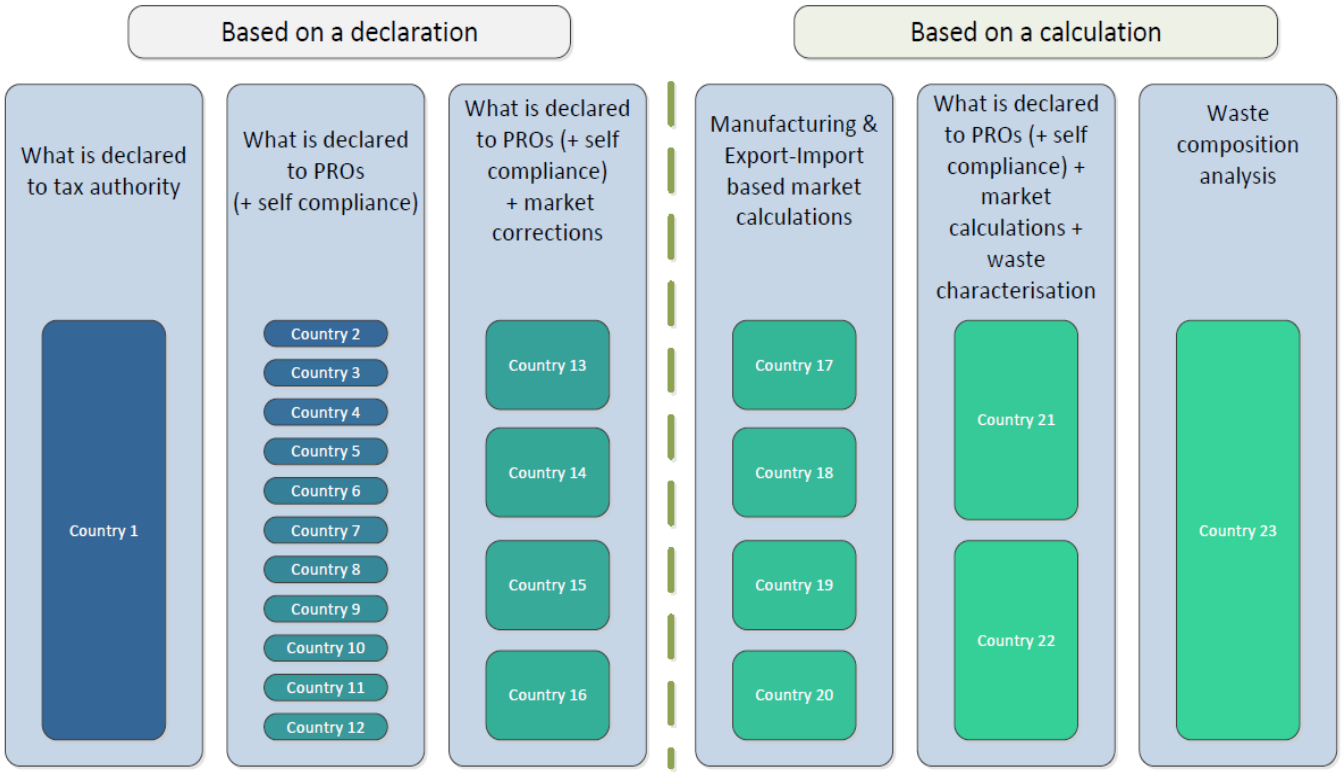
> *"Member States shall calculate the weight of packaging waste generated and recycled in a given calendar year. Packaging waste generated in a Member State may be deemed to be equal to the amount of packaging placed on the market in the same year within that Member State."*

Approaches to gathering this data and resolving data quality issues are detailed in Section 3.1.1.

Waste generation data can also be estimated by using the measurement of weight and composition of waste (waste composition analysis, e.g. at the point of collection, or at the outputs of recycling plants). This can be used as the sole method for the collection of waste generation data in a Member State (see Section 3.1.1.7), or to validate and cross-check PoM data, as detailed in Section 3.1.3.

Methods of collecting and compiling waste generation data are shown in Figure 3 for a selection of 23 Member States. As can be seen these methods are mostly based on placed on the market data, whether this is declared via reporting made to Producer Responsibility Organisations (PROs) or tax authorities, or based on calculations of market data on manufacturing volumes compensated for imports and exports.

Figure 3: Comparison of Waste Generation Data Collection Methods



3.1.1 Placed on the market data

3.1.1.1 Data sources and collection methods

As stated in the Directive, Member States can gather PoM data from a variety of 'economic actors'. Typically, producers provide information on the amount of packaging PoM through an Extended Producer Responsibility (EPR) scheme. They do this via reporting to Producer Responsibility Organisations (PROs), which are organisations producers join in order to meet their EPR obligations, and which operate under EPR schemes. Aside from EPR scheme reporting, other data sources include:

- Data sourced directly from producers;
- Independent consulting companies;
- Primary data submitted directly to national authorities. This may include data submitted for other administrative purposes, such as under a packaging tax, or production and trade statistics; and
- Production and import / export statistics and factors to estimate the amount of packaging associated with these product flows.
- Regional authorities.

If there are multiple data sources, e.g. multiple EPR schemes, data from all schemes must be gathered to ensure amounts are not underestimated. Member States should likewise make sure that, when adding up data from EPR schemes, there is no double-counting.

Data can be collected in a variety of ways, including reports/studies; databases; forms; online registers; and surveys. In order to improve the collection of data, Member States are recommended to ensure that databases on packaging PoM are established, where not already in place. The databases should include data based on Annex III of the Directive (total packaging placed on the market, in units or tonnes). Further details of recommended design considerations for this database are provided in Appendix A.1.1.

3.1.1.2 Data quality issues

Member States should assess the quality of the PoM data used. The quality of collected data may be compromised by a number of data collection issues. These include, but are not limited to, the following:

- Data collection may not be regular and/or comprehensive, and data may not be collected from every relevant producer either directly or through EPR schemes, leading to gaps in the data collected. This can be due to:
  - The use of a *de minimis* threshold for reporting standards;
  - Legal exemptions from reporting (e.g. the agricultural sector);
  - Free-riding, typically facilitated by online sales and cross border trade;
  - Uncertainty around reporting obligations due to complexity in how some producer responsibility schemes are organised.
- Imports and exports of packaging/packaging waste prior to collection
- Time-series issues: reliance on occasional studies and surveys, which may quickly become out of date, can be a problem; and
- Reliance on inaccurate or incomplete industry data can lead to data inaccuracies.

These and other data quality issues are further discussed in Appendix A.1.2.1. Specific measures to improve the quality of data are discussed in Sections 3.1.1.3 to 3.1.1.6 below.

3.1.1.3 Improving the comprehensiveness of PoM data

Measures to improve the comprehensiveness of PoM data – i.e. to move towards capturing data for *all* packaging placed on the market, are described in this section.

Accounting for de minimis thresholds

Full data reporting may prove challenging for smaller producers. For this reason, Member States may choose to set a *de minimis* reporting threshold for the lowest level of reporting required (see Appendix A.1.2.2.1). When setting a *de minimis* threshold, Member States should seek to ensure that the vast majority of packaging PoM accounted for by PROs is reported to the full standard.

It is recommended that *de minimis* thresholds should be based on annual turnover, rather than kilograms of packaging PoM, as turnover data is more accessible. However, if minimum reporting requirements are to be based on PoM amounts for specific types of packaging, it is crucial that any *de minimis* does not compromise a Member State's ability to obtain accurate PoM data. Therefore, any typical packaging weights applied need to be accurate, and Member States should review such weights, along with their *de minimis* thresholds,

periodically. Lastly, where small producers are not reporting to PROs/compliance schemes, it is recommended that Member States require them to report directly to the relevant authority.

A best practice example of a Member State (the Netherlands) setting a *de minimis* reporting threshold is provided in Section 3.1.1.7.

Identifying and reporting on free-riders

In the context of packaging, free-riding involves companies selling goods into a country without contributing to the subsequent collection and treatments costs associated with the packaging waste arising from those goods. The free-rider thereby benefits from access to a market, without accruing the full mandated costs of EPR fees. It is useful to distinguish between two forms of free-riding: underreporting by companies that are registered within the system (partial free-riding), and companies that do not engage with the EPR system in the Member State where products are sold (total free-riding). It can be the case that a company is compliant in one Member State but is free-riding in another.

Furthermore, in both partial and total free-riding, companies do not report accurate data on packaging PoM, so total amounts of packaging PoM are underestimated. Therefore, where Member States gather data from producers (directly or via PROs), there is a risk of reporting substantially inaccurate values for packaging PoM.

A number of steps can be taken to identify and report on free-riders. Partial free-riding/underreporting can be dealt with through regular audits of companies registered within an EPR system. Automated data analysis can reveal discrepancies to be followed up, such as where a company reports significantly lower quantities in one period than compared with the same period in the previous year. Annual audits of a selection of companies can also reveal partial free-riding. It should be noted that data discrepancies can result from issues with understanding the reporting process and are not, in all cases, intentional activities to avoid a financial obligation.

Total free-riding is more difficult to identify as companies will not be in contact with an EPR system. Sales made through online marketplaces have been highlighted as hotspots for free-riding of EPR, and Member States should engage with multi-seller platforms and companies undertaking order fulfilment activities, seeking their commitment to take action on free-riding. It is also recommended that Member States introduce legislation that requires online multi-seller platforms to check that their sellers are registered with EPR schemes, and to either prohibit access to sellers without appropriate EPR documentation or else take on the EPR obligations of their sellers where sellers fall below a relevant *de minimis.*

Detailed information on identifying and reporting on free-riders is provided in Appendix A.1.2.1.2.

3.1.1.4 Adjustments for imports and exports of packaging waste

Member States collecting data on packaging waste generated through a PoM approach need to take into account the movement of packaging waste between MSs i.e. packaging waste collected that was originally PoM in another MS (and vice versa, packaging PoM which is then collected in another MS). Such packaging can be imported/exported by consumers on a

personal basis. In order to account for the portion of waste generated due to such imports/exports, Member States should make an appropriate adjustment to their waste generated tonnage. This section provides guidance on this issue.

Note that this is not related to the specific case of Member States exporting waste they have collected to another Member State for recycling (or to outside the EU for treatment under broadly equivalent conditions). That scenario is referred to Article 6a (7) and (8) of the Directive, and is covered by Section 3.2.6 and Appendix A.2.7 of this guidance.

Packaging PoM in one Member State could subsequently enter another Member State in a number of different ways, including:

- Commercial exports/imports of products subsequent to their initial placement on the market, undertaken by companies other than those originally placing the products on the market.
- The cross-border transit of products by consumers motivated by price differences between Member States (e.g. consumers from one Member States travelling to another to purchase alcohol at a lower price and then returning home with the packaged product).
- Cross-border workers (e.g. those working in freight) and tourists transporting packaged products between Member States (i.e. their 'home' Member State, their 'destination' Member State, and Member States visited en route).
- The purchase of packaged products PoM in one Member State that are then shipped to consumers in a different Member State. This most often happens with online purchases.
- The movement of littered packaging waste by natural forces – such as packaging washing downstream – whereby it leaks out of its country of origin.

These cross-border transfers create a problem for accurate data reporting when Member States report packaging PoM as their figure for packaging waste generated. In this case, the packaging described in the examples given above will be reported as generated in the Member State in which it was PoM but reported as recycled (or otherwise treated) in the (different) Member State in which it becomes waste. Thus, the numerator and denominator in the recycling rate calculation (i.e. amount recycled / amount generated) will be different in scope, and the calculated recycling rate will be inaccurate.

Therefore, where Member States are taking a PoM approach to reporting packaging waste generated, their PoM figure must be corrected to include packaging waste collected within their borders despite being PoM in another Member State. In addition, they need to exclude packaging waste PoM in their market but which has been exported and become waste abroad. However, where Member States measure waste generated directly (as described in Section 3.1.2), no such correction is necessary.

Examples of methods Member States could use to form a basis for this correction include:

- Litter surveys;

- Studies/surveys of cross-border movements of packaged products due to price differentials;
- Estimates from DRS schemes of cross-border movements;
- Assessments of worker/tourist movements and buying habits; and
- Analyses of imports from online trading.

Member States should make their own independent estimates of cross-border movements of packaged products and packaging waste to account for – to the greatest extent possible – all cross-border movements of packaging waste, and should use these estimates to correct their PoM data. The Member States involved in cross-border movements of packaging do not need to agree their estimates with each other.

General guidance on applying corrections and estimates to PoM data is given in Section 3.1.1.5.

3.1.1.5 Approaches to applying corrections/estimates

Where there are concerns in the coverage or accuracy of PoM data, it is often necessary for Member States to make use of corrections/estimates. This should include corrections for the issues described above, i.e. 'free-riding' (including non-registration of packaging waste in online sales, and underreporting of units by producers that do report to an EPR scheme), under-coverage due to legally exempt (including *de minimis*) units, and private imports/exports.

The accuracy of these corrections/estimates clearly depends on the quality of the data upon which they are based, and this can vary between Member States.

The following steps are recommended to improve current estimation methods:

1. Member States should make substantiated estimates based on monitoring across a representative sample of producers, for example, across those that fall below a *de minimis* threshold or online sellers. Statistical modelling could also be used to estimate the number of producers in a country and the quantity of packaging PoM, as demonstrated for plastic packaging in WRAP's PlasticFlow 2025 report.[6] In a best-case scenario, this would be a representative survey of the weights of packaging PoM in a Member State.
2. Member States should use targeted stakeholder interviews to:
    a. Refine the estimates generated by the above techniques for certain types of producers who may be significantly different from other producers; and
    b. Test the validity of the estimated number of producers through industry expert interviews.

[6] WRAP (2018) PlasticFlow 2025: Plastic Packaging Flow Data Report. Available at https://wrap.org.uk/resources/report/plasticflow-2025-plastic-packaging-flow-data-report

These corrections should be made and used to amend packaging PoM data to provide a more accurate figure. A description of the approach taken to correction should be given as part of the responses to questions 18.5.2 and 18.5.3 of the quality report (see Section 5 for further details on completing the quality report).

A best practice example of a Member State (the Netherlands) that uses estimates to make corrections to its PoM data is provided in Section 3.1.1.7.

3.1.1.6 Data verification and audits

Member States should verify the data they collect, using a combination of checks. This will help to identify any potential issues with the PoM data. If data errors are identified, then Member States can engage with the organisations providing the data to correct the issues.

The following data verification techniques can be used:

- Annual checks should be made by producer responsibility organisations (PROs) and regulators as appropriate, to check any clear anomalies in producer data; e.g. a significant increase or decrease in a particular material quantity from previous years. Ideally, this should be done by an automated software system/algorithm to minimise labour requirements.
- Producers should be subject to random third party spot-check auditing by their PROs and, less regularly but in more detail, by the relevant regional or national authorities. These investigations should:
    - Check data sources and their reliability;
    - Check for any anomalous or suspicious individual packaging weights; and
    - Check calculations (e.g. Excel formulae).
- It is recommended that PROs be subject to occasional audits by national authorities.
- Member States should require producers to, as accurately as possible, assess their suppliers for the weight of packaging PoM.
- Cross-check the data submitted by the PRO/s against other collective sources of data, for example from producer associations and sales data.

Data verification of the kinds listed above should always be undertaken by independent experts without any conflict of interest with regard to the producer or PRO being audited.

3.1.1.7 Best practice example - Netherlands

In the Netherlands, PoM data is collected through the national EPR scheme, run by Afvalfonds Verpakkingen. Producers/importers of packaged products are required to report PoM data as part of their essential EPR requirements.

The Netherlands sets a *de minimis* producer/importer reporting threshold of 50,000 kg per year of packaging PoM. While only 3% of companies placing packaging on the Dutch market fall above this *de minimis* threshold, these companies account for 93% of the market. Afvalfonds Verpakkingen then estimates the weight of packaging PoM by producers/importers falling below the *de minimis* threshold, based on a survey it has undertaken in order to understand the gaps in the PoM data.

‘Logistieke hulpmiddelen’ (logistical resources) packaging is also exempt from reporting requirements – mainly tertiary packaging, used for the transportation and storage of goods. Here again, Afvalfonds Verpakkingen estimates the weight of this packaging PoM.

The case of the Netherlands therefore illustrates that it can be possible to capture the majority of PoM data from a minority of companies, with extrapolations made up to full market coverage based on estimates.

Afvalfonds Verpakkingen is the Netherlands’ only EPR organisation, and it is empowered with the right to demand access to producers’/importers’ records. It maintains an active programme to identify potential free-riders, in order to ensure a full customer database and sign-up to the EPR scheme.

A system of data verifications and audits is employed to help ensure the accuracy of the PoM data. The top 125 producers/importers, responsible for 65% of all packaging PoM, are audited once in every five years by external auditors – or more frequently if necessary. Meanwhile, the top 750 producers/importers, responsible for 90% of all packaging PoM, are audited once every five years by Afvalfonds Verpakkingen staff with a background in accountancy – or again, more frequently if necessary. In addition, PoM data for the remaining 1,600 producers/importers is verified based on data analysis.

Afvalfonds Verpakkingen also cooperates with municipalities and companies as part of the Netherlands’ Packaging Agreement, under which the EPR system collects money from producers/importers and remunerates municipalities for packaging collection costs. In addition, a quality protocol between Afvalfonds Verpakkingen and municipalities defines the quality criteria for all collected materials.

3.1.2 Data from waste composition analysis

Member States can also use waste composition analysis to calculate packaging waste generated. Waste analysis provides information about the amounts and types of materials in a particular waste stream. The results give a breakdown of the total composition of waste which has been sampled.

To ensure full coverage of all packaging waste, it is necessary to perform analyses on multiple waste streams, at appropriate points in the waste management chain. For example, analyses of household, commercial and industrial waste are required, and data may be collected at the point of collection (e.g. from the bins, from the waste trucks), and/or data from sorting/reprocessing/disposal facilities may be used. These may be further verified/cross-checked with reference to other datasets, such as national registers of waste movements, databases of waste exports, compliance scheme reports etc. An example (from Ireland) to illustrate the systems required to capture waste generation data from waste analyses is provided.

3.1.2.1 Methodology for waste composition analysis

Waste composition analysis typically applies the following methodological steps:

1. Samples of specific waste streams are taken;

2. The sample volume is reduced to a manageable size;
3. Each sample is physically sorted, often by hand, into separate, predetermined categories; and
4. The amount of waste in each category is calculated by weight.

At present, a variety of methods for waste analysis are employed in Europe and there are various existing standards and methodological guidance documents for carrying out waste compositional analyses. For examples see Appendix A.2.4.1.

It is beyond the scope of this document to provide comprehensive guidance on how waste analysis should be conducted; however, a number of key principles are outlined in Appendix A.1.1.

3.1.2.2 Corrections and data quality

If Member States take a stratified random sampling approach to waste composition analysis, then in order to ensure high data quality it is recommended that a minimum of 50 households should be sampled within each stratum in order to account for variation in waste categories across households.

Other important considerations to ensure data quality are frequency of sampling, level of granularity of categories used to classify the waste, and the range of potential characteristics of the households and businesses being sampled. Information on all these considerations is provided in Appendix A.1.3.

Waste composition data for each stratum will need to be weighted in order for the overall results to realistically represent the municipal area being studied. Weightings are calculated based on the percentage of total households represented by each stratum.

Information on using waste composition analysis to cross-check waste generation data from other sources is provided in Section 3.1.3.

3.1.2.3 Best practice example – Ireland

Ireland has established a data collection system that focuses on capturing all packaging waste generated in the country. This approach captures waste that is below the *de minimis* for compliance and waste that is generated by non-compliant packaging producers and online sales. The data are processed and compiled by the Irish Environmental Protection Agency (EPA).

The system differentiates between packaging waste that is recycled and packaging waste that is not recycled, with a different approach to collecting data on each. In general, the measurement point for the former is outputs from waste treatment facilities, while the measurement point for the latter is at the point of waste collection. The sum of the two is assumed to be the total packaging waste generated; adjustments are made where necessary.

Data on recycled packaging waste is collected primarily via annual environmental reports (AERs) submitted by authorised waste facilities (providing administrative data) and annual surveys of local authorities and waste brokers.

Data on non-recycled packaging waste is collected via reports submitted by waste collection permit holders to local authorities via an electronic register maintained by the National Waste Collection Permit Office (NWCPO); this includes data on the transport of waste loads from kerbside to waste facilities, as well as transfers between waste facilities. To estimate the packaging content of mixed non-recycled waste, the EPA applies national factors determined by waste compositional analysis. These studies are well developed and control for geographical, seasonal and socio-economic variations as far as possible.[7]

Ireland carries out a number of validation exercises and cross-checks on this data in order to verify it. AER data from waste facilities are subject to desktop validations, and site visits to waste treatment facilities are undertaken. The data collected via the AERs and EPA surveys is cross-checked against other independent data sources: data collected by the NWCPO, the National Trans Frontier Shipment Office's (NTFSO) national register of waste exports, and compliance scheme reports from Repak, Ireland's sole packaging compliance scheme.

Repak provides input and output data for Irish waste recycling facilities, which the EPA then uses to cross-check data it has compiled. In addition, Repak provides data on the end destinations of packaging exported for recycling and recovery, both within and outside of the EU.

Finally, the Central Statistics Office's National Household Survey[8] and data collected from local authorities are used to estimate unmanaged household waste.

Figure 4 presents an overview of Ireland's approach.

[7] Further information is available at the EPA website: https://www.epa.ie/our-services/monitoring--assessment/waste/national-waste-statistics/waste-characterisation/

[8] Further information is available from the Central Statistics Office webite: https://www.cso.ie/en/statistics/environmentstatistics/householdenvironmentalbehaviours/

Figure 4: Overview of Ireland's approach to packaging waste generation data collection

3.1.3 Requirement to cross-check waste generation data

According to Article 6f of Decision 2005/270, data shall be verified by appropriate measures, in particular:

> *"the amount of packaging waste generated shall be subject to verification and cross-checking, including by using data on the amount of packaging placed on the market, relevant data on waste and composition analyses of mixed municipal waste."*

In essence, this requires using data from both of the approaches outlined above in sections 3.1.1 and 3.1.2. Therefore, both placed on market (PoM) data and data from waste analyses should be generated in each Member State for cross-checking and balancing.

If PoM data is the primary source for waste generation data, then waste analyses should be carried out at least once every 4 years in order to establish the type and composition of packaging waste. Such a waste analysis should be conducted at least once before the reporting of data for reference year 2025, when compliance with the new recycling targets is first to be proved. Factors calculated from these analyses, relating to the proportion of different types of packaging in certain types of waste, should then be used for annual cross-checks.

Through such cross-checking, Member States should identify, for each material, the gap between the weight recorded as PoM and the measured weight of waste generated. The likely reasons for differences in these amounts are:

- Changes in weight between PoM and waste due to differences in natural humidity and contamination or non-targeted materials; and
- Free-riders, underreporting and the use of *de minimis* thresholds in PoM reporting.

As of 1 January 2021, a Member State contribution based on non-recycled plastic packaging waste became a new revenue source to the EU budget, following the adoption and approval of the own resources decision (Council Regulation (EU) 2021/770)[9]. As a result, for plastic packaging waste, the cross-checks between the amount of packaging PoM and the amount generated as waste will be required on an annual basis (as per Article 5(5) of Council Regulation (EU) 2021/770). Waste analyses do not have to be carried out on an annual basis, but the periodically derived factors (see above) should be applied to different waste arisings in a given year.

In order to narrow the gap between the two methods, Member States should ensure that all possible data inaccuracies and errors are corrected. Such inaccuracies are noted in sections 3.1.1 and 3.1.2, and above. A detailed explanation of the differences between both calculation approaches should be provided by Member States under subsections 18.1; 18.3.1 and 18.3.2; 18.4.4; 18.5.1 to 18.5.3; 18.6.1 and under subsections 13.1; 13.1.1; 15.2; 15.4.1; 18.3.4 of the national ESMS metadata file to demonstrate the process of cross-checking, and, if there is a remaining gap between waste analysis and PoM data, to clearly explain the reasons why this is the case. Improvements in the two methods need to be identified and implemented (e.g. improved methods to correct for under-coverage) so that the differences are reduced to plausible amounts.

3.1.4 Summary of data requirements for reporting

This section lists the data components that Member States are required to estimate as part of their calculations of packaging waste generation, depending on the approach taken. Member States are required to provide information on certain of the listed data components as part of their reporting in the quality report.

Where Member States take the packaging PoM approach (as described in Section 3.1.1), and are basing their calculations on EPR data, they will need to generate estimates for the following data components:

- Placed on the market based on EPR scheme data prior to any adjustment.
- Estimates for units below the threshold (*de minimis*).
- Estimates for self-managing producers.
- Estimates for free-riders.
- Post placed-on-the-market exports.

[9] Council Regulation (EU, Euratom) 2021/770 of 30 April 2021 on the calculation of the own resource based on plastic packaging waste that is not recycled, on the methods and procedure for making available that own resource, on the measures to meet cash requirements, and on certain aspects of the own resource based on gross national income (OJ L 165, 11.5.2021, p. 15).

- Private imports.
- Any other adjustments.

These data components are illustrated in Figure 5, which provides an example mass flow for packaging waste placed on market and waste generated.

Figure 5: Illustrative Flows of Packaging Placed on Market and Waste Generated

Where Member States take the packaging PoM approach, but base their calculations on data other than EPR data, they will need to generate an overall estimate of packaging waste generation prior to any adjustments, and also generate estimates for any adjustments required.

Where Member States take the waste analysis approach (as described in Section 3.1.2), they will need to generate estimates for the following data components:

- An overall estimate of packaging waste generation prior to any adjustments.
- Adjustments for humidity (see Appendix A.2.2.2 for further details).
- Adjustments for contamination.
- Any other adjustments.

Furthermore, Member States should note the considerations for reporting waste generation of reusable packaging detailed in Section 3.4.

3.2 Recycling

This section sets out the main approaches used for the collection, calculation and verification of recycling data. It relates to reporting in Tables 1 and 1a and under subsections 3.2.1;

3.4.2; 3.4.3; 18.3.3; 18.3.6; 18.4.5; 18.5.4 to 18.5.6; 18.6.2 and 18.6.3 of the national ESMS metadata file.

3.2.1 Identification of calculation points for packaging materials

Article 6a of Directive 94/62/EC states that:

> *"[…] the weight of packaging waste recycled shall be measured when the waste enters the recycling operation."*

This provides the basis for the concept of the calculation point, as presented in this guidance document. The definition of 'recycling operation' is then provided in Annex II of Decision 2005/270, as this relates to a range of materials. As such, the Directive and Decision 2005/270 together establish the points at which recycling tonnages should be calculated. The 'calculation point' can differ from the 'measurement point' i.e. the point in the recycling chain at which waste is measured (see Section 3.2.2), prior to the calculation of recycling tonnages.

Calculation points for each material type as set out in Annex II of Decision 2005/270 are as follows:

- **Plastic packaging** – plastic separated by polymer that does not undergo further processing before entering pelletisation, extrusion, or moulding operations; and plastic flakes that do not undergo further processing before their use in a final product.
- **Paper and cardboard packaging** – sorted paper that does not undergo further processing before entering a pulping operation.
- **Glass packaging** – sorted glass that does not undergo further processing before entering a glass furnace or the production of filtration media, abrasive materials, glass fibre insulation and construction materials.
- **Metal packaging** – sorted metal that does not undergo further processing before entering a metal smelter or furnace.
- **Wooden packaging** – sorted wood that does not undergo further treatment before utilisation in particleboard manufacture; and sorted wood entering a composting operation.
- **Fabric/textile packaging** – sorted textile material that does not undergo further processing before its utilisation for the production of textile fibres, rags or granulates.
- **Composite packaging** – plastic, glass, metal, wood, paper and cardboard and other materials resulting from the treatment of composite packaging or of packaging composed of multiple materials that do not undergo further processing before reaching the calculation point established for the specific material.

Further information on the relevance of the calculation points to the location of recycling activities is provided in the Appendix A.2.1. at the end of this guidance.

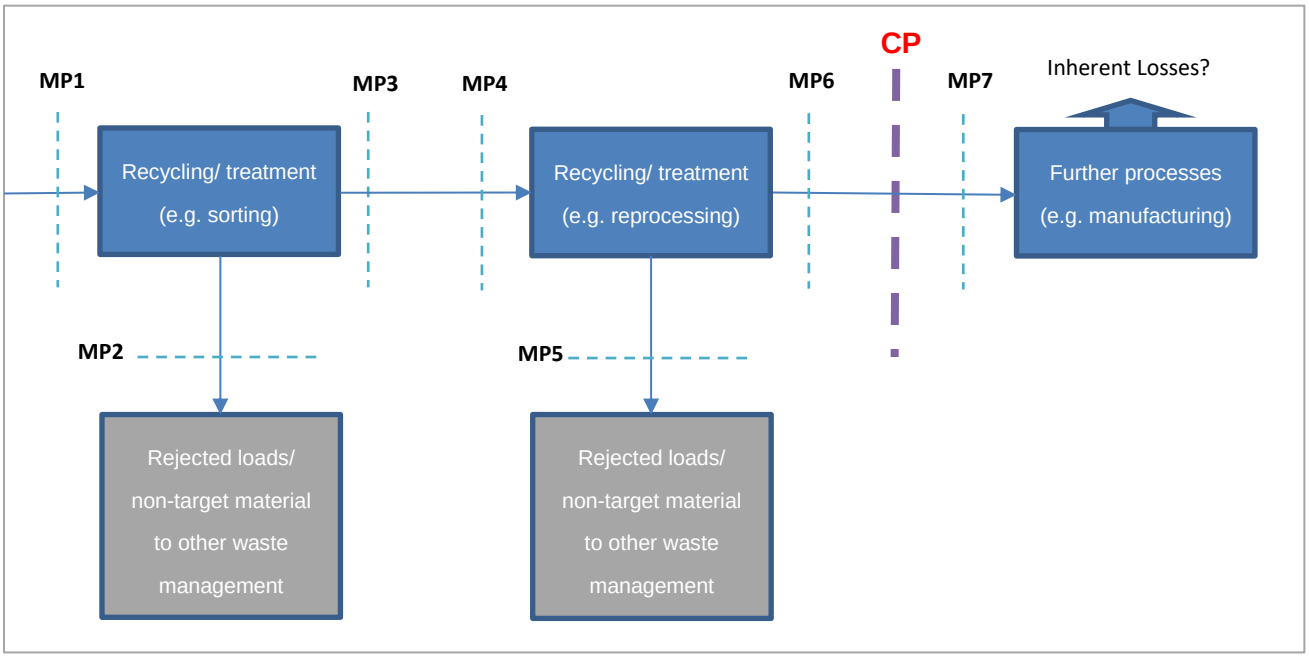
3.2.2 Measurement methods and data collection

3.2.2.1 Allowable measurement methods

The measurement method is the approach(es) taken to calculating the amount of recycling at the calculation points defined above. The approach(es) could make use of different measurement points and arithmetic formulas to make the calculation.

A generalised multi-stage recycling value chain is shown in Figure 6. The weight of material at the calculation point should be calculated and reported for each material.

Figure 6: Generalised Measurement Method Schematic



In this example, there are a number of ways to calculate the weight of material at the calculation point (CP):

- CP = MP7
- CP = MP6
- CP = MP4 - MP5
- CP = MP3 - MP5
- CP = MP1 - MP2 - MP5

This measurement method approach should be applied to each material flow as relevant to the individual Member State. For all these example calculation points, any inherent losses (losses in weight of materials or substances due to physical or chemical transformation processes inherent in the recycling operation where packaging waste is actually reprocessed into products, materials or substances) need to be deducted from the calculated weights.

In most cases, it can be assumed that the weight of material at the output of one operation is equivalent to the weight of material at the input to the next operation (e.g. MP3 = MP4). An exception to this is where entire loads are rejected, and it is important to make sure that

rejected loads are subtracted if the source of data is the output of the prior facility, as such loads are not recycled in practice.

Where facilities process material from multiple sources (i.e. packaging and non-packaging, and/or from different countries), a comprehensive understanding of facility inputs and outputs is needed. In addition, consideration should be given to the flows of materials from a given recycling process that are sent for further recycling but are not the primary target material of the recycling process. Member States should consider the different recycling flows on a national level to ensure that such material is included in the amounts reported as recycled.

Please see Appendix A.2.2.1 for detailed guidance on the rules around allowable measurement methods.

3.2.2.2 Obtaining recycling data at the measurement points

The preferred measurement point for packaging waste is the total output weight of targeted material(s) (i.e. the recycled material intended to be sold as a secondary raw material, without further processing). This will generally be a known quantity, as financial transfers (gate fees or payments for materials) will generally be related to the quantities of material (in tonnage) purchased or sold. Any loads rejected after this measurement point due to downstream quality checking procedures would have to be deducted, as failure to make such reductions will cause the amounts reported as recycled to be overestimated. Such deductions should also be considered for waste exported for recycling.

Alternatively, the total plant input (i.e. the weight of material received at the plant) can be used as a measurement point. This is also highly likely to be known as financial transfers are likely to be made in relation to material quantities recycled/treated. This weight should relate to the amount of material accepted by the reprocessing plant, and should not, therefore, include the weight of material rejected after any initial quality checking procedures.

A final measurement point for packaging waste is the total output weight of non-targeted material arising from a given recycling operation (i.e. the material which the recycling operation is not targeting). Again, this is likely to be known as this material will be sent on to further operations that might include recovery or disposal operations, and related financial transactions will generally be made on the basis of the quantity (and quality) of recyclable materials sold. Data from this measurement point (‘MP5’ / ‘MP2’ in Figure 6) can be deducted from the weight of recycling measured prior to sorting/reprocessing operations to calculate the weight of material at the calculation point. If any non-target material is sent to a process where material could be extracted and recycled, an appropriate calculation point would need to be defined to ensure any recycled material is accurately reported.

Having obtained the data, it may be necessary to make adjustments for moisture within material at the calculation points in order to ensure that the correct weight (dry or wet) of material is compared with the corresponding amount of waste generated showing the same level of moisture.

Article 6c (e) and (f) of Decision 2005/270 state that:

"(e) Where the humidity rate of packaging waste at the measurement point differs from that of packaging placed on the market, the amount of packaging at the measurement point shall be corrected in order to reflect the natural humidity rate of the packaging waste comparable to the humidity of equivalent packaging placed on the market.

(f) The amount of recycled packaging waste shall exclude non-packaging materials collected together with the packaging waste, such as waste of the same material that does not originate from packaging, and residues from products that the packaging used to contain."

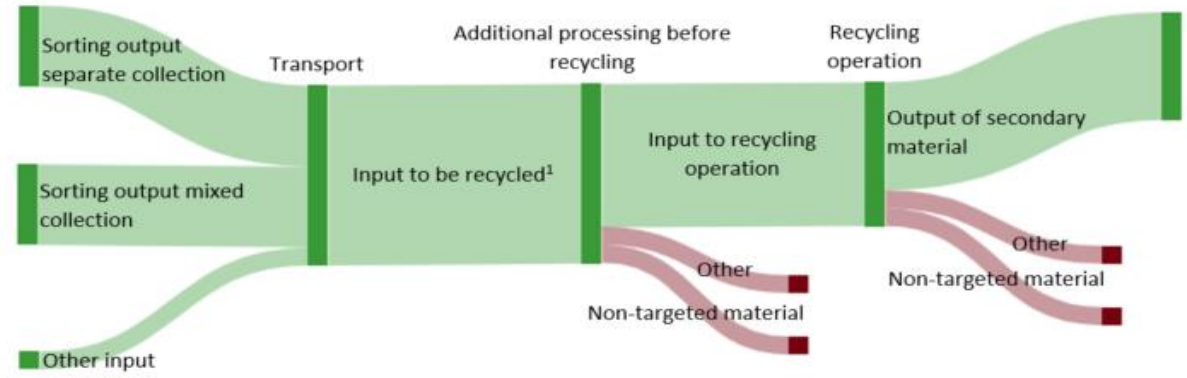
Therefore, recycling quantities should be reported at the same natural humidity rate as packaging when it is placed on the market, and should not include non-packaging material (see Section 3.2.2.3 below) or contamination from product remains. Please refer to Appendix A.2.2.2 for more information regarding humidity rates and non-packaging material.

The European reprocessing industry has confirmed that plant operators will hold data relating to the amount at the calculation points (or relevant measurement points), so Member State authorities will need to ensure they have the legal means in place to request these data, and systems in place to enable these data to be reported efficiently. To gather data relating to these measurement points, Member States should therefore consider establishing electronic registries, in order to gather data directly from the various operators in the recycling value chain.

Legal requirements to provide data may be needed at the national level to mandate the submission of the necessary information by private sector operators to the electronic registries. Until such registers are in place, Member States could rely on other data gathering approaches (e.g. via EPR schemes and surveys).

It can also be useful to build reporting requirements for private sector recycling plant operators into their recycling contracts. For example, in some Member States recycling plants are required to disclose their recycling rates. Member States may also require certification of recycling plants, which establishes standards that are helpful in determining whether packaging waste exported for recycling has been treated under broadly equivalent conditions.

Figure 7: Illustrative Flows of Packaging Waste Sorting Outputs and Treatment Routes



[1] the input consists of waste generated in the respective MS only

3.2.2.3 *Methodology for identifying and correcting data gathered from multi-stream treatment plants*

At measurement points further down the recycling value chain, and closer to the calculation point, waste from different sources may have been mixed. Therefore, the weight of material at the calculation point may not wholly relate to packaging waste. In such circumstances, the total plant output cannot be used to calculate the amount of material contributing to the specific recycling targets at the calculation point because this amount would include non-target material, and therefore overestimate the recycled amounts of a given material. Therefore, it is necessary to identify the proportion of the total material that should be counted as packaging waste.

If the plant operators cannot easily determine whether the entirety of the waste entering their plant is packaging waste, periodic surveys (e.g. at least every 1–2 years) of the supply chain could be carried out to determine average proportions of in-scope wastes in plant inputs, or to develop nationally applicable protocols for individual materials that could be applied to the total tonnage of all material at the calculation point.

Utilising approaches that are based only upon the proportion of in-scope waste inputs to plants assumes that overall plant losses are equivalent to the losses that would occur if plants were treating only one waste stream, in isolation. However, in cases where the losses associated with packaging wastes are different to those of the other waste streams, this may lead to inaccurate data being reported. Consequently, a more detailed approach may be needed to produce reliable data. These issues are described in further detail in Appendix A.2.4.

3.2.3 Metals from incinerator bottom ash

Recycled metals from incinerator bottom ash require particular consideration when gathering data. Article 6(a)(6) of the Directive outlines that this material can be included in the reporting of performance against the metal packaging recycling targets, stating:

> *"For the purposes of calculating whether the targets laid down in points (f) to (i) of Article 6(1) have been attained, Member States may take into account the recycling of metals separated after incineration of waste in proportion to the share of the packaging waste incinerated provided that the recycled metals meet certain quality criteria laid down in the implementing act adopted pursuant to Article 11a(9) of Directive 2008/98/EC."*

Article 6(d) in Decision 2005/270, further specifies that

> *"the amount of recycled metals separated from incineration bottom ash shall be the mass of metals in the metal concentrate that is separated from raw incineration bottom ash originating from packaging waste, and shall not include other materials contained in the metal concentrate such as mineral adhesions or metals that do not originate from packaging waste" and sets out the methodology for calculating the mass of recycled metals separated from incineration bottom ash in Annex III.*

Further guidance on identifying the calculation point for incinerator bottom ash, methods for measuring and obtaining data, and guidance on accounting for losses within the incineration process, is provided in Appendix A.2.3.

This section provides further guidance on the use of the calculation methodology set out in Annex III of Decision 2005/270.

3.2.4 Calculation points and measurement methods for packaging waste composted/digested

As Article 6a(1a) of the Directive states, for packaging waste to be classified as 'recycled', waste materials must be reprocessed into "*products, materials or substances"*.

The calculation rules for biodegradable packaging waste are set out in the Directive. Member States can count biodegradable packaging waste entering composting or anaerobic digestion processes as recycling under certain circumstances, as stated in Article 6a(4):

> *"…biodegradable packaging waste that enters aerobic or anaerobic treatment may be counted as recycled where that treatment generates compost, digestate, or other output with a similar quantity of recycled content in relation to input, which is to be used as a recycled product, material or substance. Where the output is used on land, Member States may count it as recycled only if this use results in benefits to agriculture or ecological improvement."*

The calculation point should be the entry to a biowaste treatment facility, provided that all materials sent to other treatment options by the facility are subtracted. Furthermore, the calculation point should subtract non-biodegradable materials which remain in facility outputs from reported figures.

If Member States include any compostable plastic packaging in the amounts recycled, evidence of benefits to agriculture or ecological improvement where the output was used on land must be provided along with the quality report. The amounts of compostable plastic packaging that are included in the total plastic recycling and total plastic waste generation figures must also be stated separately in tonnage terms in the quality report. Additionally, it is important that compostable plastic packaging that is not fully composted is not included in the amounts recycled.

Where compostable packaging residues from biological treatment are sent for incineration (including pyrolysis and gasification), they are not to be considered as recycled.

Further guidance on how to comply with the methodological requirements of the Directive and of Decision 2005/270 is set out in Appendix A.2.5.

3.2.5 Applying the average loss methodology

Under Article 11a of Directive 2008/98/EC[10] and Article 6a of the Directive, Member States may apply average loss rates (ALRs) under certain circumstances.

Article 6a(2) of the Directive states that:

> *"…the weight of packaging waste recycled may be measured at the output of any sorting operation provided that:*
>
> *(a) such output waste is subsequently recycled;*
>
> *(b) the weight of materials or substances that are removed by further operations preceding the recycling operation and are not subsequently recycled is not included in the weight of waste reported as recycled"*

In summary, this Article states that recycling can be measured at an earlier point in the recycling chain (i.e. at the output of **any** sorting operation), providing that any losses of material later in the chain are deducted prior to reporting. Various methods to establish the amount of losses to exclude from reporting, including the use of ALRs, are set out in Article 6a(3):

> *"To ensure the reliability and accuracy of the data gathered on recycled packaging waste, the system may consist of electronic registries set up pursuant to Article 35(4) of Directive 2008/98/EC, technical specifications for the quality requirements of sorted waste, or average loss rates for sorted waste for various waste types and waste management practices respectively. Average loss rates shall only be used in cases where reliable data cannot be otherwise obtained and shall be calculated on the basis of the calculation rules established in the delegated act adopted pursuant to Article 11a(10) of Directive 2008/98/EC."*

[10] OJ L 312, 22.11.2008, p. 3; for the consolidated version see: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02008L0098-20180705&qid=1645031879392

Recital 15 of the Directive further clarifies that ALRs should:

> *"…preferably be established at the level of individual sorting facilities and should be linked to the different main types of waste, different sources (such as household or commercial), different collection schemes and different types of sorting processes. Average loss rates should only be used in cases where no other reliable data are available, in particular in the context of shipment and export of waste."*

The ALR exemption rule allows Member States to calculate losses that occur after first sorting operations (taking these as measurement points), in order to estimate the recycling tonnage at the calculation point. However, Recital 15 makes clear that ALRs should only be used where no reliable data on the weight of waste recycled can be obtained at the calculation point.

If ALRs are applied, a full description of the approach used to calculate ALRs must be provided in question 18.5.6 of the quality report. This should include details of the sorted packaging waste to which ALRs are applied, types of sorting plants to which different ALRs apply, and the methodological approach taken to calculating ALRs at such point(s) including the statistical accuracy of any surveys used and the nature of any technical specifications. See Appendix A.2.6 for further guidance on ALRs.

3.2.6 Requirement on 'broadly equivalent conditions' for exported waste

Where waste is exported from the Union for recycling, it should only be accounted for when there is sound evidence that treatment was carried out under broadly equivalent conditions to those required under EU environmental law. Appendix A.2.7 provides guidance on how such evidence should be obtained. Details regarding this evidence should be reported under question 18.4.3. of the quality report.

In order to achieve broad equivalence, a receiving facility should operate under a system of rules that meet EU standards on the licensing and operation of waste facilities, emissions to air, and emissions to water. The facility should be subject to an appropriate permitting system as well as an appropriate inspection, record keeping and enforcement system, it should conform with EU rules around industrial emissions, and it should have adequate records to demonstrate the fate of the material it receives.

In order to confirm that broadly equivalent conditions are in place in receiving countries/facilities, Member States (and the responsible bodies within them) will need to make more consistent assessments than are currently made in practice. See Appendix A.2.7.2 for suggestions for such a monitoring and reporting process.

3.2.7 Summary of data requirements for reporting

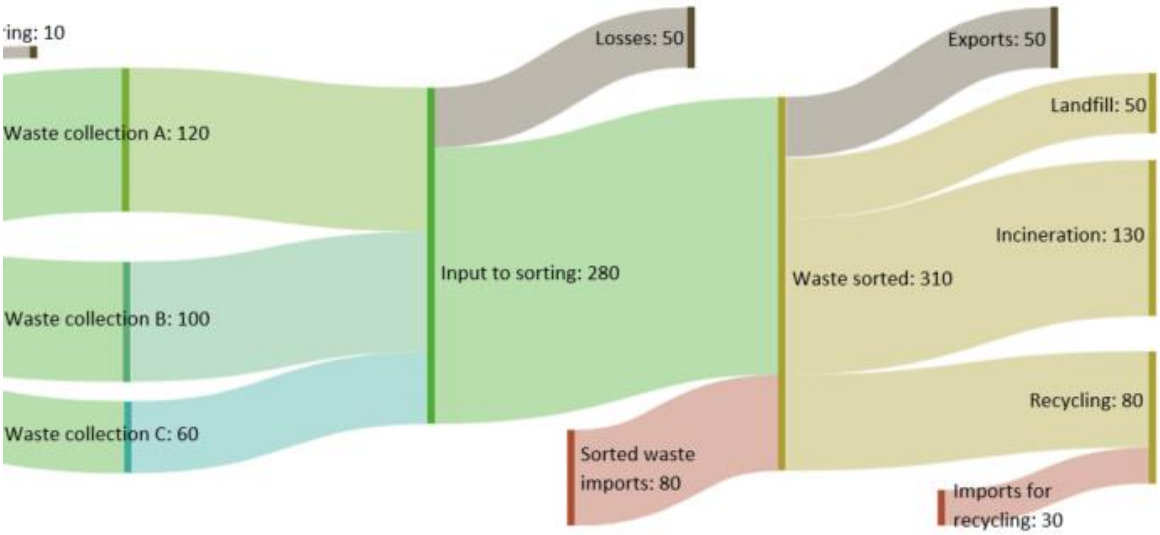
This section lists the data components that Member States are required to estimate as part of their calculations of packaging waste recycling. Member States will need to generate estimates for:

- Packaging waste sent for recycling in the Member State.

- Packaging waste sent for recycling in another Member State.
- Packaging waste sent for recycling outside of the EU (see Section 3.2.6 and Appendix A.2.7 for further details).
- Total packaging waste sent for recycling.
- Adjustments for non-targeted materials.
- Adjustments for humidity (see Section 3.2.2.2 and Appendix A.2.2.2 for further details).
- Any other adjustments (e.g. imports of waste for recycling).

A generalised schematic of flows to be considered when reporting recycling data is provided in Figure 8.

Figure 8: Illustrative Flows of Packaging Waste Collected and Treatment Routes



3.3 Recovery

This section sets out the general principles of collecting and reporting on the recovery of packaging waste, relating to Tables 1 and 1a and subsections 3.2.1; 3.4.2 and 3.4.3; 18.3.3; 18.3.6; 18.4.5; 18.5.4 to 18.5.6; 18.6.2 and 18.6.3 of the national ESMS metadata file. Guidance on the correct reporting of specific uses of waste, for example, waste used as fuel, or treated in what is generally referred to as 'chemical recovery' is also provided.

3.3.1 General principles for reporting on recovery

As defined in Directive 2008/98/EC, 'recovery' means:

> *"…any operation the principal result of which is waste serving a useful purpose by replacing other materials which would otherwise have been*

used to fulfil a particular function, or waste being prepared to fulfil that function, in the plant or in the wider economy."

'Recycling' is a subset of recovery, and means:

> *"…any recovery operation by which waste materials are reprocessed into products, materials or substances whether for the original or other purposes. It includes the reprocessing of organic material but does not include energy recovery and the reprocessing into materials that are to be used as fuels or for backfilling operations"*

Reporting for the purposes of the Directive requires Member States to collect separate data on two types of recovery, specifically:

- Energy recovery – which include all types of energy recovery: both energy recovery at R1[11] facilities and (other) incineration at waste incinerators with energy recovery; and
- Other recovery – that is recover operations other than energy recovery and recycling.

In addition, correction factors should also be applied to ensure the weight of packaging recovered is equivalent to that placed on the market. Correction factors (for recovered and recycled waste) relating to natural humidity rates and the exclusion of non-packaging material are described under Article 5 of Decision 2005/270:

> *"1. For the purposes of calculating and verifying attainment of the targets set in points (a) to (e) of Article 6(1) of Directive 94/62/EC, the weight of recovered or recycled packaging waste shall be measured using a natural humidity rate of the packaging waste comparable to the humidity rate of equivalent packaging put on the market.*
>
> *Corrections shall be made to measured data relating to the weight of recovered or recycled packaging waste, if the humidity rate of that packaging waste regularly and significantly differs from that of packaging placed on the market and if this factor risks leading to substantial over- or underestimates of packaging recovery or recycling rates.*
>
> *Those corrections shall be limited to exceptional cases, caused by specific climatic or other conditions.*
>
> *Significant corrections shall be reported in the descriptions regarding the data compilation in the data quality check report.*
>
> *2. For the purposes of calculating and verifying attainment of the targets set in points (a) to (e) of Article 6(1) of Directive 94/62/EC, the weight of recovered packaging shall, as far as is practical, exclude non-packaging materials collected together with the packaging waste.*

[11] Annex II of the revised Waste Framework Directive and Article 6a of Directive 94/62/EC

Corrections shall be made to the data relating to the weight of recovered or recycled packaging waste, if non-packaging materials in the waste sent to an effective recovery or recycling process risk leading to substantial over- or underestimates of packaging recovery or recycling rates.

No corrections shall be made in the case of small amounts of non-packaging materials, or for such contamination as can regularly be found in packaging waste.

Significant corrections shall be reported in the descriptions regarding the data compilation in the data quality check report."

Additional rules (as described in Section 3.2) apply for recycled packaging waste, and are somewhat more precise (see Article 6c (e) and (f) of Decision 2005/270). However, to ensure consistency of reported data within the reporting table, recovery data should be adjusted in the same manner as recycling data to ensure all data relate to the same approach for reporting clean and dry packaging only. If there is any deviation from reporting made using a consistent methodology, this should be clearly outlined in the quality report under question 18.6.2.

3.3.2 Guidance on classification of specific treatment processes

There are various treatment processes in which some or all of the waste is not recycled back into new products, in other words, any treatment process that is not solely material recycling. These include waste used as a fuel, or other means to generate energy, as well as hybrid processes in which some waste is concurrently used to generate energy and is included in the final product. These processes include treatment which is defined as 'chemical recovery', as detailed further in Appendix A.2.1.1.2. In this section we set out general guidance for the appropriate reporting of waste treated in these processes.

Article 6a(5) of the Directive, sets out the requirement that any end-of-waste material which is to be used as fuel, or as other means to generate energy, cannot be counted as recycling:

"The amount of packaging waste materials that have ceased to be waste because of a preparatory operation before being reprocessed may be counted as recycled provided that such materials are destined for subsequent reprocessing into products, materials or substances to be used for the original or other purposes. However, end-of-waste materials to be used as fuels or other means to generate energy, or to be incinerated, backfilled or landfilled, shall not be counted towards the attainment of the recycling targets."

Furthermore, Article 6c(1)(h) of Decision 2005/270 also states that if the principal use of a packaging waste material is as fuel or energy generation, then nothing should be counted as recycling.

"Where packaging waste materials enter recovery operations whereby those materials are used principally as a fuel or other means to generate

energy, the output of such operations that is subject to material recovery, such as the mineral fraction of incineration bottom ash or clinker resulting from co-incineration, shall not be included in the amount of packaging waste recycled, […].”

This also applies for any energy generated from the waste that is used to power the recycling process itself.

Article 6c(1)(i) further sets out that where the principal use of a packaging waste material is neither as a fuel nor to recover the target material, then a mass balance approach should be applied.

> *“Where packaging waste materials enter recovery operations whereby those materials are not principally used either as a fuel or other means to generate energy, or for material recovery, but result in output that includes recycled materials, fuels or backfilling materials in significant proportions, the amount of recycled waste shall be determined by a mass balance approach which results in taking account only of waste materials that are subject to recycling.”*

In such circumstances, it would not be appropriate to count the total input of waste feedstock into these processes as ‘recycling’. Some outputs from the process are fuels, which should therefore not be accounted for as recycling but as energy recovery. This could also apply for any energy generated from the waste that is used to power the recycling process itself. Recommended principles and steps to define a calculation point and measure packaging waste undergoing these processes are described further in Appendix A.2.1.1.2.

An example of these rules is applied to packaging waste in blast furnaces.

This industrial process consists of using treated packaging waste to substitute coke or heavy oil as a reduction agent in blast furnaces. The treated packaging waste, when burned in a controlled atmosphere, releases carbon (C), carbon monoxide (CO), hydrogen gas (H_2) and heat. Carbon monoxide and hydrogen are used as a reduction agent to convert metal ores into pure metals, by capturing the oxygen atoms from metal oxides and releasing carbon dioxide to the atmosphere. According to Article 6c(1)(h) and Article 6c(1)(i) of Decision 2005/270, recycling does only apply to the part of the waste that is not used in energy recovery.

The part of waste used in blast furnaces which can be accounted for as recycling according to Article 6a(5) of the Directive, shall be calculated using a mass balance (see Appendix A.2.1.1.2 for a more detailed explanation of this process).

3.4 Reusable packaging

This section sets out the required criteria and conditions for reporting on reusable packaging, and an overview of the methodologies for collecting this data. It relates to reporting in Tables 1, 1a, 2 and 3 and to subsections 13.1; 13.1.2; 13.2; 13.3 and 13.3.5 of the national ESMS metadata file.

Further information is included in Appendix A.3.1 as referenced throughout this section. A summary of key terminology is provided in Appendix A.3.1, and a more detailed overview of relevant legislation is provided in Appendix A.3.2.

3.4.1 Conditions for packaging to qualify as 'reusable'

It is essential to consider the conditions under which packaging qualifies as 'reusable'. In Article 3(2)a of the Directive, 'reusable packaging' is defined as:

> "…*packaging which has been conceived, designed and placed on the market to accomplish within its lifecycle multiple trips or rotations by being refilled or reused for the same purpose for which it was conceived*;"

More detailed conditions are set out in Section 4.1 of EN Standard 13429:2004, as detailed in Appendix A.3.3. The quote above refers to the concept of a 'rotation', which is defined in Article 2(1)(f) of Decision 2005/270/EC:

> *"…rotation means a trip performed by reusable packaging from the moment it is placed on the market together with the goods it is intended to contain, protect, handle, deliver or present, to the moment it is sent back for reuse in a system to reuse packaging with a view to its repeated placing on the market together with the goods".*

During a rotation, after reusable packaging is used and subsequently collected, it may need reconditioning before it can be refilled and used again.

It is important to note that reconditioning is not considered to be preparing for reuse. Preparing (or 'preparation') for reuse is specifically referred to in Article 3(16) of Directive 2008/98/EC as:

> *"…checking, cleaning or repairing recovery operations, by which products or components of products that* ***have become waste*** *are prepared so that they can be reused without any other pre-processing".*

Article 3(1) of Directive 2008/98/EC defines 'waste' *as "any substance or object which the holder discards or intends or is required to discard"*.

Thus, as further described in Appendix A.3.3, unless the packaging **becomes waste** then it is not preparation for reuse. By this definition, in most reusable packaging schemes, packaging does not become waste prior to reuse.

Finally, only established arrangements (organisational, technical and/ or financial) that ensure the possibility of reuse shall be considered as "systems for reuse" for the purposes of reporting. These include open-loop systems (systems in which reusable packaging is circulated among unspecified companies) and closed-loop systems (systems in which reusable packaging is circulated by a company or within a known group of co-operating companies). These are further described in Appendix 3.1.4, along with some examples of reusable packaging types.

So-called **hybrid systems in which packaging remains with the end user without a redistribution system leading to commercial refilling shall not be considered or reported on**, as it does not fully comply with the legal conditions for reusable packaging listed above. One example of **hybrid systems** are **polypropylene reusable bags** independently if they are replaced by another with no additional charge when they cannot be reused anymore.

3.4.2 Guidelines for correct reporting of reusable packaging

The revised Decision 2005/270 clarifies in Article 3(2) the following:

> "*Reusable packaging shall be considered to be placed on the market when it is made available for the first time, together with the goods it is intended to contain, protect, handle, deliver or present.*
>
> *Reusable packaging shall not be considered packaging waste when it is sent back for reuse. Reusable packaging shall not be considered to be placed on the market as packaging when it has been reused with a good and is made available again.*
>
> *Reusable packaging discarded at the end of its useful life shall be considered packaging waste.*
>
> *For the purposes of this Decision, packaging waste generated in a particular Member State from reusable packaging may be deemed to be equal to the amount of reusable packaging placed on the market within that Member State in the same year*"

Following from this legislation, the following points must be considered by Member States when reporting.

- As for other (non-reusable) packaging (see Section 3.1), Member States may assume that **packaging placed on the market in any given year is equivalent to waste generated in that same year**.
- **To avoid double counting, reusable packaging should not be reported as waste, or be considered (for the purposes of reporting) to be placed on the market when it is reused** (i.e. when it is 'rotated'). Only when it is made available for the first time should reusable packaging be considered as placed on the market; and only at the end of its useful life should reusable packaging be reported as packaging waste.

3.4.3 Collecting placed on the market data

Data collection is required for reporting placed on the market data in Table 3. Placed on market data for reusable packaging is also required for reporting of waste generation of (all) packaging in Table 1 – this is unless the data reported in Table 1 is based on direct measurements of waste generated (that is, not based on placed on market data, see Section 3.1.2).

In general, the primary method of data gathering is via reporting by producers to PROs. This approach, as well as alternative data sources, recommended corrections/estimates, and methods for verification/audit, sources are described in Section 3.1.1.

It is important to assess if all economic operators placing reusable packaging on the market are included in the registry of the EPR scheme or national authorities collecting the data on behalf of the Member State. For the purpose of reporting to Member States, economic operators need to clearly distinguish between reusable and single-use packaging, and between sales and other (grouped and transport) packaging. Economic operators should include only reusable packaging which is part of a closed or open loop system as defined by EN Standard 13429:2004 in their reporting on reusable packaging (see Appendix A.3.4).

Finally, we note that the guidelines for improving placed on the market data, adjustments for imports and exports, data correction and verification of placed on the market data as described in sections 3.1.1.3 to 3.1.1.6 should be followed.

3.4.4 Collecting reusable packaging rotations data

This data is required for reporting rotations per year data in Table 3. The number of rotations will be different for different reusable packaging types (e.g. plastic bottles will have a different number of rotations than plastic containers or plastic crates). It is therefore necessary that Member States conduct a more detailed collection of data on a disaggregated level, but report to Eurostat the aggregated data as required in Table 3. For the aggregated amount, rotations of reusable packaging placed on the market in previous years which has not yet become waste would need to be considered in this calculation as well.

Typically, operators of closed loop systems and businesses participating in open loop systems have information on the amount of packaging that is being refilled and placed on the market. It is recommended that the Member States require economic operators to report data on the rotation of reusable packaging in a detailed questionnaire, as shown in Appendix A.3.5. Some economic operators might claim that their data are economically sensitive, and that Member States should take measure to ensure confidentiality. In such cases, it is recommended that an independent validation procedure be established.

Data sources include:

- Closed loop systems operators:
    - Deposit return system operators – e.g. those placing refillable beverage containers on the market;
    - Pooling companies renting out reusable packaging – e.g. those undertaking pallet pooling;
    - Large supermarket chains – e.g. those with in-house pooling systems for the reuse of plastic crates;
- Open loop systems – to collect data from open loop systems, Member States could potentially implement ‘transfer note’ systems in which economic actors are required to record and report any transfer in ownership of reusable packaging. If data for open loop systems is not available, then data from industry associations and/or surveys of economic actors could be used as the basis for estimating the number of rotations.

It is important that the 'calculation period' – the reference year for which packaging and packaging waste data is reported – is clearly understood by the relevant economic operators. The 'measurement point' for capturing the rotation should be selected to provide the greatest amount of information for the calculation and to allow differentiation between new and reused packaging. For example, measurement points can be set at the point of sale, point of refilling, completion of reconditioning, warehousing, or at any other convenient point in the reuse system.

Member States should also note the proposed methodology (as set out in EN Standard 13429:2004) for the calculation of rotations set out in Appendix A.3.4.4.

3.5 Composite packaging

Particular considerations are required for composite packaging when reporting all types of packaging waste data. Article 6c(2) of Decision 2005/270 states the following:

> *"composite packaging and other packaging composed of more than one material shall be calculated and reported per material contained in the packaging. Member States may derogate from this requirement where a given material constitutes an insignificant part of the packaging unit, and in no case more than 5 % of the total mass of the packaging unit."*

Therefore, for the purposes of reporting waste data, the amounts generated or recycled of each material should be reported under the respective packaging material category. Where the derogation is applied, the mass of each given material constituting less than 5% of the packaging item need not be calculated and reported separately, but rather can be reported under the predominant material in that packaging unit by weight. Note that this principle applies to waste generation data gathered via both reporting of placed on market data (Section 3.1.1) and waste composition analysis (Section 3.1.2), and to reporting of recycling data.

To illustrate the application of this rule, consider a composite packaging unit with the following composition:

> *75% paperboard, 21% plastic, and 4% aluminium*

If the derogation were to be applied in this case, then the 4% aluminium would be assigned to the predominant material (i.e. paperboard) so the unit weight should be reported as x 21% for plastic and x 79% for paperboard.

If a product has two exactly equal 'predominant materials' (e.g. 48% plastic, 48% paperboard, with 4% aluminium), the <5% material should be apportioned equally between the two predominant materials (so the weights of both plastic and paperboard would be the unit weight x 50%).

It should be noted, however, that this method of allocation is a derogation rather than a requirement, and that Member States should calculate and report material weights as accurately as possible in all cases if known. Doing so will make the resulting statistics more accurate.

In addition, if reporting by single material for waste generation, recycling should also be reported by single material. In this case, the calculation point of each material must be applied. Consequently, if the minor components of composite packaging are discarded as non-targeted material in a recycling operation and end up in energy recovery or are landfilled, they are not to be reported as recycled. To illustrate this, consider the above example:

- Waste generated would be reported as 75% paper, 21% plastic and 4% aluminium.
- Recycling would have to be reported as 75% paper, 21% plastic and 4% aluminium **but only if the paper, plastic and aluminium was measured at the respective calculation points.** In case the aluminium is discarded as non-targeted material in the recycling operation of plastic and is not recycled, it is not to be reported as recycled.

If, however, the derogation is applied for waste generation, the same approach should be used for calculating recycling.

The application of this derogation should be detailed in the quality report under question 18.3.2 (for waste generation data) and/or under question 18.5.5. (for recycling data).

4 Guidance for the completion of the reporting tables

This section of the guidance will assist Member States in completing the reporting tables in the Excel questionnaire.

Once the required fields of each table are filled in, **Member States must verify the data before submitting the questionnaire**. This confirms that there are no pending errors (see 'ErrorLog' worksheet), and is done by clicking on the button 'Validate questionnaire' on the top left-hand corner of each table worksheet. It is important to confirm that there are no pending errors, since a questionnaire with errors (marked in the Excel file as red shadowed cells) will be rejected.

4.1 Completing Table 1 on generation and recycling of packaging waste

Table 1 of the questionnaire requires data on waste generation, recycling, repair of wooden packaging and recovery of packaging to be completed. An image of Table 1 can be found in Figure 9 below.

Below the table, the subsequent sections provide a summary of how to complete the table for each key component:

- Section 4.1.1 'Waste generation';
- Section 4.1.2 'Recycling';
- Section 4.1.3 'Repair of wooden packaging'; and
- Section 4.1.4 'Recovery'.

Note that, as indicated above, Table 1 is mandatory for reporting on packaging and packaging waste, and must be used by all Member States to report data under the new calculation rules.

Figure 9: Table 1 – Generation and recycling of packaging waste

Validate questionnaire	Restore table color	Unlock formulas	TABLE 1. Generation and recycling of packaging waste as established by Commission Decision 2005/270/EC as last amended by Commission Implementing Decision 2019/665[1] (in tonnes)

Country:	
Reference year:	2021

Packaging waste material	Generation			Recycling (The total weight of waste of each material type, at the relevant calculation points)												Repair			Recovery					
	Waste generation [2]	Standard footnotes	Explanatory footnote	Recycling in the Member State	Standard footnotes	Explanatory footnote	Recycling in other Member States	Standard footnotes	Explanatory footnote	Recycling outside the EU	Standard footnotes	Explanatory footnote	Recycling (Total)	Standard footnotes	Explanatory footnote	Repair of wooden packaging	Standard footnotes	Explanatory footnote	Energy recovery[3]	Standard footnotes	Explanatory footnote	Other recovery [4]	Standard footnotes	Explanatory footnote
Plastic																								
Wood																								
Metal (total) [5]																								
Ferrous metal																								
Aluminium																								
Ferrous metal from IBA [6]																								
Aluminium from IBA [7]																								
Glass																								
Paper and cardboard																								
Other																								
Total [8]																								

Notes:

Validate questionnaire: Before submitting the questionnaire, you have to validate the data clicking on the button 'Validate questionnaire' on the top left-hand corner of the table. It is of the utmost importance to confirm that there are no pending errors (see 'Errorlog' worksheet), since a questionnaire with errors (red shadowed cells) will be rejected.

Cell shading:

White: Data provision is mandatory.
Light grey: The calculation of data is automatic. They can be edited after unlocking the cell with the button "Unlock formulas".
Light grey: The calculation of data is automatic. They can not be edited.
Light orange: Footnotes (only to be filled-in when relevant)
Black: Not applicable.
Light purple shaded boxes: reporting is mandatory only to Member States that include those amounts in the recycling rates. Member States that report on repair of wooden packaging **SHALL NOT** include these amounts in total recycling or in total waste generated or in any other white box! Instead, please indicate in the sheet Metadata if you wish to include the amounts in your recycling rates. The calculation of the adjusted recycling rates will be conducted by the Commission according to the method set out in the guidance document.

[1] Commission Decision 2005/270/EC establishing the formats relating to Directive 94/62/EC on packaging and packaging waste as last amended by Commission Implementing Decision 2019/665

[2] The amounts reported shall exclude the amount of wooden packaging repaired and of metals from IBA. For repair of wooden pallets, the Commission will calculate the adjusted recycling rates separately.

[3] The amount reported includes all types of energy recovery. The amount reported shall include both energy recovery at R1 facilities and (other) incineration at waste incinerators with energy recovery.

[4] This excludes repair of wooden packaging, recycling and energy recovery and includes backfilling.

[5] The 'Metal (total)' row should be equal to the sum of the 'Ferrous metal' and 'Aluminium' rows.

[6] Ferrous metals recycled after their separation from incineration bottom ash shall be reported separately here and shall be included in the row for reporting ferrous metals.

[7] Aluminium recycled after separation from incineration bottom ash shall be reported separately here and shall be included in the row for reporting aluminium.

[8] The 'Total' row should be a sum of all the amounts given in the separate rows within the table (except only one of either the 'Metal (total)' or 'Ferrous metal' and 'Aluminium' rows, to ensure there is no double counting).

4.1.1 Waste generation

The following points of guidance are additional to the instructions provided in the Excel template for reporting against Table 1 in Annex I of Decision 2005/270 (reporting on the recycling targets set in Article 6 of the Directive).

There are two main approaches to calculating packaging waste generated: based on packaging placed on the market (PoM), or based on waste analysis.

Reporting by either of these approaches should cover every material of packaging. However, there may be a derogation to this rule applied to composite packaging. Composite packaging should be reported as provided in Section 3.5, and not included in the “Other packaging” row.

Also, note that compostable or biodegradable plastics should be included in the total ‘Plastics’ figures, not ‘Other’. The “Other packaging” row should only be used if the packaging material is another material category not listed (e.g. fabric etc.).

4.1.2 Recycling

As discussed in Section 3.2.1, the total weight of waste recycled must be equal to the weight of waste at the calculation points given in Annex II of Decision 2005/270.

As required under the new calculation rules, recycling data should be split into three columns depending on the location of the recycling activities (recycling in the Member State, recycling in other Member States and recycling outside the EU); this is reflected in the format of reporting required in Table 1.

Member States should note that any end-of-waste material which is to be used as fuel, or as other means to generate energy, cannot be counted as recycling, as defined by Article 6a(5) of Decision 2005/270 (see Section 3.3.2 for more details).

Metal packaging and incineration bottom ash

Member States can include ferrous metal or aluminium from incineration bottom ash (IBA) in the recycled amounts. Further guidance on how to comply with the methodological requirements is set out in Appendix A.2.3.

The 'Metal (total)' row should be equal to the sum of the 'Ferrous metal' and 'Aluminium' rows (as per footnote 7 to Table 1 in the Excel file). However, other metals which do not fit under one of these categories should be reported, together with the sum of ferrous metals and aluminium, in the ‘Metal (total)’ row, and an explanatory footnote should be added. To do so, use the ‘Unlock formular’ button in the questionnaire and add the total amount of metals by hand into the relevant ‘Metal (total)’ cell. Ferrous metal and/or aluminium separated from incinerator bottom ash (IBA) should be reported separately in the 'Ferrous metal' and/or 'Aluminium' rows (as per footnotes 8 and 9).

The ‘Total’ row should be a sum of all the material amounts given in the separate rows within the table and other metals added by hand, with the exception of the “Ferrous metal from IBA” and “Aluminium from IBA” rows, to ensure there is no double counting.

The example presented in Figure 10 shows how the cells in Table 1 should be filled in regarding metals from IBA. Eurostat will calculate the recycling rate as total recycling / generation.

Figure 10: Example of Table 1 regarding metals from IBA

Packaging waste material	Generation			Recycling (*The total weight of waste of each material type, at the relevant calculation points*)				
	Waste generation [a]	Standard footnotes	Explanatory footnote	Recycling in the Member State	Standard footnotes	Explanatory	Recycling in	Explanatory footnote
Plastic								
Wood								
Metal (total) [5]	100			80				
Ferrous metal	80			70				
Aluminium	20			10				
Ferrous metal from IBA [6]				10				
Aluminium from IBA [7]				5				
Glass								
Paper and cardboard								
Other								
Total [4]	100			80				

Metal (total) (80) = Ferrous metal (70) + aluminium (10)

= Ferrous metal from IBA (10) + ferrous metal not from IBA (e.g. 60)

= Aluminium from IBA (5) + Aluminium not from IBA (e.g. 5)

Total (80) = Metal (total) (80) OR Ferrous metal (70) + aluminium (10) + other materials

Recycling Rate = Total Recycling / Generation e.g. = 80 / 100 = 80%

4.1.3 Repair of wooden packaging

According to Article 6b(1) of Decision 2005/270:

> *"Where a Member State takes into account the amounts of wooden packaging that is repaired for reuse in the calculation of the targets laid down in point (f), point (g)(ii), point (h) and point (i)(ii) of Article 6(1) of Directive 94/62/EC, the amount of wooden packaging that is repaired for reuse shall be added to both the generated packaging waste and the recycled packaging waste."*

If repair of wooden packaging is to be included in the table, this must be included only in the respective purple shaded cells, in the Wood and Total rows under the 'Repair' column. The amount of repaired wooden packaging **should not** be added to the totals under the Waste generation and recycling columns in the table itself. This will be done automatically by Eurostat when calculating the overall recycling rates.

The reported amount will then be considered for calculating the recycling rate by including it in the numerator and the denominator:

Recycling rate = (recycling + repair) / (waste generated + repair)

The data for waste generation shall be reported excluding repair of wooden pallets in all cases. An example of how to fill out the table is shown in Figure 11.

Figure 11: Example of Table 1 regarding repair of wooden packaging

Packaging waste material	Generation			Recycling				Repair		
	Waste generation [a]	Standard footnotes	Explanatory footnote	Rec… the …		ecycling in er Member States	Standard footnotes	Explanatory footnote	Repair of wooden packaging	Standard footnotes	Explanatory footnote
Plastic											
Wood	100			20					200		
Metal (total) [5]											
Ferrous metal											
Aluminium											
Ferrous metal from IBA [6]											
Aluminium from IBA [7]											
Glass											
Paper and cardboard											
Other											
Total [4]	100			20					200		

Does not include repair of wooden pallets

Recycling rate = (recycling (20) + repair (200)) / (waste generated (100) + repair (200)) = 220 / 300 = e.g. 73%

Only include repair of wooden pallets in these two cells

Does not include repair of wooden pallets

4.1.4 Recovery

Regarding **energy recovery**, please fill in the table with the total weight of waste of each material type, where waste of that type has actually been subject to energy recovery. As highlighted in footnote 4 to the table, the amount reported should include all types of energy recovery: both energy recovery at R1[12] facilities and (other) incineration at waste incinerators with energy recovery.

Regarding **other recovery**, please fill in the table with the total weight of waste of each material type, where waste of that type has actually been subject to other recovery. As highlighted in footnote 5 to the table, only recovery operations other than Energy Recovery and Recycling should be included in this column.

Member States should note that if the principle use of a waste material is as fuel or energy generation, then nothing should be counted as recycling, and this should be recorded under energy recovery. Where the principal use is neither as a fuel nor to recover the target material, then a mass balance approach should be applied (to understand the proportion of recycling, energy recovery and other recovery). Further details on this are provided in Section 3.3.

[12] Annex II of the revised Waste Framework Directive and Article 6a of Directive 94/62/EC

4.2 Completing Table 1a on reporting attainment of the old recycling targets

Member States should only use Table 1a if they still wish to continue reporting on the attainment of the old targets until 2025 (inclusive), based on the old calculation rules. The main differences in the new and old reporting rules (relevant to Table 1 and Table 1a respectively), with respect to the attainment of the recycling targets, are summarised in Appendix 2.

In Table 1a, for plastic materials contained in packaging waste, it is only possible to report the material that is recycled back into plastics. This is because attainment against the old targets for plastics, as set out in Article 6(1) point (e) (iv) of the Directive, counts exclusively material that is recycled back into plastics.

When completing Table 1a, both the packaging waste generated and packaging waste recycled columns should be filled in (a figure of this table is provided in Figure 12 below).

Member States should use the flow chart presented in Figure 2 to help guide them through the process of completing Table 1a where appropriate. It presents the decisions around reporting that Member States need to make and the required actions that follow from these decisions, in terms of which tables they should complete; it also presents the outcomes in terms of how compliance will be measured.

Figure 12: Table 1a - Reporting attainment of old targets based on old calculation rules

Validate questionnaire | Restore table color | Unlock formulas

TABLE 1a. Generation and recycling of packaging waste calculated according to the old rules as set out in Articles 3, 4 and 5 of Decision 2005/270/EC [1] for proving compliance with the old recycling targets in Article 6 (1) of Directive 94/62/EC (in tonnes) - to be filled in only by the Member States wanting to prove compliance with the old targets until 2025 (and beyond) using the old rules.

Country:	
Reference year:	**2021**

Material		Packaging waste generated according to the old calculation rules	Standard footnotes	Explanatory footnote	Packaging waste recycled according to the old calculation rules [2]	Standard footnotes	Explanatory footnote
Glass							
Plastic							
Paper and board							
Metal	Aluminium						
	Steel						
	Total						
Wood							
Other							
Total							

Notes:

This table is only for those Member States wishing to report against the old recycling targets in Article 6 of Directive 94/62/EC using the old calculation rules.

Recycling rate (%) for the purpose of Article 6(1) of Directive 94/62/EC will be calculated as packaging waste recycled divided by packaging waste generated x 100

Validate questionnaire: Before submitting the questionnaire, you have to validate the data clicking on the button 'Validate questionnaire' on the top left-hand corner of the table. It is of the utmost importance to confirm that there are no pending errors (see 'Errorlog' worksheet), since a questionnaire with errors (red shadowed cells) will be rejected.

Cell shading:

White: Data provision is mandatory for those Member States wishing to report against the old recycling targets in Article 6 of Directive 94/62/EC using the old calculation rules (only if they have reported data according the new calculation rules in Table 1)
Light grey: The calculation of data is automatic. Can be edited after unlocking the cell with the button "Unlock formulas".
Light grey: The calculation of data is automatic. Cannot be edited.
Light blue: provision of data is voluntary.
Light orange: Footnotes (only to be filled-in when relevant)

[1] Commission Decision 2005/270/EC establishing the formats relating to Directive 94/62/EC on packaging and packaging waste

[2] For plastic materials contained in packaging waste, you must only report material that is recycled back into plastics.

4.3 Completing Table 2 for adjusting the recycling targets based on 3-yearly average share of reusable sales packaging

Table 2 needs to be completed if a Member State wants to make use – in accordance with Article 5(2) of the Directive – of the adjusted level for the recycling targets (Article 6(1), points (f) to (i)), which are required to be met no later than 31 December 2025 (with additional, higher targets set for 2030).

Article 5(2) of the Directive states:

> *"2. A Member State may decide to attain an adjusted level of the targets referred to in points (f) to (i) of Article 6(1) for a given year by taking into account* ***the average share, in the preceding three years, of reusable sales packaging placed on the market for the first time and reused as part of a system to reuse packaging.***
>
> *The adjusted level shall be calculated by subtracting:*
>
> *(a) from the targets laid down in points (f) and (h) of Article 6(1), the share of the reusable sales packaging referred to in the first subparagraph of this paragraph in all sales packaging placed on the market, and*
>
> *(b) from the targets laid down in points (g) and (i) of Article 6(1), the share of the reusable sales packaging referred to in the first subparagraph of this paragraph, composed of the respective packaging material, in all sales packaging composed of that material placed on the market.*
>
> ***No more than five percentage points*** *of such share shall be taken into account for the calculation of the respective adjusted target level."*

In principle, Table 3 (in columns #4 and #7, see Section 4.4) contains the necessary information required to calculate the share of reusable sales packaging for completing Table 2. Completion of Table 3 is mandatory from the reference year 2020 onwards. Consequently, from reference year 2023 onwards, the necessary information to complete Table 2 for three previous years can be derived from Table 3 as reported for the previous reference years.

If a Member State already wishes to see how far it is from meeting the 2025 recycling targets, it is possible to complete the data for Table 2 for the three previous reference years (2019, 2018, 2017) if such data is available. Filling in these earlier years is voluntary; however, if Member States do decide to complete Table 2, then the data reported must be coherent with the data reported in Table 3. From reference year 2023 (reporting due by 30 June 2025) onwards, the cells of Table 2 shall not be filled in by the Member States but will be calculated automatically by Eurostat, based on the information reported by the Member States in Table 3 (columns #4 and #7, see Section 4.4) in the three previous years.

Updating values in Table 2 for reference year 2023 onwards

For reference year 2023 onwards (reported in 2025), for which Table 2 will be completed automatically by Eurostat from the values reported in Table 3, MS must report updated values for Table 3 (notably columns #4 and #7) if they want to report changes to the share of reusable sales packaging in Table 2 for any relevant previous year. Please contact Eurostat about the ways to report such revisions to previously submitted data.

Figure 13: Table 2 - Adjusted level of the targets in accordance with Article 5(2) of Directive 94/62/EC

Validate questionnaire | Restore table color

Table 2. Adjusted level of the targets in accordance with Article 5(2) of Directive 94/62/EC [1]

Country:

Reference year: **2021**

1	2	3	4	5
Packaging waste material	**Share of reusable sales packaging in all sales packaging year 2018 (%)**	**Share of reusable sales packaging in all sales packaging year 2019 (%)**	**Share of reusable sales packaging in all sales packaging year 2020 (%)**	**Average share of reusable sales packaging in the three years preceding year 2021**
Plastic				
Wood				
Ferrous metal				
Aluminium				
Glass				
Paper and cardboard				
Total				

Notes:

This table can be completed if you want to make use – in accordance with Article 5(2) of Directive 94/62 - of the adjusted level for the recycling targets in Article 6(1)(f) to (i) of Directive 94/62. These targets apply from reference years 2025 respectively 2030. In principle, Table 3 contains the necessary information for completing Table 2. Then, from reference year 2023 onwards, the necessary information to complete Table 2 for three previous years can be derived from Table 3 as reported for the previous reference years. If a Member State wishes to see the distance to target for the 2025 targets already before, it is possible to complete the data for Table 2 for the three previous reference years (2017, 2016, 2015) if such data are available. Filling in these earlier years is voluntary.

Validate questionnaire: Before submitting the questionnaire, you have to validate the data clicking on the button 'Validate questionnaire' on the top left-hand corner of the table. It is of the utmost importance to confirm that there are no pending errors (see 'Errorlog' worksheet), since a questionnaire with errors (red shadowed cells) will be rejected.

Cell shading:

Light grey: the calculation of data is automatic and represents the simple average of columns 2, 3 and 4.
Light blue: data is mandatory only for the material for which the Member State has decided to achieve an adjusted target.

[1] Directive 94/62/EC on packaging and packaging waste as last amended by Directive 2018/852.

4.4 Completing Table 3 on reusable packaging

Table 3 as established by Decision 2005/270 is displayed in Figure 14.

According to Article 12(3)(a) of the Directive, Member States had to report data on reusable packaging for the first time for the reference year 2020. Subsequent reporting is mandatory on a yearly basis.

In columns #2 and #4 (as well as #3 and #5 voluntarily), packaging placed on the market for the first time is to be reported. This includes single-use as well as reusable packaging placed on the market for the first time. This data should be equal to the values reported in column #2 in Table 1.

“All packaging” (columns #2 and #3) includes transport, grouped and sales packaging, while in columns #4 and #5 only sales packaging must be reported.

In columns #6 and #7, only reusable packaging placed on the market for the first time has to be reported.

The ratios of column #7 to column #4 represent the share of reusable sales packaging. These values will serve as inputs to the calculation of the share of reusable sales packaging in Table 2 if a Member State wishes to adjust the level of the recycling targets in accordance with Article 5(2) of the Directive (see Section 4.3).

Data on tonnages collected by, or calculated based on, the detailed questionnaire (see Appendix A.3.5) for each sub-category of reusable packaging are to be summed up and reported in Table 3 columns #8 and #10. Information on the number of rotations can also be provided (voluntarily) in columns #9 and #11.

The values in columns #8 and #10 represent the total tonnage of reusable packaging rotated. This is equivalent to the number of rotations that reusable packaging completes in a given year multiplied by their mass. The data provided should account for rotations of all reusable packaging currently in circulation, including that placed on the market for the first time (in the current reporting year), and that placed on the market in previous years. Guidance on collecting this information is provided in Section 3.4.4.

The number of rotations will be different for different sub-categories of each reusable packaging type: e.g. individual plastic water bottles may show different numbers of rotations than plastic crates or containers. Therefore, to complete columns #8 and #10, it is suggested that Member States conduct a more detailed collection of data on a disaggregated level, conduct national validation, but report to Eurostat the aggregated data (see Section 3.4.4).

Figure 14: Table 3 - Reporting on reusable packaging

Validate questionnaire | Restore table color

TABLE 3. Reporting on reusable packaging as established by Commission Decision 2005/270/EC as last amended by Commission Implementing Decision 2019/665 (1)

Country:	
Reference year:	2021

1	2			3			4			5			6			7			8			9			10			11		
Packaging material	**Packaging placed on the market for the first time**												**Reusable packaging placed on the market for the first time**						**Rotations per year (4)**											
	All packaging (2)						**Sales packaging (3)**						**All reusable packaging**			**Reusable sales packaging**			**All reusable packaging**						**Reusable sales packaging**					
	(tonnes)	**Standard footnotes**	**Explanatory footnote**	**(units)**	**Standard footnotes**	**Explanatory footnote**	**(tonnes)**	**Standard footnotes**	**Explanatory footnote**	**(units)**	**Standard footnotes**	**Explanatory footnote**	**(tonnes)**	**Standard footnotes**	**Explanatory footnote**	**(tonnes)**	**Standard footnotes**	**Explanatory footnote**	**(tonnes) (5)**	**Standard footnotes**	**Explanatory footnote**	**(number)**	**Standard footnotes**	**Explanatory footnote**	**(tonnes) (5)**	**Standard footnotes**	**Explanatory footnote**	**(number)**	**Standard footnotes**	**Explanatory footnote**
Plastic																														
Wood																														
Ferrous metal																														
Aluminium																														
Glass																														
Paper and cardboard																														
Other																														
Total																														

Notes:

Validate questionnaire: Before submitting the questionnaire, you have to validate the data clicking on the button 'Validate questionnaire' on the top left-hand corner of the table. It is of the utmost importance to confirm that there are no pending errors (see 'Errorlog' worksheet), since a questionnaire with errors (red shadowed cells) will be rejected.

Cell shading:

White: Data provision is mandatory from 2022 (reference year 2020)
Light grey: The calculation of data is automatic. Cannot be edited.
Light blue: provision of data is voluntary.
Light orange: Footnotes (only to be filled-in when relevant)

(1) Commission Decision 2005/270/EC establishing the formats relating to Directive 94/62/EC on packaging and packaging waste as last amended by Commission Implementing Decision 2019/665

(2) This means all reusable and single-use packaging comprising sales, transport and grouped packaging

(3) This means reusable and single-use sales packaging.

(4) This means the number of rotations that reusable packaging completes in a given year.

(5) This means the number of rotations that reusable packaging completes in a given year multiplied by their mass.

5 Guidance for the completion of the quality report

Completion of the quality report is a reporting requirement under the Directive. It is therefore essential that the quality report is completed thoroughly.

Guidance notes for completing the quality report are included alongside the relevant questions in the ESS Metadata Handler, and can be visualised by clicking on the letter "G" next to the question. Further instructions and examples are provided here, with the relevant question number referenced.

5.1 Packaging waste generated and recycled

Verification of data on packaging waste generated (question 3.1.6) and verification of data on packaging recycling (question 3.2.10)

Pursuant to Article 6f(1) of Decision 2005/270, the amount of packaging waste generated shall be verified and cross-checked, and "*Member States shall inform the Commission of such verification carried out and, where appropriate, of any significant inconsistencies identified and corrective measures planned or taken*".

Verification methods include cross-checks, time-series checks and audits. As stated in the instructions provided in the quality report template, countries should use the final column of questions 18.4.4 and 18.4.5 ('verification process') to provide details of how they have applied these methods for each material.

In responding to both question 18.4.4 and question 18.4.5, the following should be included:

- If cross-checks are conducted, please describe which other datasets (national or European or other) are used for the cross-check, what the nature of the check is and any margins of error or tolerances identified as acceptable or not acceptable between the data being cross-checked.
- For time series checks, please explain the period over which the checks take place, and any other necessary information.
- Related to 'audits', please describe whether they are voluntary or mandatory. If mandatory, please indicate the legal basis for the audit, the nature of the entities being audited and doing the auditing, the level of training or guidance given to the auditors, and the mechanisms used to fund the audits, including who pays whom. Please also describe any penalties or further actions resulting from non-compliance with such audits.

5.2 Composite packaging

Description of the methodology to determine, per material, the amount of recycled materials contained in composite packaging or packaging composed of multiple materials, and information on any exemptions applied for materials constituting less than 5% of the total mass of the packaging unit (question 18.5.5)

A range of methods could be used to determine the composition of wastes composed of multiple materials at any calculation point, so that the amounts are recorded under the respective components of packaging waste, as set out in the Table 1 of the questionnaire.

For example, to find out the composition of the products being placed on the market, a survey could be conducted among producers whose products may become waste. The result could be assumed equivalent to the composition of such products when they become waste. The composition would then be applied to the total weight of waste composed of multiple materials, to calculate the amount of waste recycled per material.

Where exemptions have been applied for composite materials constituting less than 5% of the total mass of the packaging unit, all such exemptions should be listed in the response.

5.3 Variation from the data submitted for the previous data year

Explanation detailing the causes of the tonnage difference for any component of packaging waste generated and recycled which shows greater than a 10% variation from the data submitted for the previous data year (question 15.2)

For each waste category defined in Table 1, e.g. metals, glass, plastic, paper and cardboard, etc., calculate the % variation in waste treated from the current year of reporting relative to the previous. For example:

$$\%\, Variation = 100 \times \frac{(Waste\ treated_{Year\ x} - Waste\ treated_{Year\ x-1})}{Waste\ treated_{Year\ x-1}}$$

Where $'Year\ x'$ = the current year of reporting.

Appendices

Appendix 1 Reference manual: Further guidance on collection of waste generation data

Guidance on required and recommended steps for collecting, calculating and reporting on packaging waste generation data is provided in this section. This appendix provides more in-depth detail on specific areas to accompany the guidance provided in Section 3.1, which should be read alongside this appendix.

A.1.1 Guidance on establishing a database for PoM data collection

In order to improve the collection of data, Member States should take the necessary measures to ensure that databases on packaging PoM are established, where not already in place. The databases should include data based on Annex III of the Directive (total packaging placed on the market, in units or weight), and it should be ensured that:

- Data relate to the entire packaging unit, including separable packaging elements, such as plastic closures on packaging items (e.g. plastic closures on cartons);
- The guidance for reporting on reusable packaging placed on the market is adhered to (see sections 4.3 and 4.4, and Appendix A.3.1);
- Reporting obligations are established for all relevant producers to report annually on packaging PoM, including any small producers that might otherwise be exempt because they fall under *de minimis* thresholds under EPR schemes;
- PoM estimates are based on annual packaging PoM data from individual producers, to build the picture bottom-up by category and use data that is as accurate as reasonably possible;
- PoM data is based on sales data, considering the entire packaging unit as explained above, and empty pack weights;
- Packaging definitions are well elaborated and guidance on these definitions is easily accessible for producers. Guidance should refer to definitions and examples of packaging as stated in the Directive; and
- Clear and easily accessible guidance for producers is available that provides all the required information in one place and sets out step-by-step actions that need to be taken to ensure the correct data is collected.

In addition, it is recommended that Member States should consider a more granular EPR fee structure and associated reporting structure, based on packaging type. Such a structure could include several categories for plastic packaging based on format and polymer.

In order to reflect this, Member States should move to a position where they are collecting data on the format and type of plastic packaging PoM. Table A 1 gives an example of the plastic packaging categories as applied by Fost Plus, Belgium's PRO responsible for

household packaging waste. Member States may need to consider the most appropriate level of granularity given their planned approach to fee modulation.

Table A 1: Example plastic packaging categories by format and polymer

PET – Bottles and Flasks – Transparent, no colour
PET – Bottles and Flasks –Transparent blue
PET – Bottles and Flasks –Transparent green
HDPE – Bottles and flasks
PP – Bottles, flasks and other rigid items
PS – Rigid packaging except EPS and XPS
HDPE – Rigid packaging other than bottles and flasks
PET – Transparent, other than no colour, blue or green
PET – Rigid packaging other than bottles and flasks, transparent
PET – Bottles and flasks, opaque
PE – Films
Other rigid plastics (except EPS, XPS, compostables)
Other films (except compostables)
EPS, XPS and compostable plastics
Complex packaging of which the majority is plastic
Multi-polymer plastic pouches

Source: Fost Plus

If Member States already have the data on these categories of packaging (and similarly granular data for other materials), they are strongly encouraged to report the data at this level of detail in the final sheet of the questionnaire. While a more detailed breakdown by packaging type is not mandatory, it is desirable. Indeed, it is highly likely that such data will be required from EPR schemes in the future. It would also be of value to Member State authorities to gather a more detailed breakdown of packaging generation to aid evaluation of national packaging policies.

Furthermore, although Member States have no obligation to harmonise data reporting with other Member States, doing so would alleviate the administrative burden on producers. Harmonisation relates to the type, format and frequency of requested data. If possible, Member States should consider if they can require reporting that aligns with other Member States. Further guidelines for harmonised reporting may be included in the Commission's upcoming guidance for EPR schemes.

A.1.2 Improving the accuracy of PoM data

Even if a thorough and appropriate data collection method is used, the data provided by producers and other sources of placed on market data may be inaccurately calculated. Moreover, it is not often clear what methodology is applied by PROs and industry bodies to gather their own data, or whether they quality assure the data they submit.

A.1.2.1 Identifying data issues

The variety of methodologies, data sources and levels of validation used to measure packaging PoM can lead to problems. There may be significant inaccuracies in the data collected due to:

- Data gaps and, either intentionally or unintentionally, mis-reported data;
- Double-counting of PoM data;
- Reliance on inaccurate or incomplete industry data (e.g. inadequate sample sizes too small to be representative), or incorrect calculation methods (e.g. confusing kilograms for tonnes);
- Inadequate reflection of import and export data, including by third parties;
- Declaring only the predominant packaging material (e.g. excluding plastic lids from glass jars); and
- Excluding data on reusable packaging items placed on the market for the first time, causing an underestimate of packaging waste generated.

In addition, Member States should be aware that the following two issues can increase the risk of inaccurate PoM data:

I. The use of a *de minimis* threshold for reporting standards; and

II. Free-riding, typically facilitated by online sales and cross border trade.

These two issues are discussed in the sections below.

A.1.2.1.1 Issues with a de minimis threshold

The Commission's draft new guidance for EPR schemes recognises that full data reporting may prove challenging for some smaller producers. For this reason, Member States may apply a *de minimis* approach to reporting requirements. Using a *de minimis* would set a threshold for the lowest level of reporting required (see Appendix A.1.2.2.1). There is no standardised approach to setting *de minimis* thresholds, and where Member States apply them, the threshold levels will be set at the discretion of individual Member States. As such, *de minimis* thresholds will vary across Member States.

If a *de minimis* threshold is applied, smaller producers may not have to provide full details about the exact number of units / weight of packaging PoM. In such a situation, Member States are required to estimate the number of units PoM below the threshold. Not making such estimates can compromise the accuracy of PoM data, as it will not provide complete coverage of the market due to the lack of data on small producers. As a result, packaging waste generated would be underestimated, potentially causing an upward bias in recycling

rates. If Member States apply such estimates, this needs to be explained under question 18.5.2 of the quality report, including details on sources of information, assumptions made and when estimates were used.

A.1.2.1.2 Issues caused by free-riding

Free-riding typically takes the form of companies selling goods into a country in which they are neither contributing to either take-back for separate collection, nor funding the subsequent collection and treatment although they are obliged to do so. The free-rider experiences the benefits of access to the market, without accruing the costs of EPR fees.

In the context of packaging, free-riders are those who place packaging on the market but do not take responsibility for the costs of collecting or treating this waste, and do not report data on packaging PoM. This presents a problem for reporting packaging PoM, because the lack of data on free-riders means that the amounts of packaging PoM are underestimated, and as free-riders are not exempted by thresholds, these amounts are non-negligible. Therefore, there is a risk of reporting substantially inaccurate values for packaging PoM. This issue applies to those who gather data directly from producers.

Three common issues relating to free-riding are discussed below.

I. Wrong or misreported data

Intentional and unintentional under-reporting of packaging PoM by producers reduces the accuracy of data. Producers may under-report because EPR fees are typically based on the weight of packaging PoM. Therefore, there is an incentive for companies to choose 'low' unit weights for use in packaging calculations in order to minimise the fees they are required to pay under EPR schemes.

II. Online sales

A 2018 study by the Organisation for Economic Co-operation and Development (OECD) first showed that online multi-seller platforms are a major contributor to free-riding. This finding was re-affirmed by a larger study of EPR free-riding in online marketplaces conducted in 2021 for DG Environment. The report on this study remains unpublished.[13] The most significant free riding problem in terms of volume appears to relate to large and well-known multi-seller platforms with fulfilment centres in the EU. The OECD study estimated that online free riding accounts for 5% to 10% of all electronic and electrical equipment (EEE) sales.[14] As a result, the lack of data on online sales, both from seller websites inside and outside the EU, means that packaging PoM is understated. It is worth noting that these platforms often

[13] Unpublished, Eunomia 2022 for DG Environment, Study on the feasibility of regulatory and technical measures with the objective of improving Extended Producer Responsibility compliance and tackling free-riding in the case of online sales

[14] OECD (2018) Extended Producer Responsibility and the Impact of Online Sales. Available at https://www.oecd.org/environment/waste/policy-highlights-extended-producer-responsibility-and-the-impact-of-online-sales.pdf

fulfil orders (i.e. have a warehousing operation) in the Member State or a neighbouring country, which further contributes to the issue.

A.1.2.2 How to address data issues

A.1.2.2.1 Following the draft new EPR guidance on de minimis thresholds

If a *de minimis* is used, it is recommended to set a threshold which minimises the loss of market data while reducing reporting burdens for producers of smaller volumes of packaging. The *de minimis* threshold should be set so that the vast majority of packaging accounted for by PROs is reported to the full standard. Larger producers should be subject to the full reporting requirements.

It is crucial that the minimum reporting standard does not compromise the Member State's ability to obtain accurate PoM data. If the minimum reporting requirements are based on the PoM amount for a specific type of packaging, the typical weights applied need to be accurate. Member States should therefore review these weights and thresholds periodically.

Where small producers are not reporting to PROs/compliance schemes, it is recommended that the Member State requires them to report directly to the relevant authority.

A.1.2.2.2 Identifying and reporting on free-riders

A number of steps can be taken to identify and report on free-riders. In 2021 DG Environment commissioned a study that sought to strengthen the evidence of EPR free-riding online and set out to propose legal and technical measures to address free riding in online selling.[15] Online sales routes provide access to a wide EU market, and both sellers based out of the EU, as well as smaller sellers within the EU trading across borders are commonly not compliant across all the countries that they sell in.

Two types of economic actors are key in the online sales supply chain, both the multi-seller online marketplaces, and the fulfilment service providers that deliver items to the consumer once purchased online. Member States should engage with multi-seller platforms as a priority and obtain their commitment to take action on free-riding.

In considering legislative action that could address free riding, the following approaches could be included:

1. Place a requirement on e-commerce platforms and fulfilment service providers to:
    a. Check seller EPR registrations as part of the platform registration and contractual process; and either
    b. Prohibit access to those that cannot show appropriate EPR documentation for the products they sell; or

[15] Unpublished, Eunomia 2022 for DG Environment, *Study on the feasibility of regulatory and technical measures with the objective of improving Extended Producer Responsibility compliance and tackling free-riding in the case of online sales*

c. Take on the EPR obligations of their sellers, where the platform facilitates import (fulfils delivery):

    i. And the seller is not EPR registered; and/or

    ii. The seller falls below a *de minimis* that excludes them from obligations.

d. Provide seller quantity data in EPR product categories to PROs and/or regulators as appropriate to allow auditing of declared quantities under EPR registrations.

If a less stringent approach is required, the following is an alternative option:

2. Require online multi-seller platforms to sign up to an e-commerce code of practice. This code could be a standard for websites, requiring each seller to provide its PRO registration details, legal entity address and contact information, and potentially a logo. This could build on the SafeShops.be model and similar e-commerce quality labels. It would provide a mechanism for enforcement authorities and informed consumers to check online multi-seller platforms. However, this approach would still require Member State authorities to verify the validity of registration details.

In addition, Member States are recommended to take the following complimentary actions to identify, minimise and report on free-riders in the market (these recommendations may be included in the currently unpublished report on free-riding in online sales):[16]

1. Steps should be taken to ensure that all producer and distributor registers are electronic, public and, as far as possible, standardised for each product group. Both the trading name and the legal entity name of the website should be required for registration. Harmonisation will facilitate information exchange and checking for free riders by PROs and enforcement authorities.

2. Establish a system by which a unique identifier is given to producers, only when they are compliant. This would be best done through the producer register. Once a database of this kind is established, it would be possible to require Customs Authorities to ask for this identifier on the customs declarations form.

3. Engage with Customs Agencies to explore data sharing that will support more accurate PoM assessments. Since the new regulations for VAT for e-commerce came into force in July 2021 all consignments, including low value consignments are required to display a customs declaration form. This data is recorded by the customs authorities, and increasingly digitised providing a rich source of data.

4. Facilitate the sharing of information between PROs, enforcement agencies, customs authorities, trading standards authorities and tax authorities to identify and counter

[16] Unpublished, Eunomia 2022 for DG Environment, *Study on the feasibility of regulatory and technical measures with the objective of improving Extended Producer Responsibility compliance and tackling free-riding in the case of online sales*

free riding. One example is cross checking customs data with imports and products that are declared under EPR registration. EPR and VAT registration could also be linked. This type of interlinking already exists and cross-checking of obligations is already done automatically where there are relevant databases.

5. Implement market surveillance activities to identify producers that place unregistered packaging on the market. This could be mandated to be included as part of the operations of PROs.
6. Take steps to ensure that EPR obligations are clearly communicated to a wide audience.
    a. Ensure that EPR requirements are clearly laid out on a website with links to the relevant organisations.
    b. Provide translations of EPR legislation in the key languages of overseas distance sellers.
    c. PROs should be obligated to undertake promotional and awareness raising work overseas.

Good practice examples

A number of Member States have taken action to tackle free-riding. Although some of these examples relate to waste electrical and electronic equipment (WEEE), the methods used remain instructive:

- In 2019, France took steps to tackle free-riders by announcing new obligations for online platforms as part of the French Circular Economy Law. The Law requires online multi-seller platforms such as Amazon and Alibaba to ensure that the collection and recycling of packaging arising from products marketed and sold on their websites are properly financed (i.e. that sellers are EPR registered). If the online platforms cannot prove that this is the case then they will, by default, be held responsible for the EPR obligations of their sellers.
- In Germany, under the “Gesetz gegen den unlauteren Wettbewerb – UWG” law, a competitor can issue a “warning” (effectively a cease-and-desist letter) and demand compensation from a non-compliant producer, stop the producer from selling non-registered EEE (by an injunction), and request disclosure of sales and their recipients. The German Environment Agency can also request the “absorption” of profit gained through unfair competition. Germany has also noted that it has plans to roll out an automated procedure for identifying potential free-riders by website keyword search and is assessing the possibility of requiring online platforms to check the compliance of their sellers and to block these sellers if not compliant (a duty of examination for the platforms). The new German Packaging Law (VerpackG) tackles free riders in on-line sales via a new centralised office, which manages a packaging register collecting data on actors and the quantities of packaging they put on the German market.
- In Ireland, online sellers of EEE are required to display the EEE producer and EPR registration number. Furthermore, the Environmental Protection Agency (EPA) has an enforcement programme for its WEEE and battery system that includes free-rider

investigations. On-the-spot fines can also be used to penalise non-compliant web sites.

A.1.2.3 Applying corrections/estimates

Guidance on apply corrections/estimates to account for missing PoM data is provided in Section 3.1.1.5.

A.1.3 Principles of waste composition analysis

Member States should apply a reasonable and proportionate estimation method in order to determine the quantities of certain waste categories in specific waste streams. It is important to recognise that waste composition analysis provides data for a single, specific point in time and location. The key factors that can influence the accuracy of this data are discussed below.

Scope/number of samples – samples need to be representative of the area or waste stream in question. Consideration needs to be given to the sampling procedure followed, such as whether a stratified random sampling approach is used.

Simple random sampling, whereby households/businesses are selected for analysis randomly from among others in a study area, with all households having an equal chance of selection, is the most statistically valid sampling technique. However, this approach is both expensive and impractical, owing to the wide geographical spread of the sampled households and the difficulty of collecting such dispersed samples before the arrival of waste collection crews on any given day.

Alternatively, a stratified random sampling approach classifies areas/household/business types according to factors that influence waste composition. The overall population being sampled is divided into non-overlapping ‘strata’ based on these factors, and then sampling is conducted on a random basis within each stratum. This allows for fewer samples to be taken overall than with non-stratified random sampling, owing to less variation within each stratum. As a general rule, the sample size for each stratum should reflect the number of areas/household/business types of the relevant stratum type within the total population.

Once the sampling approach has been decided, further points to consider include:

- The size of the individual samples – the size, either by weight or by volume, of each sample should be uniform across the study. When commercial waste is included, the sample size needs to be larger to attain the same level of accuracy, as there is greater variability in the composition of waste between samples than for household waste.
- The frequency of sampling – the times of year and day can affect amounts of waste generated. For instance, more plastic beverage bottle waste tends to arise during the summer. The chosen frequency should ensure that variation in waste arisings is sufficiently taken into account.
- There should be a sufficiently detailed breakdown of the categories which the waste is sorted into, and Member States should provide guidance to ensure the consistent use of categories. More detailed reporting will also be required under fee modulation

as currently applied by some EPR schemes and proposed in the draft new EPR guidance.

On a stratified random sampling approach, the following minimum methodological requirements are recommended:

- Stratification should take into account not only socio-economic considerations, but also housing type and area type considerations (e.g. whether strata are classified as urban or rural areas).
- Between 4 and 5 strata should be used to stratify the study area. More than 5 strata can require a larger total sample size, and there is limited benefit in sampling a greater number of strata but with fewer households/businesses within each stratum.
- A minimum of 50 households should be sampled within each stratum in order to account for variation in waste categories across households.

For analysis relating to household waste, Member States should consider the following factors when conducting sampling:

- Settlement structure, e.g. rural/urban;
- Household size/number of occupants;
- Household type, e.g. single, low-rise or multi-occupancy, high-rise;
- Type of occupant and socio-economic factors (as the income and lifestyle of the occupant will affect the amount and type of waste they generate) e.g. elderly, young family, low/high income etc.;
- Waste service in operation, including the type and size of containers used (e.g. large waste containers for several households used together vs individual household waste bins) and the collection mode (e.g. weekly, door-to-door); and
- The influence of pay-as-you-throw (PAYT) / residual waste charging schemes, as the composition can change as the level of the charges increase (i.e. household members put more contaminating material in the recycling bins to avoid the charges).

For waste analysis relating to commercial waste, Member States should consider the following additional factors when conducting sampling:

- The representation of different sectors/business types in the sampling framework;
- The representation of different sized businesses in the sampling framework;
- The use of on-site audits, and the approach used for very large sites;
- The waste service in operation, including the collection cycle.

For practical implementation strategies, Member States should refer to the relevant national guidance on waste composition analysis, as well as the Methodology for the Analysis of Solid Waste developed by the European Commission.[17]

The following elements are also important to ensure high quality data on packaging waste based on waste analysis:

[17] https://www.wien.gv.at/meu/fdb/pdf/swa-tool-759-ma48.pdf

- Consideration needs to be given to the difference between the weight of packaging measured at the specific points where composition analysis is undertaken, and the weight at the point of recycling. The principle should be to obtain weights that are equivalent to the weights placed on the market, i.e. the waste fractions should be “pure, clean and dry”. This is to ensure that the weight results obtained by the sampling process are as equivalent as possible to the weight of packaging placed on the market.
- The grossing up of the sampling results to the totals should be based on a well-defined stratification approach (as per examples given above). This includes the selection of the waste flows to which the coefficients determined by the sampling are applied.

Appendix 2 Reference manual: Reporting of data on packaging waste recycling

Guidance on required and recommended steps for collecting, calculating and reporting on packaging waste recycling data is provided in this section. This appendix provides more in-depth detail to accompany the guidance provided in Section 3.2.

A.2.1 Correctly identifying the calculation points for each packaging material

Article 6a of the Directive states that:

> *"[…] the weight of packaging waste recycled shall be measured when the waste enters the recycling operation."*

This provides the basis for the concept of the calculation point, as presented in this guidance document. The definition of 'recycling operation' is then provided in Annex II of Decision 2005/270, as this relates to a range of materials. As such, the Directive and Decision 2005/270 together establish the points at which recycling tonnages should be calculated.

The sections below provide guidance on how to correctly identify the calculation points for plastic packaging, paper and cardboard, glass packaging, metal packaging, wooden packaging, fabric/textile packaging, and composite packaging.

A.2.1.1 Recycling of plastic packaging

A.2.1.1.1 Mechanical recycling

The calculation point for the recycling of plastic packaging is defined in Annex II of Decision 2005/270 as follows:

- Plastic separated by polymer that does not undergo further processing before entering pelletisation, extrusion, or moulding operations; and
- Plastic flakes that do not undergo further processing before their use in a final product.[18]

As illustrated below in Figure A 1, the above definition sets the calculation point for mechanical recycling to measure the weight of a product that has been:

- Ground/flaked (necessary for adequate sorting and washing processes);
- Sorted and washed (so that the product does not include the weight of materials that are not the required resins (polymers) to be recycled); and
- Dried (so that the weight does not include moisture in excess of the "natural humidity").

Whole loads of material that are rejected from entering a recycling process cannot be counted as recycled for the purposes of the recycling calculation.

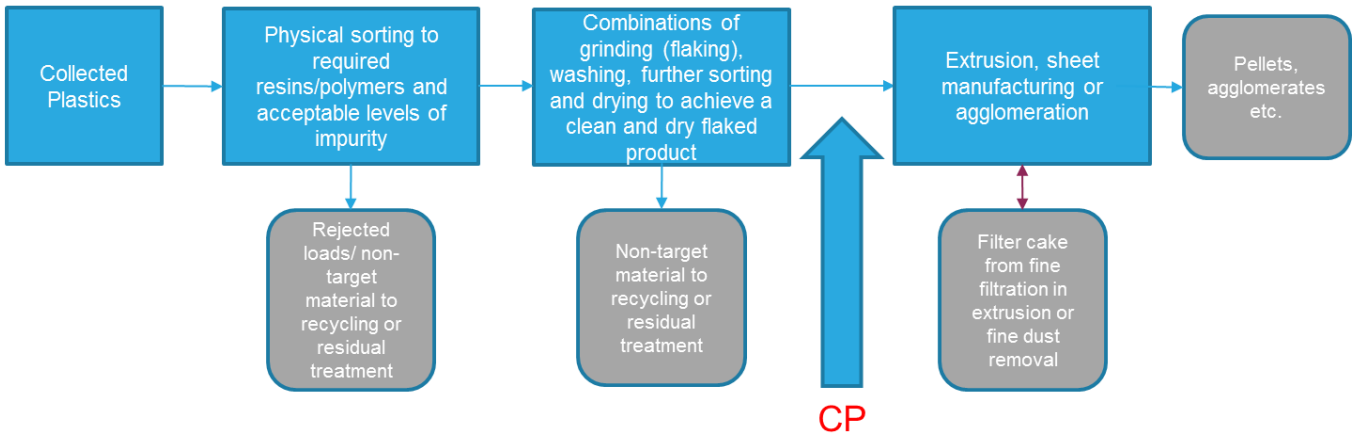
[18] Final products in this context include extruded products, sheet and agglomerates. Other examples of "final products" will be considered on a case-by-case basis, using the principle of equivalence.

In some cases, specific preliminary and multiple recycling operations are integrated into a single facility, whereas in other cases they might be located at different facilities, either operated by the same company or by different companies. Where plastics are recycled within an integrated system (i.e. where multiple stages of the recycling process take place at the same facility), the calculation point will need to be set between two stages in the same facility (i.e. between preliminary operations and reprocessing) – as opposed to being set at the output or input of a facility.

Additionally, there may be processes that do not measure the weight of the plastics at the calculation point because the material is sent on to extrusion or agglomeration processes. It is permissible to set the measurement points further down the processes, so as to measure the outputs from extrusion or agglomeration processes. In these cases, it is not necessary to deduct the weight of extruded filtration cake or fine dust that is subsequently disposed of, as these are considered to be 'inherent losses'.

In some cases, however, extruded filter cake can be re-ground and reintroduced into the recycling process where the tolerances for contamination are relatively high (e.g. polyolefin recycling batches). In such cases, if the extruded filter cake is subsequently recycled, it can no longer be considered an inherent loss, and so the measurement method should be developed in such a way that it prevents double counting (and thereby overestimation of the packaging recycled). See Figure A 1.

Figure A 1: Plastics calculation point



Note: If the weight of clean and dried flake is not known then it is acceptable to count the weight of the products produced in later processes for example the weight of pellets plus filter cake from extrusion processes may be counted as the weight recycled.

The calculation point cannot be set before any further processing step prior to the material entering pelletisation, extrusion, or moulding operations. Such processing steps include all types of washing (e.g. cold washing, hot washing, and any combination thereof). While hot and cold washing will result in different levels of contamination of the material, the effect of the difference in mass of contaminants between cold and hot washed plastic flakes is likely

to be extremely small, as even cold washed plastic entering extrusion processes for lower grade products such as plastic refuse sacks must still meet high quality standards.

The calculation point for recycling requires that polymers enter pelletisation, extrusion, or moulding operations, or that flake is used to produce a final product. Plastics entering cement kilns or other thermal technologies count as energy recovery and not recycling.

A.2.1.1.2 Chemical recycling

Chemical recycling is the process of breaking down collected plastics into their constituent monomers or other basic chemical substances. Although there is yet to be a common definition of chemical recycling, a key distinction can be defined by the occurrence of a chemical reaction in the process i.e. the breaking of chemical bonds in the polymer chain to form monomers or other chemical substances. This excludes any process aimed at recovering energy such as incineration or producing outputs that are used as fuels. Processes that act mechanically on the polymer such as grinding, flaking and remelting would not fall into this category. Equally, processes that dissolve the polymer in a solvent to remove impurities would also fall outside of this definition (e.g. chemical dissolution).

Although there are many variations of chemical recycling there are two broad categories of that encompass the majority of technologies:

- **Chemical Depolymerisation** covers a range of processes (e.g. hydrolysis, methanolysis, and glycolysis) in which polymer chains are broken down using chemicals. Once depolymerisation has occurred, monomers are recovered from the reaction mixture and purified through distillation, precipitation and/or crystallisation, to separate them from contaminants and leave a pure monomer. Most commonly this is used for PET.
- **Thermal Depolymerisation**, also known as thermal cracking and thermolysis, breaks down polymer chains using heat treatment and sometimes includes a catalyst (e.g. pyrolysis and gasification). This typically involves the breaking of chemical bonds at random positions in the polymer chain, as opposed to the controlled breakdown seen in chemical depolymerisation. For example, with pyrolysis, the resulting pyrolysis oil is usually composed of a variety of hydrocarbons, and often requires further purification and blending and subsequent steam cracking before it becomes a monomer which can then be used as a feedstock for polymer production.

Chemical recycling has potential application in recycling plastic products that are challenging to recycle using current mechanical technologies and where the output quality requirements are high. Some technologies are considered as potentially having a role to play in enabling the recycling process to further reduce contamination, or address polymer degradation, possibly allowing recycling into food-contact applications to occur with greater confidence, or substitution of higher proportions of primary material in a given application (e.g. PET bottles). However, the quality of the input material to the chemical recycling processes is still of high importance to increase yields and improve process efficiencies. Highly contaminated material is just as problematic as it is for mechanical recycling.

As discussed in Section 3.3.2, Decision 2005/270 sets out two main principles for the reporting of packaging waste material used in these processes. These are:

- If the principal use of a packaging waste material is as fuel or energy generation, then nothing should be counted as recycling (from Article 6c(1)(h)).
- If the principal use of a packaging waste material is neither as a fuel nor to recover the target material, then a mass balance approach should be applied (from Article 6c(1)(i)).

Reflecting the fact that not all the chemicals derived from chemical / feedstock recycling will necessarily be used to synthesise non-fuel products, materials or substances, it was considered appropriate to establish a calculation point, and to set in place principles, which would allow for the amount of material recycled to be determined.

The calculation point would be based around the quantity of chemicals derived from the process that were subsequently used to manufacture new non-fuel materials, products, or substances. Operators would be required to provide a full mass balance of their process to national agencies responsible for reporting on recycling. In order to enable a calculation of the quantity of plastic packaging waste input material, which had actually been recycled, operators would be required to demonstrate how the outputs were derived from the inputs. This would be necessary to ensure that only the plastic packaging waste input material from which were derived those chemical feedstocks that were used in making new non-fuel materials, products or substances were counted as 'recycled'. A possible option would be to consider as recycled the amount of chemicals (by weight) derived from the process that are subsequently used in the synthesis of new non-fuel materials, products or substances. This would also exclude any input that is consumed as a fuel as part of the process itself.

Member States should outline the full details of the mass balance approach used to identify any packaging currently reported as recycled from chemical processes as part of the quality report (under question 18.5.4). Member States should outline any quality assurance/chain of custody schemes to be established to ensure the mass balance is conducted according to the calculation rules put in place. Further calculation points and associated measurement methods may be identified for chemical recycling processes. This is subject to the Commission's further consideration of the scope and scale of such processes in future.

A.2.1.1.3 Chemical recovery

In order to use the term *chemical recycling*, the process must result in products that are not used as fuels. Chemical recovery can be applied to the same technologies if all or some of the outputs are fuels. This is particularly applicable to thermal depolymerisation. The two main technologies of pyrolysis and gasification produce pyrolysis oil and syngas respectively. These outputs can then go on to produce products and eventually polymers (and therefore be classed as recycling), however if they are used as fuels this should be classed as recovery. It is therefore possible that the same process can be classed as both a recovery and a recycling operation as outputs in both categories can be produced. Assigning accordingly based on a mass balance approach is important in order to categorise correctly.

A.2.1.1.4 Use of treated packaging plastic waste in blast furnaces as reducing agent

This industrial process consists of using treated plastic packaging waste to substitute coke or heavy oil as a reduction agent in blast furnaces. The treated plastic packaging waste, when burned in a controlled atmosphere, releases carbon (C), carbon monoxide (CO), hydrogen gas (H_2) and heat. According to Decision 2005/270 Article 6c(1)(h) and Article 6c(1)(i), recycling does only apply to the part of the plastic waste that does not contribute to generate energy in this process.

The reduction process contains three steps in which the materials consumed may be deemed as recycled and not as energy recovery. The amount of material incorporated shall be calculated using a mass balance.

- First, CO reduces iron oxide to pure iron by capturing the oxygen atoms from metal oxides and is released as carbon dioxide to the atmosphere:

$$3\ Fe_2O_3 + CO \rightarrow 2\ Fe_3O_4 + CO_2$$

$$Fe_3O_4 + CO \rightarrow 3\ FeO + CO_2$$

$$FeO + CO \rightarrow Fe + CO_2$$

  The mass of the carbon monoxide being reducing agent can be treated as recycled.

- Second, atomic hydrogen in plastic polymers will also reduce iron to produce molecular water (H_2O) and pure iron:

$$3\ Fe_2O_3 + H_2 \rightarrow 2\ Fe_3O_4 + H_2O$$

$$Fe_3O_4 + H_2 \rightarrow 3\ FeO + H_2O$$

$$FeO + H_2 \rightarrow Fe + H_2O$$

  The mass of the hydrogen shall be considered as recycled from plastic waste.

- Last, some of the atomic carbon from plastic polymers will end up as part of the cast or pig iron. Pig iron is an alloy containing an average concentration of atomic carbon (C) between 4.0 and 4.3%. At temperatures higher than 710ºC, and in the presence

of atomic iron, some carbon monoxide is fixed inside the metal by the following chemical reaction:

$$2\ CO \rightarrow C + CO_2$$

The atomic carbon remaining in the pig iron shall also be counted as recycled.

In order to estimate how much of the treated plastic packaging waste is used as a reduction agent, how much becomes part of the alloy as atomic carbon, and how much is burned and recovered as energy, a mass balance approach of the whole process in the blast furnace must be established, considering inputs (treated plastic packaging waste, iron ore and air) and outputs (melted iron, slag, blast furnace gas and moisture).

Based on inputs and outputs, it is possible to make a mass balance to determine how much of the input treated plastic packaging waste is used as a reduction agent and how much is retained in the pig iron alloy, where:

- Inputs: the total input pig iron, its purity, its composition on hematite (Fe_2O_3) and magnetite (Fe_3O_4), the ratio of carbon and hydrogen in the treated plastic packaging waste; and
- Outputs: the total output pig iron, its purity and the percentage of atomic carbon in the alloy.

This amount then shall be treated as recycled whereas the remaining amount of the plastic packaging waste shall be treated as recovered.

A.2.1.2 Recycling of paper and cardboard packaging

The calculation point for the recycling of paper and cardboard packaging is defined in Annex II of Decision 2005/270 as follows:

- Sorted paper that does not undergo further processing before entering a pulping operation.

The calculation point for paper and cardboard packaging is illustrated in Figure A 2.

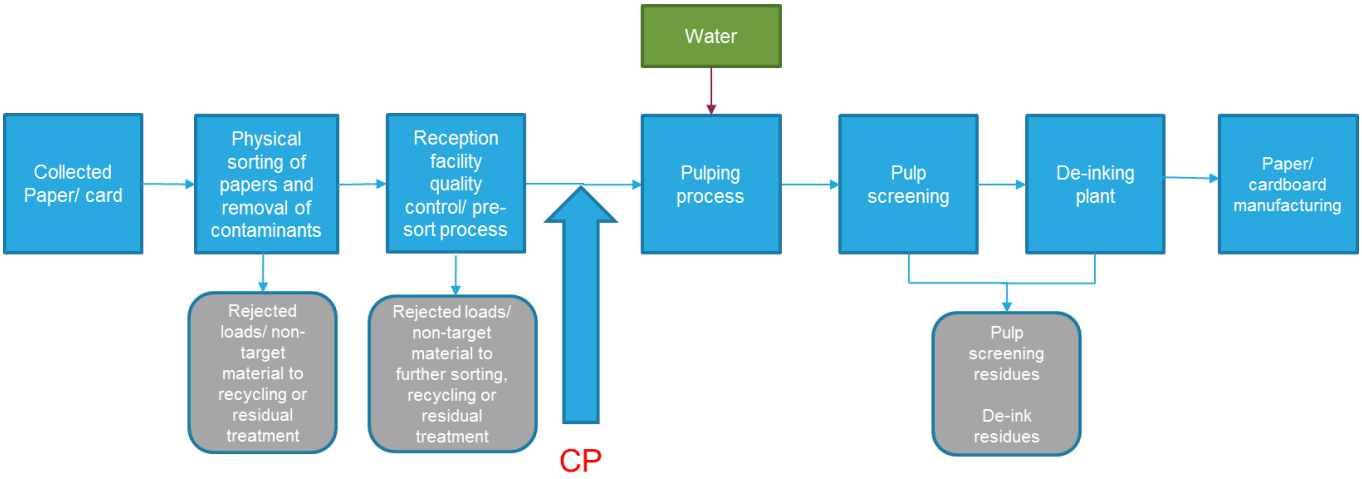
Paper and cardboard are typically reprocessed into similar materials via a pulping process. The calculation point can be set at the point at which paper and cardboard material enters the pulping process, providing that the material meets the EN643 standard.[19] This ensures that the requirement for recycling to be 'high quality' (as per Article 6a(1) of the Directive) is met. Material with higher levels of non-fibre contamination than allowed for under EN643 standards that are introduced to a pulping process would result in an overstated recycling rate, and in these cases there should be a corresponding deduction made from the mass of the material introduced to the pulping operation.

Paper may also be recycled by other processes than the pulping process.

[19] European Standard EN643, Paper and Board – European list of standard grades of recovered paper and board, December 2001, http://www.international-recycling.com/grades/Europeangrades.pdf

Certain fractions of the mass of material introduced into the pulping process do not yield fibres for remanufacturing but result in material sent for disposal or energy recovery (e.g. screened material from pulp screening or chemicals/inks from the de-inking processes). On the assumption that material introduced to the pulping operation complies with EN643 standards, the losses from the pulping process onwards count as *inherent losses,* and therefore it is not necessary to deduct the weight of these losses from the final recycling reported.

Figure A 2: Paper / cardboard calculation point



A.2.1.3 Recycling of glass packaging

The calculation point for the recycling of glass packaging is defined in Annex II of Decision 2005/270 as follows:

- Sorted glass that does not undergo further processing before entering a glass furnace or the production of filtration media, abrasive materials, glass fibre insulation and construction materials.

The calculation point for glass packaging is illustrated in Figure A 3.

Collected end-of-life glass packaging material requires sorting before it can be introduced to a glass furnace or any of the other production processes listed in the above definition. The calculation point is set to account for the material entering the glass furnace or other relevant processes after unwanted material is removed through sorting processes.

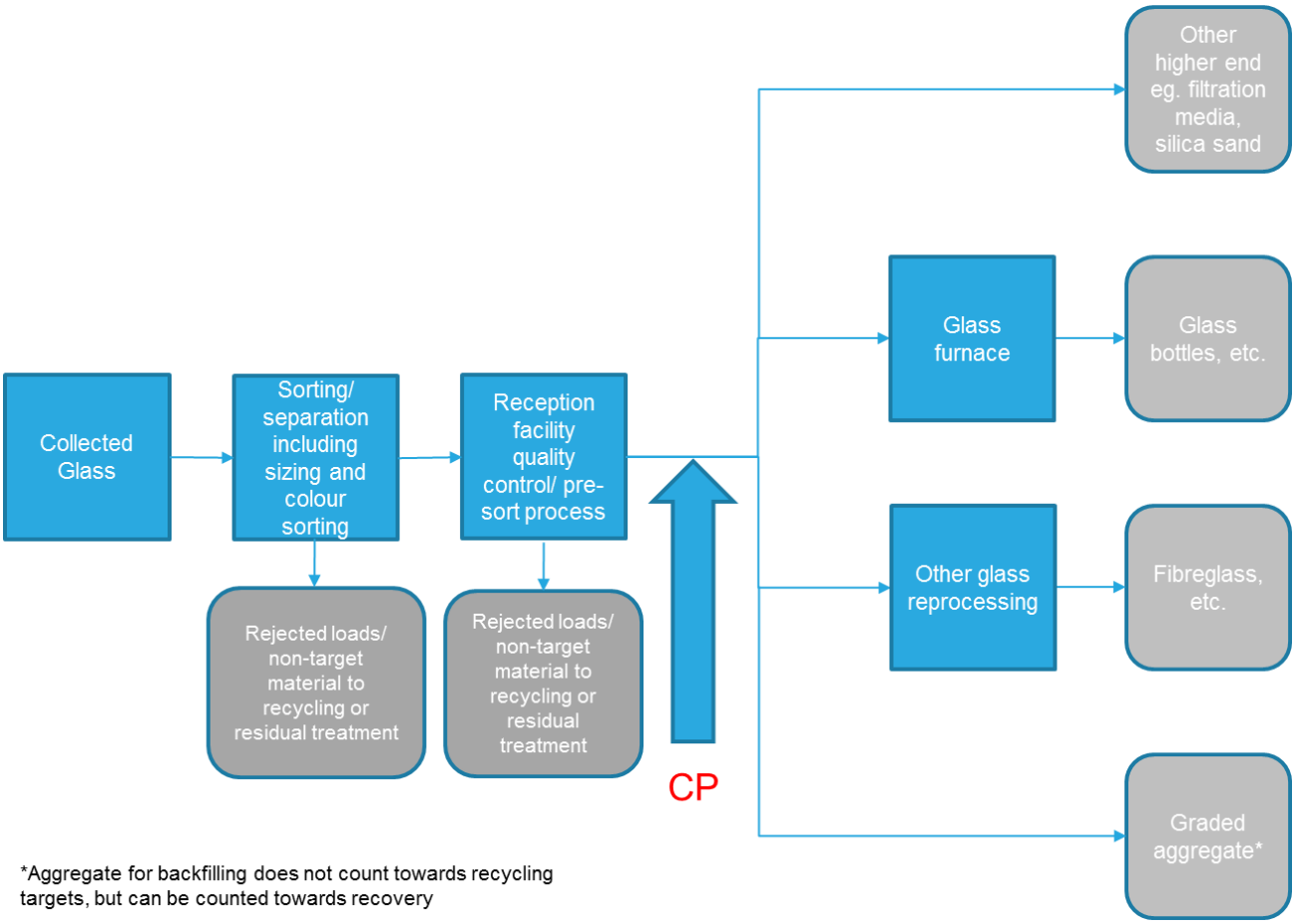
In the case of glass bottles, some materials (such as aluminium closures) may count towards recycling targets for other materials (such as aluminium recycling). Therefore, these materials should not be counted towards the recycling targets for glass, and should be captured under the calculation point for the relevant material (see below).

The production of glass aggregate for backfilling or landfilling does not count towards recycling targets, as set out in Article 6a(5) of the Directive:

> *"…end-of-waste materials to be used as fuels or other means to generate energy, or to be incinerated, backfilled or landfilled, shall not be counted towards the attainment of the recycling targets."*

However, aggregate used for backfilling can be reported towards recovery targets (as indicated in the footnote to the “Other recovery” column in Table 1 of Annex 1 in Decision 2005/270).

Figure A 3: Glass packaging calculation point



A.2.1.4 Recycling of metal packaging

The calculation point for metal packaging is defined in Annex II of Decision 2005/270 as follows:

- Sorted metal that does not undergo further processing before entering a metal smelter or furnace.

The calculation point for ferrous metal packaging is illustrated in Figure A 4 and the calculation point for aluminium metal packaging is illustrated in Figure A 5.

Collected end-of-life metals sometimes require sorting before they can be introduced to a metal smelter or furnace. The calculation point is set to account for the material entering these or other relevant processes after unwanted material is removed through sorting processes.

For the purposes of the calculation rules, tinned packaging (e.g. food cans, biscuit tins) is an acceptable input to treatment operations, and so should not be deducted from the weight of steel counted as recycled. In case Member States wish to report other metal packaging than

that made of aluminium or ferrous metals according to Article 6c(2) of Decision 2005/270, they may do so in the 'other' row for metals in the questionnaire.

Note that the preliminary treatment of metals (shown in Figure A 4 and Figure A 5 as a separate step called "reception facility quality control / pre-sort") may also take place within the metal smelting/refining facility itself. In this case, any pre-sorting prior to smelting counts as 'preliminary treatment' within the refining facility, and any waste removed during this stage **cannot** therefore be counted towards the recycled metal waste reported by that facility. This is set out in Article 6a(5) of the Directive:

- Where a facility carries out preliminary treatment prior to the calculation point in that facility, the waste removed during the preliminary treatment shall not be included in the amount of recycled packaging waste reported by that facility.

Multiple calculation points may be needed for metals, given the different flows in the recycling chain for different types of metal packaging waste. As the output of preliminary sorting operations is equivalent to the input to the metal smelter or furnace, Member States can therefore report at the entry to these specialised operation plants, if it is easier, but must still deduct any materials removed by the specialised operation which would not be inputted to the metal smelter or furnace. Or, if separately collected metals are sent directly to a smelter or furnace, then Member States can also report at the entry to these smelter or furnace plants, so long as any materials removed during any preliminary treatment are deducted from the weight of packaging waste reported as recycling.

In the case of recycled aluminium closures for glass bottles (see above), the calculation point can correspond to the output of the glass sorting facility if the separated aluminium fraction is sent directly for smelting with no prior treatment. In this case, care must be taken to avoid double counting of this fraction at the point of input into the smelter as well.

Figure A 4: Steel calculation point

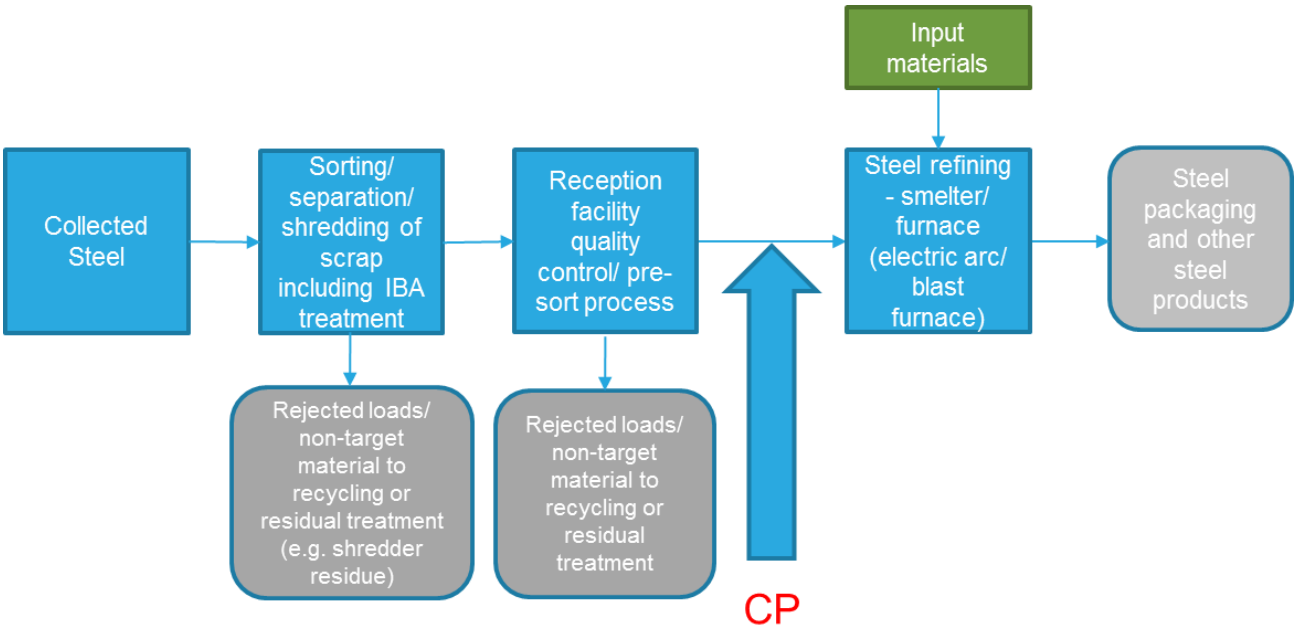
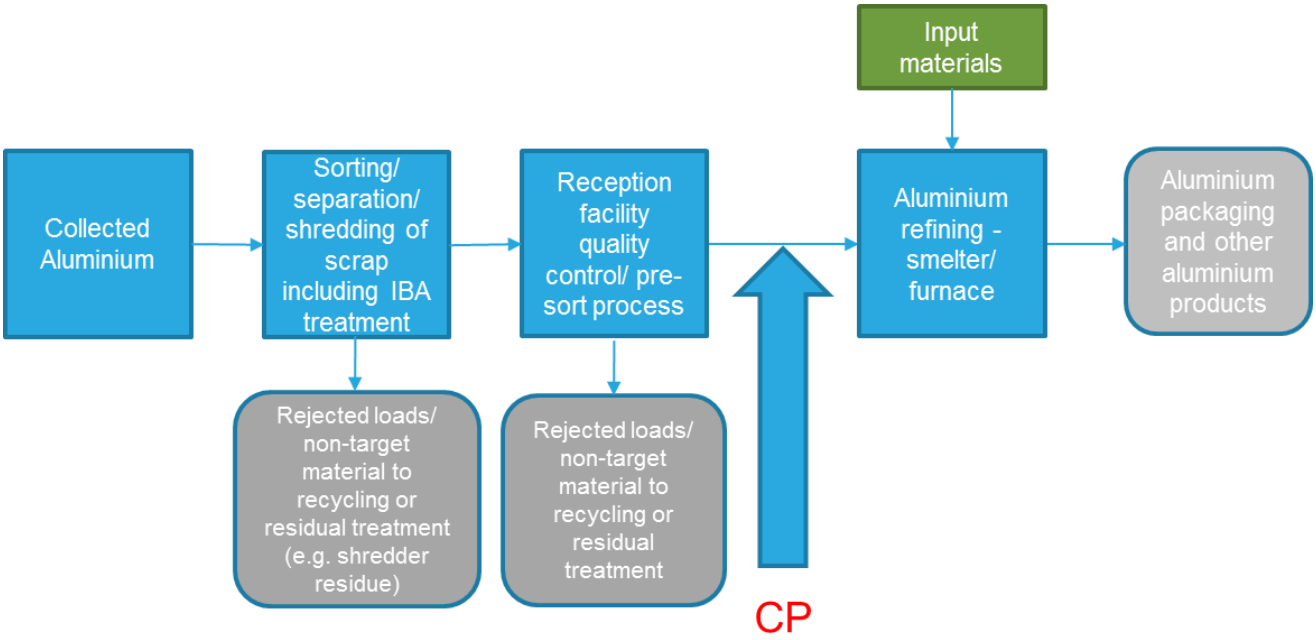


Figure A 5: Aluminium calculation point



A.2.1.5 Recycling of wooden packaging

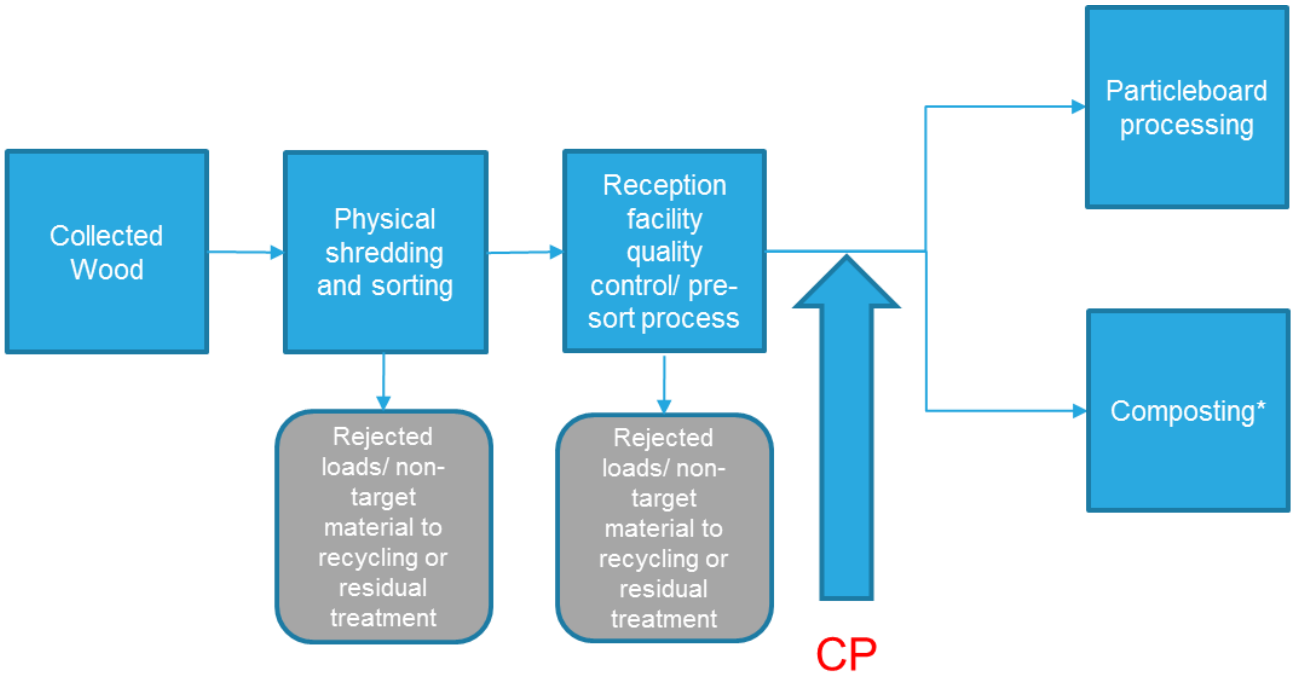
The calculation point for wooden packaging is defined in Annex II of Decision 2005/270 as follows:

- Sorted wood that does not undergo further treatment before utilisation in particleboard manufacture.

- Sorted wood entering a composting operation.

The calculation point for wooden packaging may be either the amount of fine material sent off to recycled board manufacture, or the input waste minus non-target material extracted for recycling, disposal or thermal recovery, as illustrated in Figure A 6. Sorted wood entering a composting operation would need to meet certain criteria to ensure that the quality of the output compost meets relevant standards. In addition, only food waste collected separately at source can be counted for recycling, so wood waste composted should only be counted for recycling if it also originates from segregated sources. Energy recovery of wood waste does not count as recycling.

Figure A 6: Wood calculation point



Note: Only wood waste segregated at source and composted counts towards the recycling targets

A.2.1.6 Recycling of fabric/ textile packaging

The calculation point for fabric/textile packaging is defined in Annex II of Decision 2005/270 as follows:

- Sorted textile material that does not undergo further processing before its utilisation for the production of textile fibres, rags or granulates.

The output of a sorting process is a pragmatic point for reporting, and can be reported by the plant operator to the national authorities.

Chemical recovery of textiles should also be accounted for according to the conditions set out for plastics in Appendix A.2.1.1 using a mass balance approach and with the calculation

point set as the point at which chemicals from the process are used as the basis for manufacturing new plastics (and not as fuel).

Finally, while preparation of textile packaging for reuse counts towards the recycling targets, reuse of textile packaging (such as cotton/ jute carrier bags, direct sales and donations to second-hand organisations)) does not involve the item becoming waste and thus should not count towards recycling targets (except reusable sales packaging up to 5% of the target).

A.2.1.7 Recycling of composite packaging

The calculation point for composite packaging and packaging composed of multiple materials is defined in Annex II of Decision 2005/270 as follows:

- Plastic, glass, metal, wood, paper and cardboard and other materials resulting from the treatment of composite packaging or of packaging composed of multiple materials that do not undergo further processing before reaching the calculation point established for the **specific material**.

Materials present within composites, e.g. paper, wood, metal, plastic, textiles, should be captured by calculation points for these specific materials, as separated material would be sent for further material specific recycling operations.

However, for some composite products the preliminary treatment process includes a pulping operation to recover fibres (e.g. for beverage cartons). Here, the output should not be counted, as this would not be in line with the approach for paper and cardboard recycling. However, neither should the input to the recycling plant be used, as some elements, such as the plastics, are generally sent for energy recovery and not recycling. Therefore, the approach should be to measure the input to the recycling plant and deduct any outputs sent for energy recovery or other material recycling operations.

It is important to note that deduction should only occur if the component parts are not insignificant; if they are <5% of the total item weight, they can be accounted for as being recycled along with the predominant material of the packaging.

A.2.2 Measurement methods

A.2.2.1 Allowable measurement methods

The measurement method is the approach(es) taken to calculate the amount of recycling at the calculation points defined in Annex 1 of Implementing Decision 2019/1004. The approach(es) could make use of different measurement points and arithmetic formulas to make the calculation.

This section provides guidance on measuring the amount of recycling at the calculation points for plastics, glass, wood, metal, paper, and textiles.

A generalised multi-stage recycling value chain is shown in Figure A 7. The weight of material at the calculation point should be calculated and reported for each material in line with the reporting formats in Decision 2019/1004. The following rules should be considered:

- Some amount of moisture added to the waste after any point at which that waste or product is weighed for inclusion in the denominator (e.g. waste generated) may need to be adjusted for within the amounts reported at the calculation point (see Appendix A.2.2.2 below for further detail on this).
- In most cases, it can be assumed that the weight of material at the output of one operation is equivalent to the weight of material at the input to the next operation (an exception to this may be where entire loads are rejected).

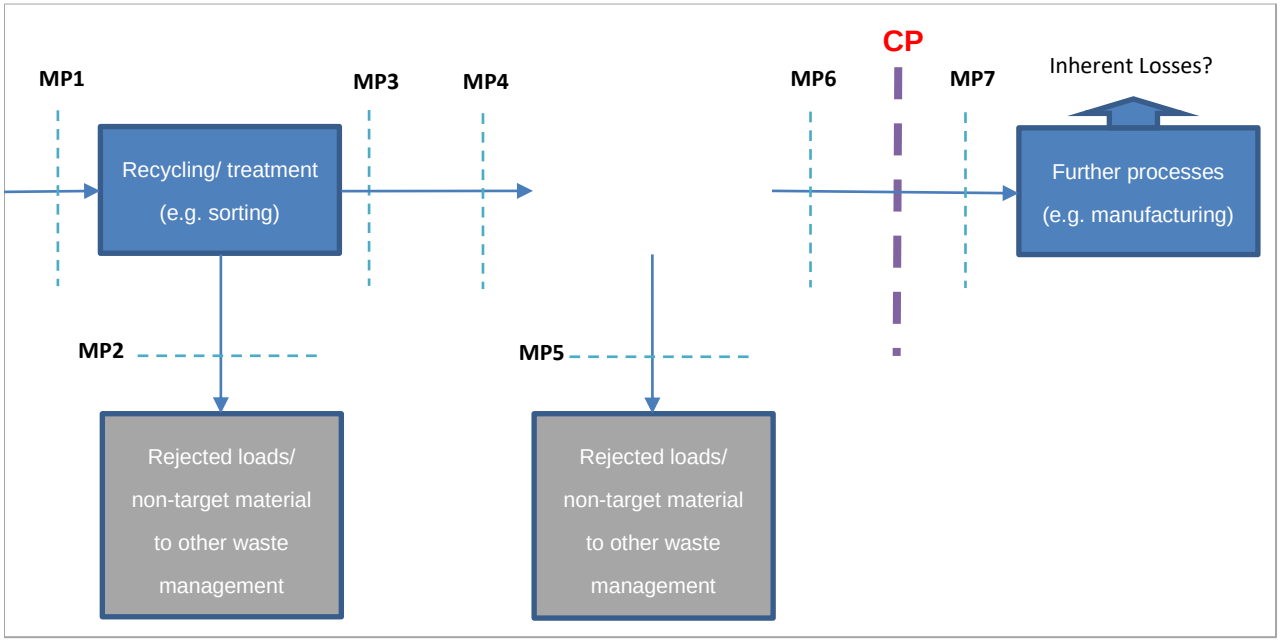
  At receiving facilities, the incoming loads are checked visually or sometimes with testing equipment. If the load does not meet the required specifications, the entirety of the load will be rejected and sent back to the facility from which it was sent. Therefore, it is important to make sure that these rejected loads are subtracted from the data if the source of data is the output of the prior facility, as such loads are not recycled in practice. Failure to subtract rejected loads would overestimate the amount of recycling for a given waste stream.
- The weight of material may be calculated at recycling processes further downstream of MP7 (Figure A 7) if they provide the more practicable points for measurements. In these cases, it is not necessary to deduct inherent losses (losses in weight of materials or substances due to physical or chemical transformation processes inherent in the recycling operation where packaging waste is actually reprocessed into products, materials or substances) that occur after MP7 from the amount of material calculated as recycled.

  Some examples of inherent losses that may be relevant to different packaging materials are provided in Table A 2:

Table A 2: Examples of inherent losses

Material	Example of inherent loss
Plastic	Extruded filter cake (not reintroduced into the recycling process)/ fine dust
Biowaste	Water/ CO_2
Metals	Slag
Glass	Glass fines
Paper/ board	Inks/ dragged fibres

Figure A 7: Generalised Measurement Method Schematic



In this example, therefore, there are a number of ways to calculate the weight of material at the calculation point (CP):

- CP = MP7
- CP = MP6
- CP = MP4 - MP5
- CP = MP3 - MP5
- CP = MP1 - MP2 - MP5

This measurement method approach should be applied to each material flow as relevant to the individual Member State. For all these example calculation points, any inherent losses (losses in weight of materials or substances due to physical or chemical transformation processes inherent in the recycling operation where packaging waste is actually reprocessed into products, materials or substances) need to be deducted from the calculated weights.

Where facilities process material from multiple sources (i.e. packaging and non-packaging, and/or from different countries), a comprehensive understanding of facility inputs and outputs is needed, taking into account the principles described within Appendix A.2.4. There may also be a need for sharing of data between competent authorities of individual Member States (for example, in cases where the quality of material processed in facilities differs between source countries), as is discussed in Appendix A.2.6 on average loss rates.

Example flow diagrams for individual packaging materials are given in Appendix A.2.1 above. In this regard, consideration will have to be given to composite packaging, which, as per Decision 2005/270, must be calculated and reported per material contained in the packaging,

except where a given material constitutes an insignificant part of the packaging unit, and in no case more than 5% of the total mass of the packaging unit.

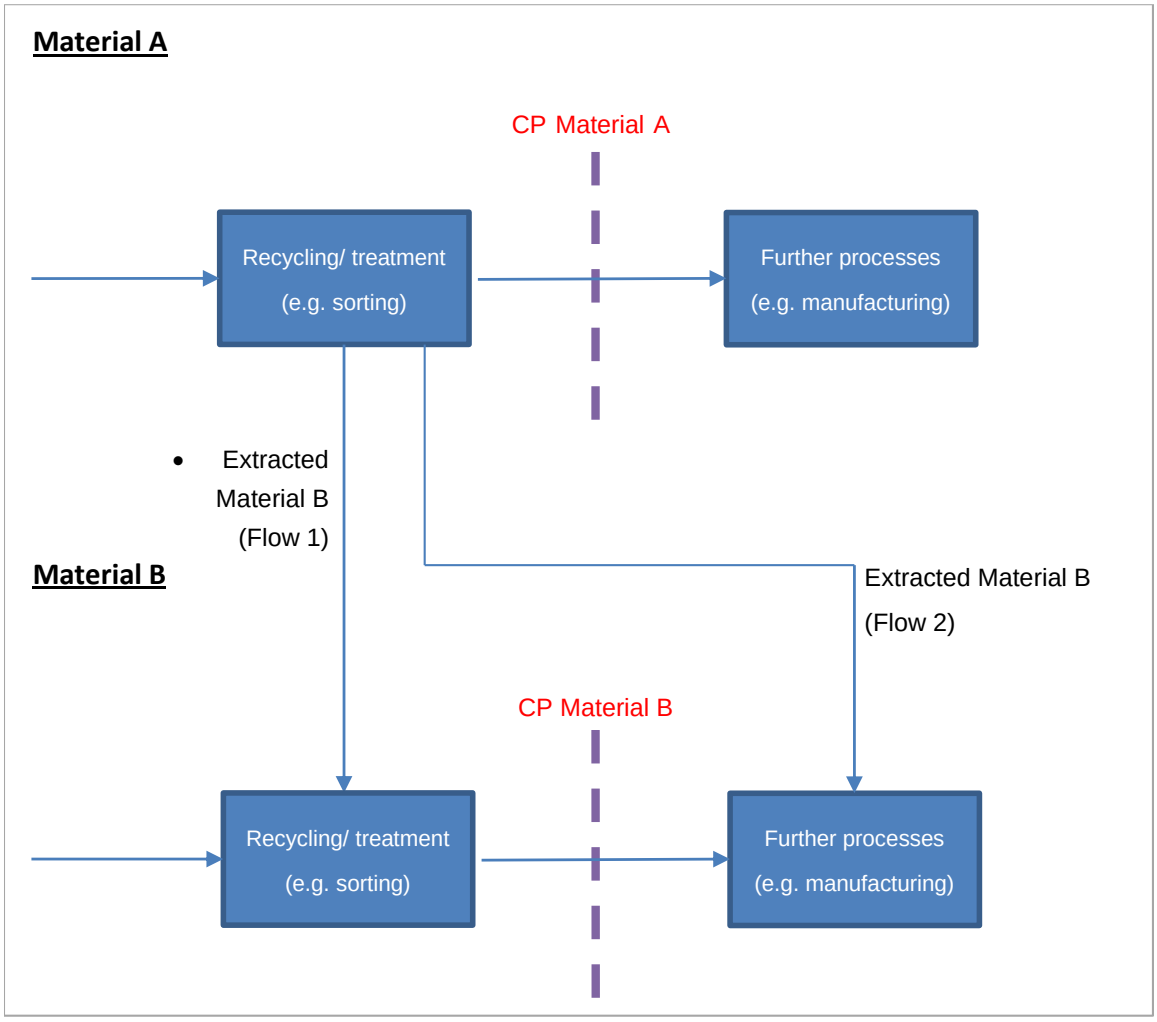
In addition, consideration should be given to the flows of materials from a given recycling process that are sent for further recycling but are not the primary target material of the recycling process. Member States should consider the different recycling flows on a national level to ensure that such material is included in the amounts reported as recycled.

The key consideration is that these output flows may, or may not, pass the calculation point for the target material(s). This is exemplified in Figure A 8. In the case of Flow 1, Material B, which is not primarily targeted by the recycling operation for Material A, is sent to a further recycling operation (which does target Material B) prior to the calculation point for Material B.

However, in the case of Flow 2, Material B does not require further sorting before being accepted as a secondary raw material in further processes, and so bypasses the calculation point for Material B. In this case, although the material has been recycled, it would not be accounted for under Material A or B.

Consequently, a clear mechanism with which to understand the fate of Material B is needed, in order to avoid either double counting or failure to count waste as recycled altogether. For example, it may be preferable to set a calculation point for Material B at the input of the ‘Further processes’ of Material B. However, if it is clear that Flow 2 does not pass a calculation point for Material B (i.e. if the Material B calculation point is set at the output of the Material B ‘Recycling/sorting’ step) it should be measured at the output of the Material A ‘Recycling/sorting’ step instead.

Figure A 8: Generalised Schematic Related to Cross-material Flows



A.2.2.2 Obtaining data at the measurement points

As discussed above, a range of measurement points could be defined with certain associated formulae used to calculate the weight of material recycled at the calculation points. This section discusses some further considerations around obtaining data at the measurement points.

The preferred measurement point for packaging waste is the total output weight of targeted material(s) (i.e. the recycled material intended to be sold as a secondary raw material, without further processing). This will generally be a known quantity, as financial transfers (gate fees or payments for materials) will generally be related to the quantities of material (in tonnage) purchased or sold. These data could be submitted by plant operators as actual weight data for this type of measurement point.

Note that any loads rejected after this measurement point as a result of downstream quality checking procedures would have to be deducted from the amount to be consistent with Decision 2005/270, as failure to make such reductions will cause the amounts reported as recycled to be overestimated.

Alternatively, the total plant input (i.e. the weight of material received at the plant) can be used as a measurement point. This is also highly likely to be known as financial transfers are likely to be made in relation to material quantities recycled / treated. These data could be submitted by plant operators to provide actual weight data for this type of measurement point. This weight should relate to the amount of material accepted by the reprocessing plant, and should not, therefore, include the weight of material rejected after any initial quality checking procedures.

A final measurement point for packaging waste is the total output weight of non-targeted material arising from a given recycling operation (i.e. the material which the recycling operation is not targeting). Again, this is likely to be known as this material will be sent on to further operations that might include recovery or disposal operations, and related financial transactions will generally be made on the basis of the quantity (and quality) of recyclable materials sold. Data from this measurement point ('MP5'/'MP2' in Figure A 7) can be deducted from the weight of recycling measured prior to sorting/reprocessing operations to calculate the weight of material at the calculation point. If any non-target material is sent to a process where material could be extracted and recycled, an appropriate measurement point for this non-target material would need to be defined to ensure any recycled material is accurately reported (also see Figure A 8 above).

Having obtained the data above, it may be necessary to make adjustments for moisture within material at the calculation points in order to ensure that the correct weight (dry or wet) of material is compared with the corresponding amount of waste generated showing the same level of moisture. Moisture is particularly relevant for paper/board, which absorbs water, although water can also be present in food and drink packaging; in plastic packaging, moisture can account for a relatively significant proportion of the overall weight of the wet item.

Moisture limits in technical specifications should be used to form the basis of factors for correcting the measured data. Article 5 of Decision 2005/270 sets this requirement:

> *"…the weight of recovered or recycled packaging waste shall be measured using a natural humidity rate of the packaging waste comparable to the humidity rate of equivalent packaging put on the market.*
>
> *Corrections shall be made to measured data relating to the weight of recovered or recycled packaging waste, if the humidity rate of that packaging waste regularly and significantly differs from that of packaging placed on the market and if this factor risks leading to substantial over- or underestimates of packaging recovery or recycling rates."*

Accordingly, a natural humidity rate of packaging placed on the market will firstly have to be established through surveys of each packaging type in each Member State, to be undertaken periodically. This can be compared against the humidity rate for packaging waste, which tends to be known by buyers (who, in many cases, have established specifications with tolerances for moisture/ humidity content, as this is an important consideration for the

recycling process). For those packaging waste types that exhibit a significant variation in natural humidity rates (e.g. where the packaging waste humidity rate exceeds the natural humidity rate by 5% or more), more detailed surveys will need to be undertaken, with the aim of establishing a protocol whereby correction factors can be adopted to adjust for such variation. The natural humidity rates thereby established should be deducted from the recycling data received by Member States prior to submission to the Commission. It is recommended that these rates should be reviewed every two years.

The European reprocessing industry (particularly for plastic packaging) has confirmed that plant operators will hold data relating to the amount at the calculation points (or relevant measurement points), so Member State authorities will need to ensure they have the legal means in place to request these data, and systems in place (e.g. electronic registries) to enable these data to be reported efficiently.

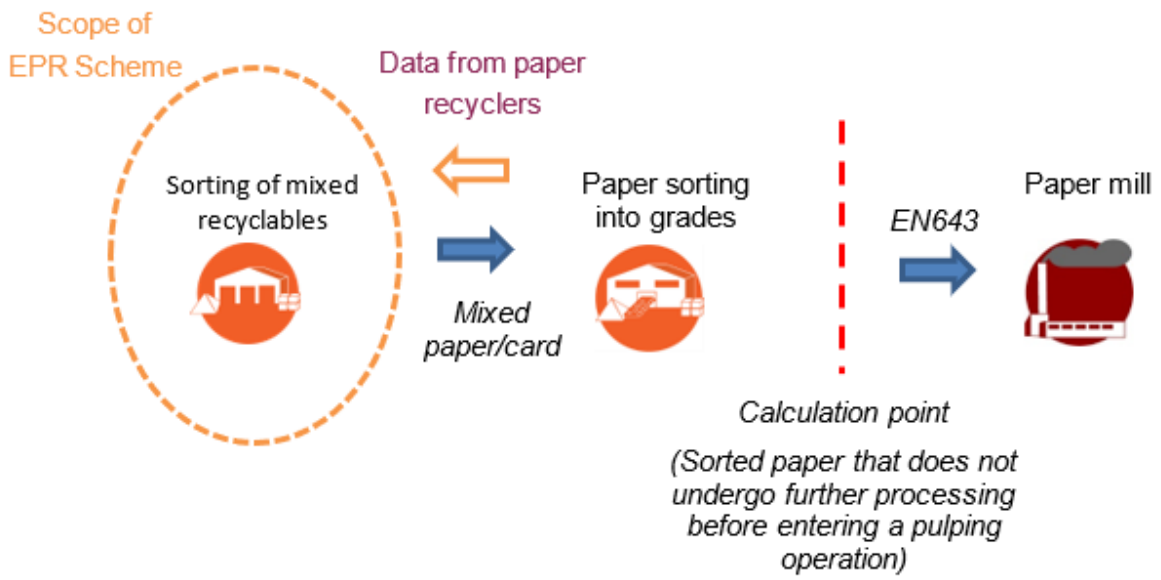
To gather data relating to these measurement points, Member States should therefore consider establishing electronic registries, in order to gather data directly from the various operators in the recycling value chain, as supported by Article 6a(3) of the Directive:

> *"3. Member States shall establish an effective system of quality control and traceability of the packaging waste to ensure that the conditions laid down in point (a) of paragraph 1 of this Article and points (a) and (b) of paragraph 2 of this Article are met. To ensure the reliability and accuracy of the data gathered on recycled packaging waste, the system may consist of electronic registries set up pursuant to Article 35(4) of Directive 2008/98/EC, technical specifications for the quality requirements of sorted waste, or average loss rates for sorted waste for various waste types and waste management practices respectively."*

Legal requirements to provide data may be needed at the national level to mandate the submission of the necessary information by private sector operators to the electronic registries. Until such registers are in place, Member States could rely on other data gathering approaches, e.g. from extended producer responsibility (EPR) schemes (subject to these being audited independently to ensure the data is reliable) or surveys of recycling operators and the development of statistical models.

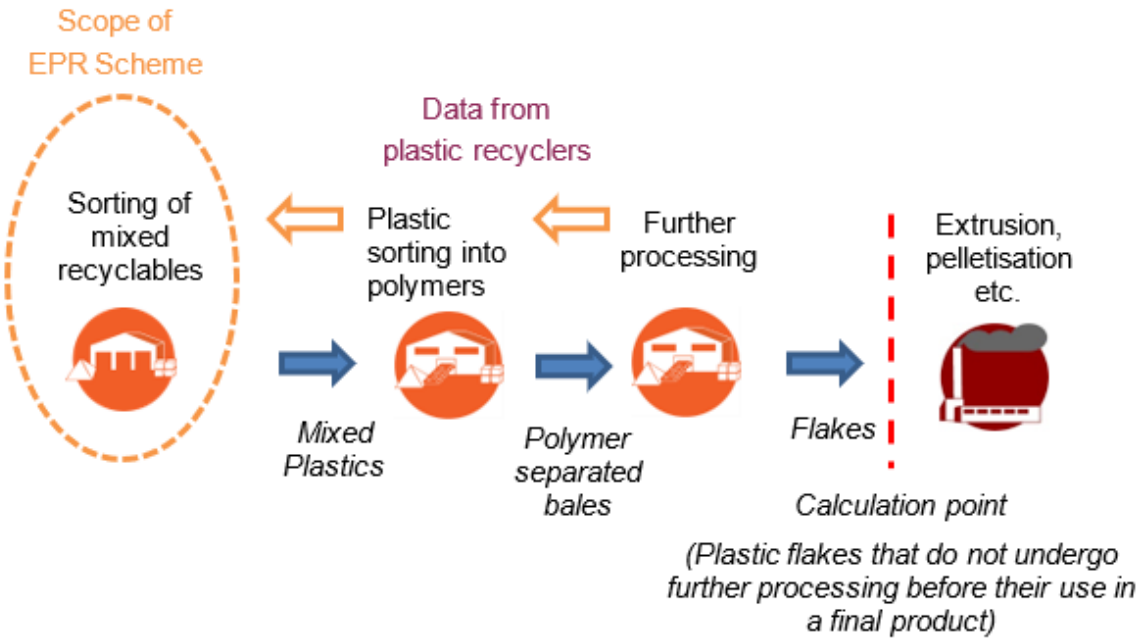
The current scope of reporting from EPR schemes can be limited, as downstream recycling/ treatment operations may not be under the control of EPR schemes. Therefore, if data are to be gathered through EPR schemes in the short term, these EPR schemes would most likely need to obtain data from operators of any further recycling/ treatment plants prior to the calculation points in order to gather data on all the relevant measurement points. This is exemplified in Figure A 9, which shows a situation in which there are two stages before the calculation point. Here, the 'data from paper recyclers' would have to be collected by the plant undertaking 'paper sorting into grades', which may not currently be under the scope of reporting by EPR schemes.

Figure A 9: Potential data flows via EPR Schemes for 2-stage Process



The process becomes more complicated when there are three stages before the calculation point, as shown in Figure A 10. In such cases, data may need to be passed through intermediate companies if the EPR scheme is to be able to report information on all the measurement points. Direct reporting from all operators in the chain would alleviate this problem, which is why the suggested focus is on implementing nationwide electronic registries with mandatory reporting requirements in law.

Figure A 10: Potential Data Flows via EPR Schemes for 3-stage Process



A.2.3 Metals from incinerator bottom ash (IBA)

Article 6(a)(6) of the Directive outlines that recycled metals separated after incineration of packaging waste can be included in the reporting of performance against the metal packaging recycling targets, stating:

> *"For the purposes of calculating whether the targets laid down in points (f) to (i) of Article 6(1) have been attained, Member States may take into account the recycling of metals separated after incineration of waste in proportion to the share of the packaging waste incinerated provided that the recycled metals meet certain quality criteria laid down in the implementing act adopted pursuant to Article 11a(9) of Directive 2008/98/EC."*

Article 6(d) in Decision 2005/270, further specifies that

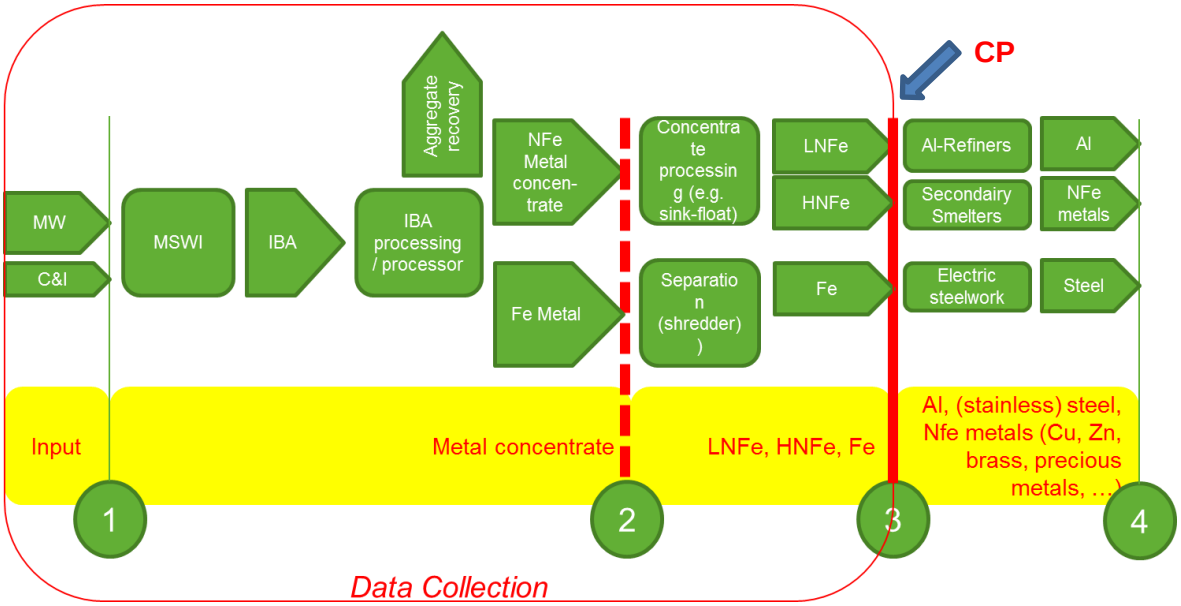
> *"…the amount of recycled metals separated from incineration bottom ash shall be the mass of metals in the metal concentrate that is separated from raw incineration bottom ash originating from packaging waste, and shall not include other materials contained in the metal concentrate such as mineral adhesions or metals that do not originate from packaging waste" and sets out the methodology for calculating the mass of recycled metals separated from incineration bottom ash in Annex III.*

This section provides further guidance on the use of the calculation methodology set out in Annex III of Decision 2005/270.

A.2.3.1 Correctly identifying the calculation point

The key flows of metals are illustrated in Figure A 11.

Figure A 11: Key Metal Flows



Source: CEWEP

Waste from a range of sources (municipal, including packaging, as well as commercial and industrial wastes) are input to Municipal Solid Waste Incinerators (MSWIs) at point 1. At this point, due to the mixing of wastes, it may no longer be possible to identify the source of the waste.

The output of MSWIs includes incinerator bottom ash (IBA), which contains, among other things, metallic elements. Some processing of the IBA may occur on site. The most common approach is to extract ferrous (Fe) metals using over-band magnets. Although steel is a Fe metal, Stainless Steel (StS) is not magnetic, so it is not extracted using over-band magnets but is identified and extracted separately. Some facilities now also extract non-ferrous (NFe) metals using eddy-current separators; however, this is less common, and most operators choose to send IBA to dedicated processors.

At these dedicated IBA processing sites, the IBA is usually separated into an aggregate fraction – for use as a secondary raw material – and two metallic fractions, Fe and an NFe concentrate, the latter including light and heavy NFe metals and StS. The Fe fraction is further processed to shred into different fractions for sale as varying grades, with different technical specifications, to steel plants. The NFe concentrate is sent to further metal recovery companies that specialise in extracting different metals from metal concentrate. These processes used result in a large number of different fractions, of different metals and particle sizes. The light NFe is almost exclusively aluminium. The heavy NFe would include StS, brass, zinc and other metals.

Based on this material flow, and in-line with the calculation points discussed above for other metals (see Appendix A.2.1.4), the calculation point for metals from IBA should be:

- Sorted metal that does not undergo further processing before entering a metal smelter or furnace.

This calculation point comes at data collection point 3 in Figure A 11, at which only the weight of metal that is actually recycled is measured, therefore taking any losses into account. Examples of these losses are discussed in the next section.

A.2.3.2 Allowable measurement methods and obtaining data at the measurement points

The measurement method for metals from IBA is set out in Annex III of Decision 2005/270. The method is designed to take into account the fact that, at the point of input to a furnace or smelter, it may not be possible to determine the source of the material. Therefore, measurement points are set to measure the metallic outputs from IBA processing that are sent to furnaces and smelters, with the amount adjusted to take the source of the waste into account.

It is also important to add that, for the aluminium and steel targets, the weight of material counted as recycled is not 'pure' metal, but an aluminium or steel product that may contain alloying elements accounting for a few percent of the total mass of the metal. These alloying elements are an integral part of the material, and are desired by manufacturers who will mainly use alloyed materials in their products. Therefore, the alloys should not be deducted from the weight of aluminium or steel recycled.

The measurement method is described in the following steps.

1. Gather data on the annual tonnages of metal concentrates from facilities that separate metal concentrates from raw IBA. Fe fractions can be reported under the 'Steel' packaging fraction – along with StS –, the aluminium fraction in the metal concentrate under the 'Aluminium' packaging fraction.

   Use the formulae in Paragraph 4 of Annex III (shown below) to calculate the concentration of metals needed to adjust the total metal concentrate figures under step 1, which will approximate the concentration of ferrous metals and aluminium resulting from the processing of metal concentrates extracted by facilities that separate metal concentrates from IBA. 'C' means concentration and 'm' means mass (see Annex III of Decision 2019/665 for the full list of formula definitions).

$$c_{IBA\ metals} = \frac{m_{IBA\ metals}}{m_{IBA\ metal\ concentrates}} = \frac{\left(m_{IBA\ metal\ concentrates} - m_{non\text{-}metallic}\right)}{m_{IBA\ metal\ concentrates}}$$

For example, a specific facility determines that for NFe, 5,600 tonnes of IBA NFe metal concentrates is produced in a given year. 1,960 tonnes of this are non-metallic. This means that 3,640 tonnes are NFe metals. This gives a NFe metal concentration of 65%.

For Fe, it is determined that 45,000 tonnes of IBA Fe metal concentrates are produced in a given year. 2,250 tonnes of this are non-metallic. This means that 42,750 tonnes are Fe metals. This gives a Fe metal concentration of 95%.

2. As per Annex III of Decision 2019/665, concentrations shall be calculated based on data collected by regular surveys from facilities that process metal concentrates and from other facilities that use metals separated from IBA to produce metal products.

   Calculating the concentrations requires an understanding of the total plant input and the total metallic content. These can be determined by studies, spot sampling or available purity data at the treatment plants based on metal concentrate sale (e.g. metal concentrate sale as a proportion of total plant input). According to stakeholders, data should be available at the plant level for the three main fractions: Fe, NFe and StS.

   At the Member State level, a mean average concentration (plus or minus a percentage) for each of the three key categories should be calculated. When calculating each mean value, this should be done at the 95% confidence interval, to show the range of values (margin of error) expected at this level of confidence. Further guidance on this is provided in the box below. Where sampling has been used to determine the metallic element of the concentrate, the resulting value should be statistically significant (i.e. the data should be tested for statistical significance to see if the outcome is due to something other than chance, and is therefore a significant result) and sampling should be repeated at least every 3 years.

Mean and 'Confidence Interval' Calculation Example for IBA Metal Concentrates

Member States should calculate the mean concentration and margin of error at a 95% confidence level for each metal. They should do this using the concentrations calculated for each facility, as shown in step 2 above. The following formula should be used:

$$\bar{x} \pm 1.96 \frac{s}{\sqrt{n}}$$

Where $\bar{x}$ represents the mean metal concentration, s represents the standard deviation and n represents the number of facilities sampled. The standard deviation of the metal concentration x, is calculated using the following formulae:

$$s = \sqrt{\frac{\sum |x - \bar{x}|^2}{n - 1}}$$

For example, if 5 facilities sampled give NFe concentrations of 0.65, 0.7, 0.75, 0.68 and 0.72, then the mean $\bar{x}$ is calculated as:

$$\frac{(0.65 + 0.7 + 0.75 + 0.68 + 0.72)}{5} = 0.7$$

The standard deviation s is calculated as:

$$\sqrt{\frac{(0.65 - 0.7)^2 + (0.7 - 0.7)^2 + (0.75 - 0.7)^2 + (0.68 - 0.7)^2 + (0.72 - 0.7)^2}{5 - 1}} = 0.038$$

The 95% confidence interval is then calculated as:

$$0.7 \pm 1.96 \frac{0.038}{\sqrt{5}}$$

This example gives a final NFe concentration coefficient for the Member State of 0.7 ± 0.03 at the 95% confidence level.

Member States should apply the mean and 95% confidence interval coefficients for the concentration of metals to the total amounts of metal concentrate captured, to produce a total amount of IBA metals and a 95% confidence interval for it at the national level. For example, if the Member State in the example given here had a total annual tonnage of 100,000 tonnes of metal concentrate, the total IBA NFe metals would be 70,000 tonnes with a 95% confidence interval (margin of error) of plus or minus 3,000 tonnes. The same steps should be followed to produce the mean metals concentration and 95% confidence interval for Fe metals.

Apply the concentrations calculated in steps 2 and 3 to the total amounts of metal concentrate from step 1 to estimate the total amount of ferrous metals and aluminium recycled from IBA.

3. Use the formula under Paragraph 5 of Annex III of Decision 2019/665 to estimate the mass of recycled ferrous metals/aluminium originating from packaging waste in all recycled ferrous metals/aluminium separated from IBA. This effectively applies a further coefficient (proportion of packaging waste) to the figure calculated under step 4. The concentrations should be calculated at the Member State level; however, they may be derived from weighted concentrations sourced from specific facilities.
4. As per Annex III of Decision 2019/665, the concentration of metals in the incinerated waste shall be determined through sampling surveys of the waste that enters the incineration operation. These surveys shall be carried out at least every five years and when there are reasons to expect that the composition of the incinerated waste has significantly changed.
5. Such sampling already exists in several Member States. For example, in Belgium, incinerator operators are required to sample inputs to determine the overall packaging proportion, and in Estonia operators are required to sample 4 times per year to determine the proportion of biodegradable wastes in relation to renewable energy support schemes. Therefore, input sampling surveys can be carried out without critical impact on incinerators; however, some stakeholders have indicated that the costs can be high.

   Under Article 8a (4a) of the Waste Framework Directive – Extended Producer Responsibility – there is a requirement on EPR organisations to ensure financial contributions cover the costs of data gathering and reporting necessary for measuring Member State performance against targets. The reporting of metals collected from IBA is relevant to reporting against the packaging element of municipal and packaging waste targets. Therefore, part of any incinerator sampling could be carried out through, or part-funded by, national government or packaging waste EPR schemes (relating to packaging waste) to help minimise the burden of sampling on industry. The approach should be risk based; for example, initially a survey should be carried out on an annual basis, and if the variation in the data is small, the survey could then be carried out on a two-yearly basis, and again on a five-yearly basis. If any surveys see a significant change in the proportions, sampling on an annual basis should start again.
6. The consequence of not carrying out these surveys is that the proportion of packaging is inaccurate, and either over- or understates the amount recycled.
7. Finally, an adjustment factor may be needed to address the reduction in the amount of material passing through an incinerator. For example, tin plate is oxidised from the surface of steel cans, and thin aluminium foils also oxidise to some extent (see further detail in Appendix A.2.3.3 below). Therefore, if only the input to a MSWI is used in the

calculation, these effects would not be taken into account which might lead to over- or underestimation of the amount of material counted for under the recycling targets. This may be particularly relevant for the aluminium packaging target, where thin packaging foils are more subject to these issues, thereby reducing the relative proportion of the recovered light NFe metals that are from packaging sources compared to the input. Member States should seek to assess the significance of such losses through reviewing relevant evidence and make the necessary adjustments.

A description of the methodological approach(es) taken should be provided under question 18.3.6.of the Quality Report. Where sampling has been used to determine the metallic element of the concentrate or the proportion of packaging waste, details of the sampling procedure used should be reported, including:

- The percentage of total national sites sampled (i.e. incinerators, facilities that process metal concentrates, and other facilities that use metals separated from IBA to produce metal products);
- How the sample sites were selected;
- The number of samples taken at each site and across all sites; and
- How the samples were taken.

For reporting of data under the new rules from 2021, where surveys of incinerator plants, bottom ash and metal concentrates do not currently exist, Member States may use average values from the survey results under the measurement method study (see Section 6.0 Task 4 of the final study report).[20]

A.2.3.3 Losses within the incineration process

Metals passing through incinerators undergo, to varying degrees, a number of physical and chemical transformations. The extent of the transformations depends on the physical and chemical structures of the metals themselves and how they tolerate the conditions to which they are exposed during the incineration process (such as high temperatures and varying levels of oxygen). These transformations are important to consider in the context of metal packaging because:

- They may reduce the volume of metals which end up in IBA;
- They may alter the properties of metals in a way which affects the efficiency of their removal and subsequent recycling; and
- The effects may vary across packaging and non-packaging waste streams (where relevant material-specific recycling rates apply).

[20] Eunomia et al (2019) *Study to Support the Implementation of Reporting Obligations Resulting from the New Waste Legislation Adopted in 2018*, Final Report for the European Commission DG Environment under Framework Contract No ENV.B.3/FRA/2017/0005, https://op.europa.eu/en/publication-detail/-/publication/3d72ef00-bcac-11e9-9d01-01aa75ed71a1

This could have implications for the calculation of the recycling rate for metal packaging that is incinerated. Although all metals will undergo transformation to some extent, aluminium is of particular interest because it is commonly used for packaging of consumer goods and is one of the metals commonly removed from IBA for recycling.

The literature indicates that several small-scale laboratory and site-based tests have been conducted on how aluminium behaves through the incineration and IBA treatment process. There is still, however, a degree of uncertainty around the exact way losses may occur in incineration. The main transformations that aluminium can undergo are:

- The presence of oxygen and high temperatures means that the exposed aluminium may undergo oxidation into aluminium oxide. Aluminium will melt at around 660°C, and this melt often gains an aluminium oxide skin that encloses it, protecting it from further oxidation.[21] This aluminium will form nuggets which will be present in the IBA;
- Very fine particles of aluminium/aluminium oxide can be carried up the flue of the incinerator due to convection, and will be transferred mainly into the air pollution control residues (APCR).[22]
- Some aluminium will react with nitrogen in the air to form aluminium nitride, occurring at around 900°C. [23] It is not clear to what extent this is lost via the flue or whether it remains in the IBA (and if it is in the flue gas, whether it may be found in APCR).
- Some aluminium will be lost as a result of volatilisation.[24]

Several of the aforementioned tests have sought to determine the influence of different factors on the rates of oxidation and loss to volatilisation/APCR. Factors, which influence these transformations include:

- The characteristics of the metal packaging itself:
    - Surface area to volume ratio. Large pieces of metal which have a small surface area relative to their total mass will experience limited oxidation, whereas small thin pieces of metal with large surface areas will experience far more pronounced, or even complete, oxidation.

[21] Bunge, R. (2015) Recovery of Metals from Waste Incinerator Bottom Ash. Institut für Umwelt und Verfahrenstechnik UMTEC, April 2015. http://umtec.hsr.ch/fileadmin/user_upload/umtec.hsr.ch/Dokumente/News/1504_Metals_from_MWIBA__R._Bunge.pdf

[22] Hu, Y., Bakker, M.C.M, and de Heij, P.G. (2011). Recovery and distribution of incinerated aluminum packaging waste. Waste Management, 31, 2422-2430.

[23] Bunge, R. (2015) Recovery of Metals from Waste Incinerator Bottom Ash. Institut für Umwelt und Verfahrenstechnik UMTEC, April 2015. http://umtec.hsr.ch/fileadmin/user_upload/umtec.hsr.ch/Dokumente/News/1504_Metals_from_MWIBA__R._Bunge.pdf

[24] Biganzoli, L., Gorla, L., Nessi, S. & Grosso, M., (2012). Volatilisation and oxidation of aluminium scraps fed into incineration furnaces. Waste Management, 32, 2266–2272.

- Particle size is an important factor in oxidation (the greater the particle size the lower the rate of oxidation), and some studies have found thickness to be relevant as well (the thicker the particle, the lower the rate of oxidation).[25]
- Composition of the packaging waste (i.e. how much aluminium as compared with other materials such as paper). This can affect the level of oxidation as non-aluminium material can 'protect' the aluminium from oxidation.[26, 27]

- The conditions in the incinerator:
  - There are differences in the temperature and oxygen availability in different parts of the incinerator and so not all aluminium will undergo the same level of oxidation and/or other transformations.
  - IBA processing, such as quenching of the aluminium with water in the bottom ash, can promote oxidation.[28]
  - PH value and salt contamination are also thought to affect oxidation.[29]

Oxidation is largely a problem for the recycling potential of the aluminium, because the oxide cannot actually be recovered in the secondary smelter, and it therefore results in a reduced mass of aluminium that can ultimately be recycled. There is a small evidence base relating to quantifying rates of oxidation in aluminium. According to the CEN standard on '*Packaging. Requirements for packaging recoverable in the form of energy recovery, including specification of minimum inferior calorific value'* (EN 13431:2004), thin-gauge aluminium foil (up to 50 µm thick) is considered recoverable in the form of energy, suggesting that it is considered to be fully oxidised. However, it is unclear what evidence underpins this assumption. Laboratory tests have been conducted through which the oxidation level of different aluminium products in municipal waste were determined for several types of consumer products: however, these tests measured the incinerator input as compared with the output of recyclate from IBA, and therefore also take into account the effectiveness of bottom ash removal techniques. What this research did show is a large difference in the recovery rates between different types of aluminium packaging waste: thin foil, foil containers and cans, with recovery factors of 77, 88 and 93 wt.%, respectively. It is not known how representative these figures are.

Other studies have found similar variability between packaging types, with average oxidation levels for aluminium in the residues of the incineration process as equal to 9.2% for cans,

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[25] Biganzoli, L., Gorla, L., Nessi, S. & Grosso, M., (2012). Volatilisation and oxidation of aluminium scraps fed into incineration furnaces. Waste Management, 32, 2266–2272.

[26] López, F., Román, C., García-Díez, I. and Alg, F., (2013) Energetic Valorisation Of Semi-Rigid And Flexible Aluminium Packaging By Oxidation At High Temperature. Braga, Wastes: Solutions, Treatments And Opportunities 2nd International Conference.

[27] Biganzoli, L., Gorla, L., Nessi, S. & Grosso, M., (2012). Volatilisation and oxidation of aluminium scraps fed into incineration furnaces. Waste Management, 32, 2266–2272.

[28] Biganzoli, L., Gorla, L., Nessi, S. & Grosso, M., (2012). Volatilisation and oxidation of aluminium scraps fed into incineration furnaces. Waste Management, 32, 2266–2272.

[29] Hu, Y., Bakker, M.C.M, and de Heij, P.G. (2011). Recovery and distribution of incinerated aluminum packaging waste. Waste Management, 31, 2422-2430.

17.4% for trays and 58.8% for foils. This study also looked at compacted beverage cans, which were characterized by a low overall oxidation level (9.2%) compared with other materials, due to the reduction in exposed surface area.[30]

Additional studies looking at oxidation rates for different packaging types report that oxidation never exceeds 17%[31], and that the oxidation of aluminium limits the recycling factor to a maximum of 82.5 %[32], though another study reports a third of the mass of aluminium being lost to oxidation.[33]

The only available estimation of how much aluminium is lost to APCR puts this at 10 wt.% for municipal waste.[34] However, this is likely to vary according to different waste compositions and incineration technologies, as well as the nature of the flue gas treatment.

A.2.4 Identifying the packaging waste proportion in multi-stream treatment plants

Figure A 12 provides an example of a recycling value chain for paper where the whole amount of the waste is in-scope (i.e. all the waste material is packaging waste). In this case, the total weight of recycling at the calculation point can be counted under the respective target.

[30] Biganzoli, L., Gorla, L., Nessi, S. & Grosso, M., (2012). Volatilisation and oxidation of aluminium scraps fed into incineration furnaces. Waste Management, 32, 2266–2272.

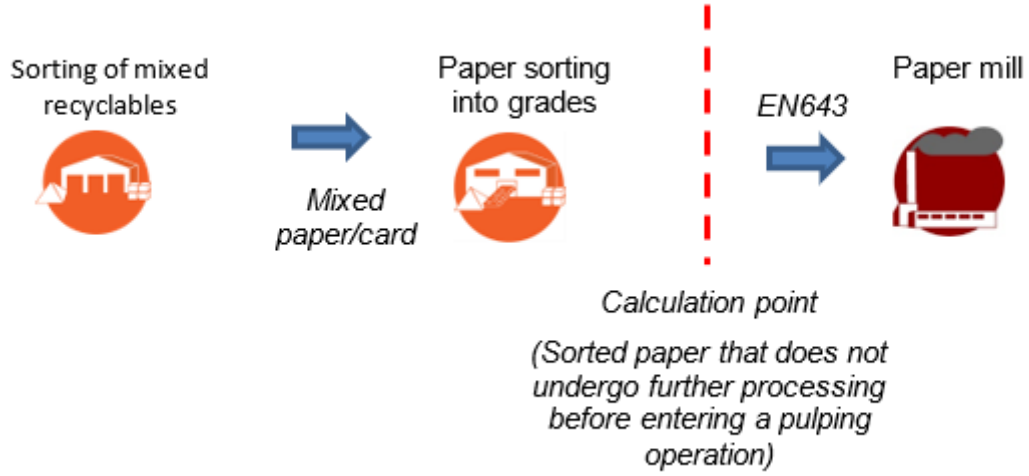
[31] López, F., Román, C., García-Díez, I. and Alg, F., (2013) Energetic Valorisation Of Semi-Rigid And Flexible Aluminium Packaging By Oxidation At High Temperature. Braga, Wastes: Solutions, Treatments And Opportunities 2nd International Conference.

[32] Claassens, H.J.P. CO2 emissions in the recovery and recycling of aluminium from MSWI bottom ash. https://dspace.library.uu.nl/handle/1874/310195

[33] Bunge, R. (2015) Recovery of Metals from Waste Incinerator Bottom Ash, Institut für Umwelt und Verfahrenstechnik UMTEC, April 2015, http://umtec.hsr.ch/fileadmin/user_upload/umtec.hsr.ch/Dokumente/News/1504_Metals_from_MWIBA__R._Bunge.pdf, p. 15/16

[34] Claassens, H.J.P. CO2 emissions in the recovery and recycling of aluminium from MSWI bottom ash. https://dspace.library.uu.nl/handle/1874/310195

Figure A 12: Example with total plant input being MSW or packaging



However, at measurement points further down the recycling value chain, and closer to the calculation point, waste from different sources may have been mixed. This means that the weight of material at the measurement point may not wholly relate to packaging waste. In such circumstances, the total plant output cannot be used to calculate the amount of material contributing to the specific recycling targets at the calculation point because this amount would include out of scope material, and therefore overestimate the recycled amounts for a given target. Therefore, some approach(es) are needed in order to identify the proportion of the total material that should be counted as packaging waste recycled.

If the plant operators cannot easily determine whether the entirety of the waste entering their plant is packaging waste, periodic surveys (e.g. at least every 1–2 years) of the supply chain could be carried out to determine average proportions of in-scope wastes in plant inputs, or to develop nationally applicable protocols for individual materials, that could be applied to the total tonnage of all material at the measurement point.

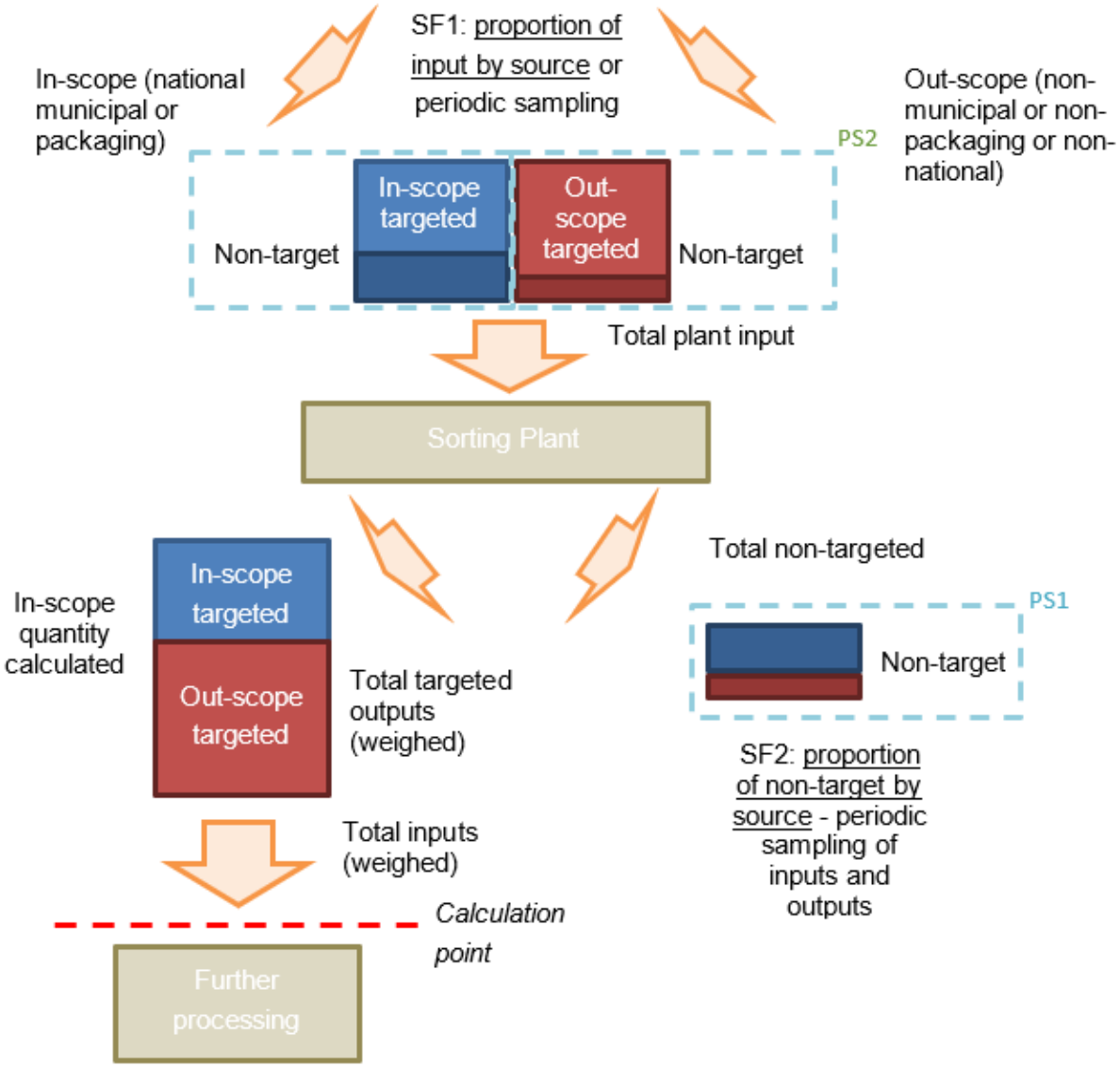
It is important, however, that the classification of packaging wastes and the approaches for identifying the in-scope material are fit for purpose, recognising that packaging is a part of most waste streams and that the targets are material specific.

In order to ensure sufficient funding for these activities, it may be appropriate to seek for financing from packaging EPR schemes in accordance with the new requirements around EPR in Article 8a of the Waste Framework Directive.

Utilising approaches that are based only upon the proportion of in-scope waste inputs to plants assumes that overall plant losses are equivalent to the losses that would occur if plants were treating only one waste stream, in isolation. However, in cases where the losses associated with packaging wastes are different to those of the other waste streams, this may lead to inaccurate data being reported. Consequently, a more detailed approach may be needed to produce reliable data.

Figure A 13 below depicts a situation in which waste is mixed prior to a sorting/treatment phase, and the proportion of non-target material is different between the 'in-scope' and 'out of scope' waste streams

Figure A 13: Concept diagram for source calculations



In Figure A 13, ‘in-scope’ wastes refer to packaging waste, and ‘out of scope’ refers to non-packaging wastes. To calculate the quantity of in-scope wastes recycled, two Source Factors (SFs) are needed:

- SF1: is a factor that describes the proportion of input waste that comes from in-scope sources. As noted above this may be derived from the national waste statistical system (or from improvements to it) in a straightforward way by sorting plant operators submitting the total inputs to the system from in and out of scope sources. However, in some situations, the in and out of scope waste might have been collected together or mixed prior to arrival at the site. In this case, periodic surveys of upstream waste handling processes may need to be carried out in order to determine the factor. For packaging, including biodegradable plastic packaging, sampling of the waste stream may be needed to determine the proportion at the input (sampling methodologies are considered further below).
- SF2: is a factor that would be applied to the total stream of non-target material leaving the plant. It would not be possible to identify the source of the material at this point. Firstly, periodic sampling (PS) would have to be carried out at point PS1 in order to determine the characteristics of the waste material in the output non-target stream. Sampling at the input, point PS2, for both in and out of scope wastes would then need to be carried out to estimate the proportion of non-target material in both streams. These data would then be used to calculate SF2, assuming that the relative proportions of non-target material at the input were the same as at the output. Sampling would be carried out in accordance with standards and to provide an appropriate level of statistical accuracy (e.g. 95% confidence that results are accurate to within +/- 10%).

If it were not possible to accurately identify the type of waste (packaging) in the waste streams, batch sampling of each type of waste may have to be carried out to estimate the relative proportions of non-target material in each type; i.e. a batch of waste from a known source, which was wholly packaging, would be run through the plant and total inputs and outputs measured.

Using this approach, where there is difficulty in sampling the output directly, the following calculation could be developed to provide data relating to the amount of in-scope waste recycled at the calculation point for submission against packaging waste targets:

$$\textit{Recycling (in scope)} = \textit{Weight plant input} \times \textit{SF1} - (\textit{Weight non-target} \times \textit{SF2})$$

Further information on sampling standards and methodologies is given in the next section.

A.2.4.1 Sampling standards and methodologies

Waste sampling needs to be undertaken to a high quality using a consistent minimum standard and accepted procedures in order to ensure valid results. For example, several standards and technical reports already exist at EU level regarding the sampling and analysis of waste:

- EN 14899: Framework for the preparation and application of a Sampling Plan;
- CEN/TR 15310-1: Characterization of waste. Sampling of waste materials – Part 1: Guidance on selection and application of criteria for sampling under various conditions;
- CEN/TR 15310-2: Characterization of waste. Sampling of waste materials – Part 2: Guidance on sampling techniques;
- CEN/TR 15310-3: Characterization of waste. Sampling of waste materials – Part 3: Guidance on procedures for sub-sampling in the field;
- CEN/TR 15310-4: Characterization of waste. Sampling of waste materials – Part 4: Guidance on procedures for sample packaging, storage, preservation, transport and delivery;
- CEN/TR 15310-5: Characterization of waste. Sampling of waste materials – Part 5: Guidance on process of sample defining the sampling plan; and
- BDS EN 15002: Characterization of waste. Preparation of test portions from the laboratory sample.

These standards cover the entire process of waste sampling, from initial planning and preparation of a sampling plan through to final testing of collected samples.

In addition to the European CEN standards, Eurostat publishes a comprehensive Manual on Waste Statistics, which was developed over several years and utilised the experience of multiple stakeholders to develop its methodology. The aim of the manual is to ensure that waste statistics are comparable and harmonised across Member States due to their importance in EU law. The manual covers the whole process of data collection and statistical distribution, including waste generation and treatment, data collection, and data processing, as well as guidance on approaches to statistical surveying to generate waste statistics.

In addition, in the UK, there is a compulsory testing and reporting scheme in place for Material Recovery Facilities (MRFs) which sort mixed recyclable waste. The Environmental Permitting (England and Wales) (Amendment) Regulations 2014 contain requirements for MRFs to routinely sample and test:

- The composition of their input streams by individual supplier; and
- Their main outputs by material stream, e.g. cardboard, paper, metals (in order to understand the level of non-target materials therein).

MRF operators must report the average (or arithmetic mean) percentage composition of target material, non-target material and non-recyclable material every quarter. The organisation WRAP has produced guidance regarding how the samples should be taken and tested.

Finally, initial input from EPR schemes suggests that the use of waste sampling protocols in order to identify the packaging waste proportion for reporting recycling is already underway in several Member States. These protocols vary between Member State EPR schemes depending on the existing collection and treatment systems and also by material. However, they are designed to be aligned with Article 6c(a) and (b) of Decision 2005/270:

(a) *"The amount of recycled packaging waste shall be the amount of waste at the calculation point. The amount of packaging waste entering the recycling operation shall include targeted materials. It may include non-targeted materials only to the extent that their presence is permissible for the specific recycling operation."*

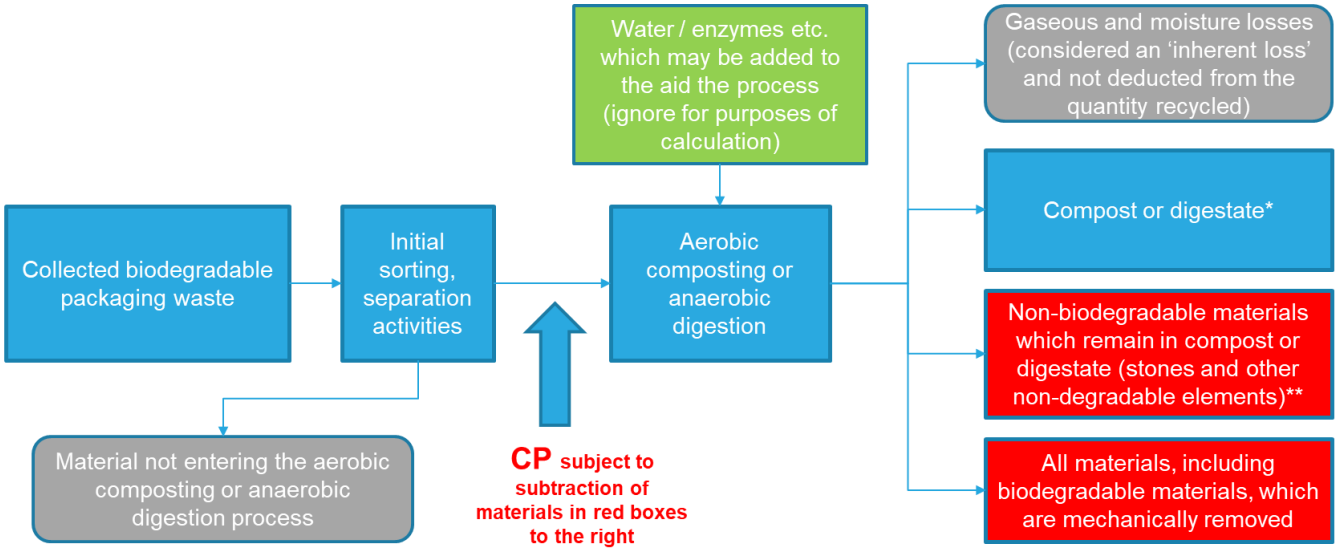
(b) *"Where the measurement point relates to the output of a facility that sends packaging waste for recycling without further preliminary treatment, or to the input of a facility where packaging waste enters the recycling operation without further preliminary treatment, the amount of sorted packaging waste that is rejected by the recycling facility shall not be included in the amount of recycled packaging waste."*

A.2.5 Measuring the amounts of packaging waste composted / digested

A.2.5.1 Correctly identifying the calculation point

The calculation rules for biodegradable packaging waste are set out in the Directive. The details of the legal requirements are discussed further below. The calculation point for biowaste treatment which is either composting or anaerobic digestion is illustrated in Figure A 14, while the calculation point for other types of biowaste treatment is illustrated in Figure A 15.

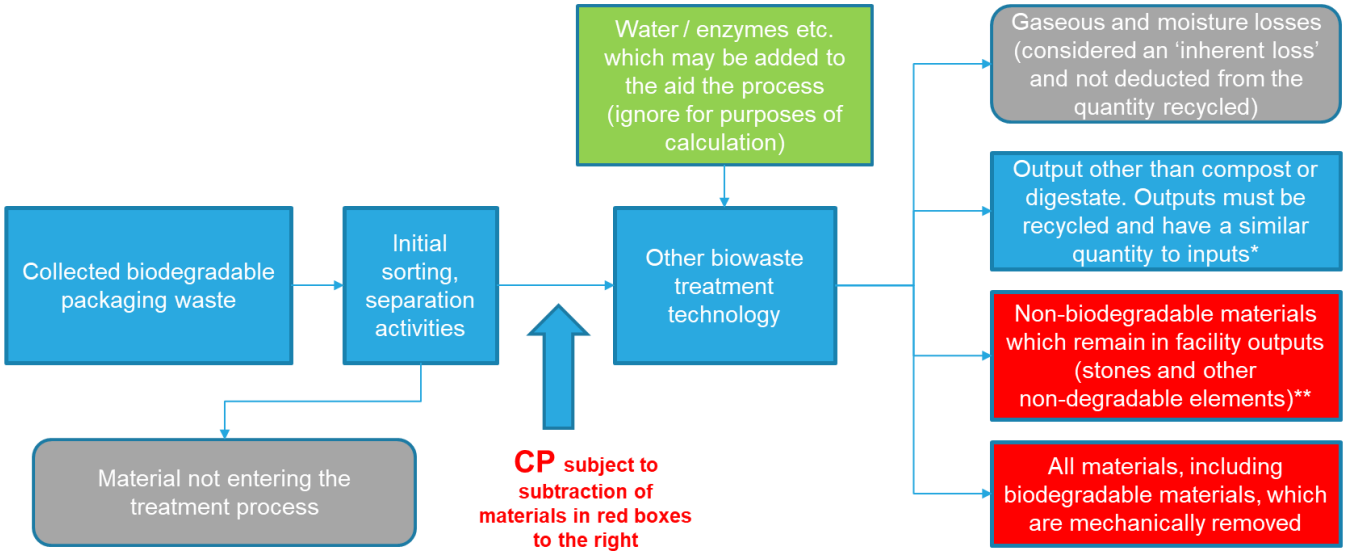
Figure A 14: Biowaste composting or anaerobic digestion calculation point



*Where output is used on land, Member States may count it as recycled only if this use results in benefits to agriculture or ecological improvement. Compost standards or end of waste criterion could be used to help establish the conditions under which these requirements are satisfied. In the case that a proportion of the compost or digestate is not recycled (i.e. used for backfilling, subsequent energy recovery or disposal) then the amounts to be reported should be scaled according to the proportion of output used for each purpose.

**Determined though input sampling to the biowaste treatment process.

Figure A 15: Biowaste treatment which is not composting or anaerobic digestion recycling collection point



*The outputs must have a similar quantity of recycled content in relation to input, and must be used as a recycled product, material or substance. If recycled outputs are less than biowaste inputs, then then the amounts to be reported as recycled should be scaled downwards accordingly.

**Determined though input sampling to the biowaste treatment process.

According to the calculation rules in Article 6a of the Directive, biodegradable packaging waste entering composting or anaerobic digestion processes can be counted as recycling under certain circumstances:

"4. For the purposes of calculating whether the targets laid down in points (f) to (i) of Article 6(1) have been attained, the amount of biodegradable packaging waste that enters aerobic or anaerobic treatment may be counted as recycled where that treatment generates compost, digestate, or other output with a similar quantity of recycled content in relation to input, which is to be used as a recycled product, material or substance. Where the output is used on land, Member States may count it as recycled only if this use results in benefits to agriculture or ecological improvement."

It is necessary to break the above article down to clarify individual aspects:

1) Firstly, consider the following element of Article 6a(4) of the Directive (emphasis added):

*"... the amount of **biodegradable** packaging waste that enters aerobic or anaerobic treatment may be counted as recycled where …"*

- Thus, in practice, in order to **include only the amount of biodegradable waste in the calculation**, the non-biodegradable part of the waste (which may be removed within or after the composting/ anaerobic digestion (AD) process) should be subtracted from the numerator (recycled amount), but included in the denominator (total packaging waste) of the packaging waste recycling calculation. The calculation point should be the entry to a biowaste treatment facility, provided that all materials sent to other treatment options by the facility are subtracted.
- Furthermore, the requirement to only count **biodegradable** waste as recycled means that non-biodegradable parts of the waste **which are not removed** within or after the composting/ anaerobic digestion (AD) process should also be subtracted from the amount of packaging waste measured at the input to the process. Therefore, to reach the amount at the calculation point non-biodegradable materials which remain in facility, outputs should be subtracted from reported figures. This will need to be established by sampling input material entering biowaste treatment operations. Such input sampling should be careful in relation to moisture and biological matter which is likely to stick to the sampled non-biodegradable materials; to provide a true indication of non- degradable material, the sampled non-degradable materials might be dried to ambient (though not dry) conditions to facilitate an accurate analysis.
- Furthermore, although the term 'biodegradable' is used in the applicable terminology, it would seem sensible in the case of packaging waste to link this to the term 'compostable' as currently indicated in EN 13432, thereby discounting material that does not meet the standard.

2) Secondly, consider the following element of Article 6a(4) (emphasis added):

*"... the amount […] that enters aerobic or anaerobic treatment may be counted as recycled **where that treatment generates compost, digestate** […] which is to be used as "*

- This means quantities entering a process which produces compost or digestate count as recycling (subject to subtraction of certain elements covered by other rules discussed above and below). In these cases, it is not necessary to deduct evaporation or losses from biological degradation (i.e. gas and moisture loss) from the amounts reported as recycled. This aligns with the 'general rule' principle within Directive 2008/98/EC, recital 46, which says (emphasis added):

  "As a general rule, the actual measurement of the weight of municipal waste counted as recycled should be at the point where municipal waste enters the recycling operation. […] ***Losses in weight of materials or substances due to physical or chemical transformation processes inherent in the recycling operation whereby waste materials are actually reprocessed into products, materials or substances should not be deducted from the weight of the waste reported as recycled****"*

- However, while inherent losses or changes are allowable, any material removed either at the input or from the outputs of a process should not be counted as recycled.
- In effect, all material mechanically removed from the compost/digestate does not contribute to amounts recycled (except in the instance that it is counted under a different recycling process).

3) Thirdly, consider the following element of Article 6a(4) (emphasis added):

"…the amount of biodegradable packaging waste that enters aerobic or anaerobic treatment may be counted as recycled ***where that treatment generates compost, digestate, or other output with a similar quantity of recycled content in relation to input, which is to be used as a recycled product, material or substance****."*

- This means that quantities entering specific processes that produce outputs which are not compost or digestate may only count as recycled if:
  - The output quantities have a similar share in relation to the input quantities as compared to treatments generating compost or digestate;
  - The outputs are used as a recycled product; and
  - The other rules discussed above and below are also met.

This aligns with recital 17 of Directive 2018/852, amending the Directive, which says:

"While the output of such [aerobic or anaerobic] treatment is most commonly compost or digestate, other output could also be taken into account provided that it contains comparable quantities of recycled content in relation to the amount of the treated biodegradable waste."

- The generation of such other outputs is expected to be less common or significant for Member States, but can be understood to apply to processes such as biochemical

technologies producing feedstocks which are recycled as substances or products (for instance starch which may be used in paper or paperboard strengthening, textile warp sizing liquor, starch bags and liners etc.).

- Recital 17 continues with the following qualification that the reprocessing of biodegradable packaging waste, resulting in products which are to be used in other processes (such as pellet fuel production facilities) which do not recycle compost or digestate or other recycled materials where the amount recycled is similar to the input quantity, is not considered recycling:

> *"In other cases, in line with the definition of recycling, the reprocessing of biodegradable waste into materials which are to be used as fuels or other means to generate energy, which are disposed of, or which are to be used in any operation that has the same purpose as recovery of waste other than recycling, should not be counted towards the attainment of the recycling targets."*

4) Finally, consider the last sentence of Article 6a(4) **(emphasis added)**:

> *"Where the output is used on land, Member States may count it as recycled only if this use results in **benefits to agriculture or ecological improvement.**"*

- The extent to which biodegradable packaging waste will fulfil this requirement depends on the specific definition of *"benefits to agriculture or ecological improvement".* No such definition exists at present in EU legislation.

- The Directive explicitly states that the use should result in 'benefits'. The spirit of Article 6a(4) is that biodegradable packaging waste provides the same, or at least broadly similar, benefits to agricultural soil as other composted organic matter. This goes beyond the requirements of the current Standards for Compostability EN 13432 which states that the compost is "not negatively affected by the addition of that packaging material or packaging component" according to plant growth test OECD 208. The implication of this is that conformance with this standard does not necessarily imply that the requirements of Article 6a(4) are also met.

A.2.5.2 Rules concerning compostable plastics

Concerning compostable plastic packaging, Article 22(1) of Directive 2008/98/EC allows this to be collected, and thus treated, with biowaste:

> *"Member States may allow waste with similar biodegradability and compostability properties which complies with relevant European standards or any equivalent national standards for packaging recoverable through composting and biodegradation, to be collected together with bio-waste"*

However, a recent study by the Commission found inconclusive evidence regarding the ecological benefit or otherwise of composting this material.[35] Consequently, the abovementioned rules alone provide the basis of whether compostable packaging can be counted under the recycling targets or not. **If Member States include any compostable plastic packaging in the amounts recycled, evidence of benefits to agriculture or ecological improvement where the output was used on land must be provided along with the quality report**. The amounts of compostable plastic packaging that are included in the total plastic recycling and total plastic waste generation figures must also be stated separately in tonnage terms in the quality report. Details can be provided under question 18.5.4. in the quality report.

However, identifying the amount of compostable plastics entering a biowaste treatment facility separately from other types of waste may be challenging if the compostable plastics arriving at the site is not separate from other wastes arriving at the facility. Also, the amount of compostable packaging in the waste stream may change in the future, particularly given the increase in the use of compostable plastic packaging. Ensuring these wastes are included in the packaging recycling rates may, therefore, become more important over time.

Surveys could be carried out on plant inputs (either on a plant-by-plant basis, or through wider research on composition levels within collected wastes) to estimate the amount of compostable packaging entering such facilities. Given the rapid changes in the amount of compostable plastics on the market, as driven by changes in trends in packaging, such surveys should be carried out on a relatively frequent basis. Indeed, Article 6c(d) of Decision 2005/270 states that:

> *"Where biodegradable packaging that is subject to aerobic or anaerobic treatment is included in the recycled amounts for the respective packaging material, the amount of biodegradable packaging in biodegradable waste shall be determined by performing regular composition analyses of the biodegradable waste entering those operations."*

By way of example, there has been a survey in Italy carried out by the Italian Composting Association (CIC), in cooperation with the PRO for plastics (COREPLA), which included a comprehensive sampling programme of input materials at composting sites. This programme was able to identify: a) the amount of fossil-derived plastics (and how much thereof, were bags or packaging); and b) the amount of compostable plastics ending up in composting sites. The survey found that the proportion of compostable plastics in the total weight of material collected through separate food waste collections entering the plants was 1.4%.

[35] "Relevance of biodegradable and compostable consumer plastic products and packaging in a circular economy" https://op.europa.eu/s/n3Rv

Additionally, it is important that compostable plastic packaging that is not fully composted is not included in the amounts recycled. This is consistent with Article 6c (d) of 2005/270, which states that:

> *"Biodegradable packaging waste that is removed before, during or after the recycling operation shall not be included in the recycled amounts."*

A.2.5.3 Processes in which recycling and energy recovery of biowaste are combined

There are technologies that treat separately collected biowastes, or materials derived from biowaste, from which the output streams include both biological materials and also products that can be used to generate energy. One example already discussed above is anaerobic digestion (AD), where the anaerobic degradation of biomass leads to the generation of methane, which can be used for various purposes (in combined heat and power generation, or, after further cleaning, for use as vehicle fuel, or for injection into the gas network, typically for use as heating fuel). In such cases, subject to the solid/liquid output material being used as a recycled product, material or substance, the input material, net of rejects and non-biodegradable waste, is deemed to be recycled.

As per Article 6a(4) of the Directive, this applies for biowaste in the following cases:

- A technology where compost is generated and recycled (i.e. composting).
- A technology where digestate is generated and recycled (i.e. anaerobic digestion).
- Other technologies producing other recycled outputs **but only** where a similar quantity of recycled content is produced in relation to input compared to the processes listed above.

In addition, where the output is used on land, Member States may count it as recycled only if this use results in benefits to agriculture or ecological improvement (see Appendix A.2.5.1). In situations such as where the outputs are used for backfilling, then this would classify as "other recovery".

As noted above, it is not the intention of the Directive (Art. 6a(5)) to count material as being recycled where end-of-waste materials are used as fuels or other means to generate energy:

> *"However, end-of-waste materials to be used as fuels or other means to generate energy, or to be incinerated, backfilled or landfilled, shall not be counted towards the attainment of the recycling targets"*

Where compostable packaging waste is concerned, therefore, it is clear that sending the residues from biological treatment for incineration (including pyrolysis and gasification) **is not to be considered to have been recycled.**

In a situation where a facility creates a compost or digestate output, and through the course of the year a certain percentage of the output is used as compost or digestate, but for another part of the year a percentage of the output is backfilled, and another part of the year a percentage of the output is thermally treated for energy production – then the amounts

reportable for recycling, energy recovery and other recovery should be scaled according to the proportion of output used for each purpose.

A.2.6 Applying the average loss methodology

A.2.6.1 Application of average loss rates (ALRs)

Under Article 6a of the Directive, ALRs may be applied in certain circumstances:

> *2. "[…] the weight of packaging waste recycled shall be measured when the waste enters the recycling operation.*
>
> *By way of derogation from the first subparagraph, the weight of packaging waste recycled may be measured at the output of any sorting operation provided that:*
>
> *(a) such output waste is subsequently recycled;*
>
> *(b) the weight of materials or substances that are removed by further operations preceding the recycling operation and are not subsequently recycled is not included in the weight of waste reported as recycled.*
>
> *3. Member States shall establish an effective system of quality control and traceability of municipal waste to ensure that the conditions laid down in point (c) of paragraph 1 of this Article and in paragraph 2 of this Article are met. To ensure the reliability and accuracy of the data gathered on recycled waste, the system may consist of electronic registries set up pursuant to Article 35(4), technical specifications for the quality requirements of sorted waste, or average loss rates for sorted waste for various waste types and waste management practices respectively. Average loss rates shall only be used in cases where reliable data cannot be obtained otherwise […]."*

Recital 15 of the Directive, provides further guidance:

> *"(15) The calculation of the recycling targets should be based on the weight of packaging waste which enters recycling. As a general rule, the actual measurement of the weight of packaging waste counted as recycled should be at the point where packaging waste enters the recycling operation. Nevertheless, in order to limit administrative burdens, Member States should, under strict conditions and by way of derogation from the general rule, be allowed to establish the weight of packaging waste recycled on the basis of measuring the output of any sorting operation. Losses of materials which occur before the waste enters the recycling operation, for instance due to sorting or other preliminary operations, should not be included in the waste amounts reported as recycled. Those losses can be established on the basis of electronic registries, technical specifications, detailed rules on*

the calculation of average loss rates for various waste streams or other equivalent measures. Member States should report on such measures in the quality check reports accompanying the data which they report to the Commission on waste recycling. The average loss rates should preferably be established at the level of individual sorting facilities and should be linked to the different main types of waste, different sources (such as household or commercial), different collection schemes and different types of sorting processes. Average loss rates should only be used in cases where no other reliable data are available, in particular in the context of shipment and export of waste. Losses in weight of materials or substances due to physical or chemical transformation processes inherent in the recycling operation where packaging waste is actually reprocessed into products, materials or substances should not be deducted from the weight of the waste reported as recycled."

ALRs should only be used when there is no other reliable data available on material losses that occur before the calculation point, such as data from electronic registries. The main instance in which ALRs might be applied is where waste is exported for recycling and reliable data on such losses cannot be obtained from the operators in the receiving country. In this case, further conditions as specified under Appendix A.2.6.3 should be applied.

ALRs can be applied at different outputs of sorting processes in the waste management chain, and are dependent upon the source and type of packaging material. After initial sorting, different materials are subject to a range of down-stream processes before the recycling calculation point, each with varying loss rates. This is especially true for plastics, as different polymer types can follow different recycling processes. It is reported that mixed plastic polymers have high levels of material rejects that are sent for disposal or energy recovery. In comparison, materials that are easier to sort, such as steel cans, typically have much lower reject rates. As such, ALRs for mixed plastic packaging should ideally only be applied after the plastics are separated into different polymer types.

Annex IV of Decision 2019/665 (paragraph 2.2.5.) provides a table for reporting the use of ALRs, as shown in Figure A 16. The information provided under the 'description' column should include a description of the methodological approach taken to calculate the ALRs, including the statistical accuracy of any surveys used and the nature of any technical specifications. This format is provided for reporting in question 18.5.6 of the quality report.

Figure A 16: Table for reporting the use of ALRs

Sorted waste material and sorting plant type	ALR applied (in %)	Description

Add rows as appropriate.

A.2.6.2 Approaches to calculating ALRs

ALRs are calculated as the weight of the average losses from sorted packaging waste up until the calculation point, in relation to the weight of the sorted packaging waste.

ALRs can be defined and calculated in different ways. For instance, they can be defined at the national level, by plant type, or on a plant by plant basis. Calculating ALRs may be based on data collected in the following ways: periodic surveys to sample losses throughout the chain from output of sorting to the calculation point, using technical specifications regarding the allowable levels of non-target material in certain material streams at the output of sorting, and extrapolating loss rates provided by other Member States.

The surveys referred to above should include data from at least one of the following methods:

- Representative sampling of the input and output of preliminary treatment of batches of sorted packaging waste from waste treatment facilities in a Member State.
- Representative sampling of the total input and output of waste treatment facilities carrying out preliminary treatment.
- Data on the total annual input and output of waste treatment facilities carrying out preliminary treatment, which may be calculated as an average of up to three consecutive years.

The most appropriate approach depends upon a number of factors including:

- The variation in non-targeted material for in-scope waste streams;
- The proportion of input to facilities that is from in-scope waste streams; and
- The variation in overall loss rates for different configurations of sorting operations.

A.2.6.3 Tracking ALRs through the recycling chain

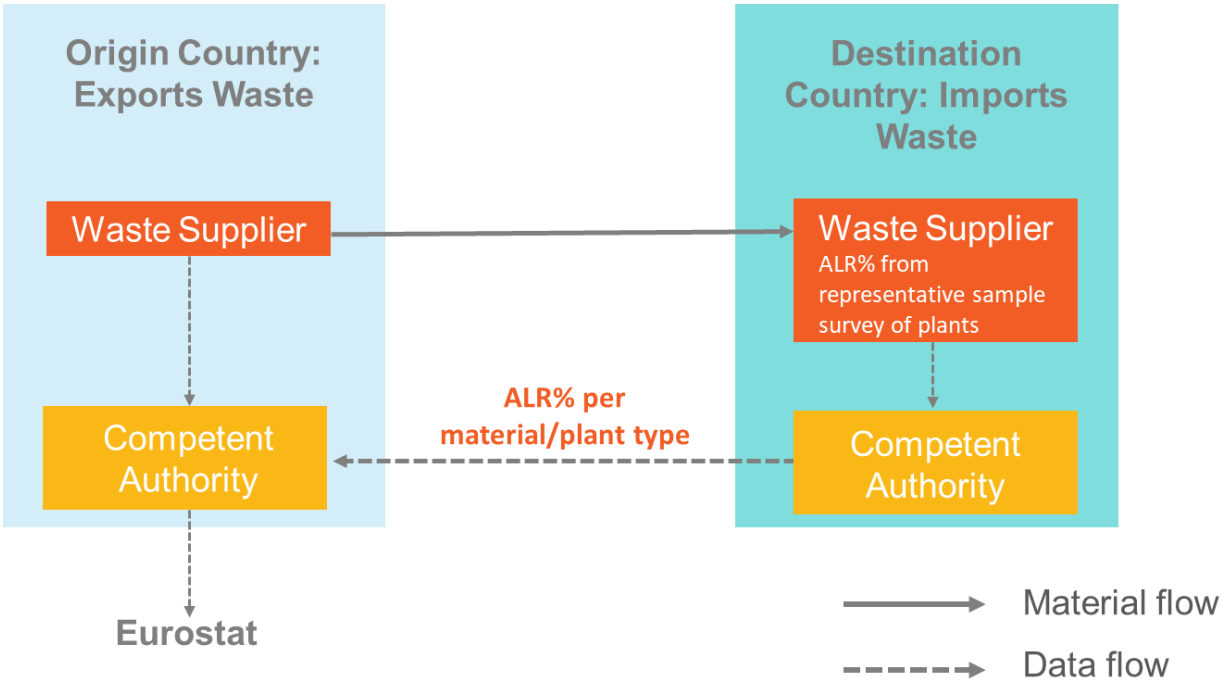
Where ALRs are to be applied to packaging waste sent for further treatment in another country, an appropriate mechanism needs to be defined in order to transfer ALRs from the destination country back to the country of origin. This is necessary in order to report the total weight of packaging waste exported, along with the relevant ALRs, to the competent authorities in the waste's country of origin.

Figure A 17 demonstrates the approach to transferring ALRs between Member States. The ALR data is passed between the competent authorities of each Member State – the exact mechanism still needs to be developed, and direct transfer between operators is still within scope of a future Delegated Act. Requests for ALRs would need to be made by the competent authority and a common categorisation of treatment plant types would need to be developed.

However, it is noted that there are a number of challenges in applying ALRs to exported waste, particularly outside of the EU. The systems described above require other countries and operators to partake in the system, potentially requiring legislation in the destination countries. If such approaches were not feasible, a method for ensuring that non-target

material was deducted from the amount of waste reported as exported for recycling would be required. For example, the highest ALR for a given material and process type used anywhere in the EU could be applied to any exports of that type. Alternatively, further studies could be carried out to develop ALRs for various countries to which certain types of packaging waste are exported for recycling.

Figure A 17: ALRs Reported between Competent Authorities



A.2.6.4 Data collection and verification

In order to ensure that the ALRs used are accurate, measures should be taken to verify the data used for calculating the ALRs and to ensure that the sampling methods used are highly accurate. Member States should also take measures to ensure that the sorted waste from the various facilities surveyed is of comparable quality. Member States should conduct verification of the evidence from waste recycling operators at least annually.

A.2.7 Guidance on proving compliance with requirement to ensure all waste outside the EU is treated under broadly equivalent conditions

Article 4 of Decision 2005/270 states that:

> *"1. For the purposes of calculating and verifying attainment of the targets set in points (a) to (e) of Article 6(1) of Directive 94/62/EC, packaging waste exported out of the Union shall be counted as recovered or recycled only if there is sound evidence that the recovery and/or recycling took place under conditions that are broadly equivalent to those prescribed by the relevant Union legislation."*

In considering how Member States can provide evidence that waste is being exported to facilities where broadly equivalent conditions apply, it was noted that there is currently no standard or certification that a facility can obtain that would show that it meets the test of broad equivalence.

Member States have previously expressed interest in the Commission preparing an approved list of facilities and/or countries where broadly equivalent standards were in place, recognising that it makes little sense for each Member State to make its own individual assessment if the standard is to be applied in a consistent manner, and that an EU-wide approach could reduce administrative costs (e.g. around the translation of documents received from waste receiving countries) and produce greater harmonisation. However, there was also concern regarding whether this was an appropriate undertaking for the Commission, whether the Commission had the resources to undertake such assessments, and whether an EU-wide approach might give rise to problems in relation to World Trade Organisation (WTO) rules on non-discrimination.

Accordingly, the guidance in the following sections has been provided for Member States to assist them in meeting their obligations under Art. 6a(8) of the Directive regarding recycling exports and proving compliance with this requirement. This includes the interpretation of the term “broadly equivalent”, establishing whether broadly equivalent conditions are in place, and addressing potential statistical issues.

A.2.7.1 A definition of “broadly equivalent conditions”

An appropriate definition might be as follows:

> *“A receiving facility that operates under ‘broadly equivalent conditions’ to those situated within the EU is one that operates under a system of rules that broadly replicates the requirements of the acquis that help guard against, or limit, negative environmental impacts arising from the facility.”*

While the language used varies slightly between different pieces of legislation, there is no significant difference between formulations such as “broadly equivalent conditions” and “broadly equivalent standards”, not least since, apart from in the case of WEEE, codification of the implied conditions within a set of standards has not taken place.

The relevant standards that must be met in order to achieve broad equivalence are the laws on:

- The licensing and operation of waste facilities;
- Emissions to air; and
- Emissions to water.

Therefore, the standards that are relevant are those that relate to the environment, including environmental laws focused on human health. These include:

- The receiving facility should be subject to a permitting system, in line with Chapter IV of Directive 2008/98/EC.

- The receiving facility should be subject to an inspection, record-keeping and enforcement system, in line with Chapter VI of Directive 2008/98/EC.
- For processes that fall under Annex I of Directive 2010/75/EU (e.g. the processing of metals, and the handling of any residues that may not be suitable for recycling), the facility should conform with the requirements of Directive 2010/75/EU[36] on industrial emissions regarding permits, inspections, record keeping and enforcement.
- The receiving facility should maintain adequate records to demonstrate the fate of the material it receives – e.g. the proportion that is recycled (and who purchases the material), and the quantity that is rejected or lost through processing (and how such material is managed.

In line with the requirements of Article 27 of Directive 2008/98/EC, these requirements shall also take account of the standards set out in any relevant Best Available Techniques reference document (BREF), in particular the Best Available Techniques (BAT) Reference Document for Waste Treatment[37] and any sections of BAT Reference Documents for the production of materials insofar as they relate to techniques specific to the use of waste material as feedstock, such as the BREFs for:

- Pulp, Paper and Board[38];
- Iron and Steel[39]; and
- Non-ferrous Metals[40].

Where receiving facilities would, if within the EU, be subject to Directive 2010/75/EU, the permitted limit values for emissions should be in line with any relevant BAT Reference Documents, as required by Article 14 of the Directive 2010/75/EU. A key example would be facilities that process secondary metals.

The use of the term “broad equivalence” rather than “equivalence” implies that the standards met by receiving facilities need not be identical to those in the EU, or achieve exactly the same results. However, it would be difficult to demonstrate broad equivalence if any of the issues covered by EU law are entirely unaddressed in the standards that the facility must meet, or if those standards (or the performance achieved) are substantially lower than would be required in the EU.

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[36] Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control) (OJ L 334, 17.12.2010, p. 17–119)

[37] European Commission (2018) Best Available Techniques (BAT) Reference Document for Waste Treatment, 2018, https://ec.europa.eu/jrc/en/publication/eur-scientific-and-technical-research-reports/best-available-techniques-bat-reference-document-waste-treatment-industrial-emissions

[38] DG JRC (2015) Best Available Techniques (BAT) Reference Document for the Production of Pulp, Paper and Board, 2015, https://ec.europa.eu/jrc/en/publication/eur-scientific-and-technical-research-reports/best-available-techniques-bat-reference-document-production-pulp-paper-and-board-industrial

[39] Joint Research Centre (2013) Best Available Techniques (BAT) Reference Document for Iron and Steel Production, January 2013, https://ec.europa.eu/jrc/en/publication/reference-reports/best-available-techniques-bat-reference-documentforiron-and-steel-productionindustrial-emissions

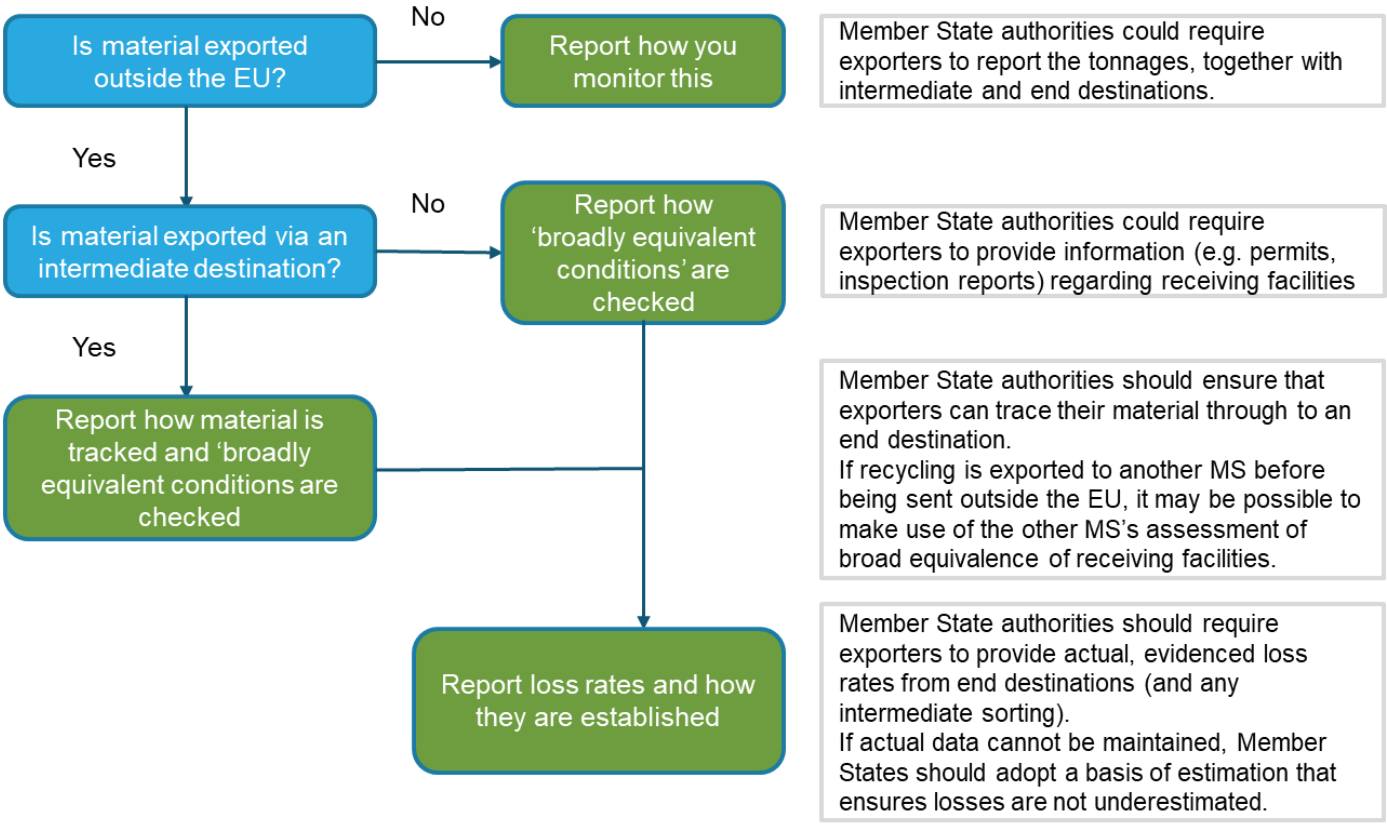
[40] Joint Research Centre (2017) Best Available Techniques (BAT) Reference Document for the Non-Ferrous Metals Industries, 2017, https://op.europa.eu/en/publication-detail/-/publication/c0bc6046-651c-11e7-b2f2-01aa75ed71a1

Recycling facilities that meet these requirements – not necessarily exactly as specified in EU law, but achieving the same or very similar effects – should be regarded as operating under conditions that are broadly equivalent to the requirements of the relevant Union environmental law."

A.2.7.2 Guidance on establishing whether broadly equivalent conditions are in place

In order to confirm that broadly equivalent conditions are in place in receiving countries/facilities, Member States (and the responsible bodies within them) will need to make more consistent assessments than are currently made in practice. A proposed process for doing so is shown in Figure A 18.

Figure A 18: Outline Monitoring and Reporting Process



This process is supplemented by the following guidelines:

- Regarding materials that may be of greater or less significance for waste exports, examples include:
    - Glass and biowaste will rarely be exported from the EU, and it may be appropriate to take a proportionate approach to seeking to validate that no such material has been exported.
    - Exports of plastic and paper are commonplace, and are associated with concerns regarding quality, loss rates and leakage. Exports therefore require more careful scrutiny.
    - Metal recycling operations can give rise to high levels of industrial emissions, and involve processes that within the EU would be subject to the Industrial

Emissions Directive. Therefore, facilities receiving exports will require similar scrutiny focused on their emissions.

  - Any recycling operation may give rise to residues and losses that require disposal and Member States should require information regarding the treatment of these materials, which must also take place under broadly equivalent conditions.

- Regarding the types of positive evidence that might demonstrate whether, in general, exports to a particular country may be permissible, examples might include:
  - Documentary evidence of the existence of an effective system of permitting that applies similar operating requirements and emissions limit values to those in force in the EU.
  - Documentary evidence of the existence of an effective system of inspection and enforcement, including steps being taken to deal with non-compliant facilities.
  - Documentary evidence regarding the disposal/treatment arrangements for residues and losses.
- Regarding the types of positive evidence that might demonstrate whether exports to a particular facility may be permissible, examples might include:
  - The facility's operating permit, showing that it is required to meet appropriate standards regarding site operations, emissions and the handling of residues/losses.
  - The facility's inspection and compliance record, demonstrating that the required standards are in fact being met.
  - Independently audited quality standards met by the facility, potentially providing additional assurance that appropriate procedures are being followed.
- Regarding negative evidence that might indicate that, irrespective of other evidence, a country or facility is not applying broadly equivalent conditions, examples might include:
  - Inspection or enforcement records indicating that the facility is failing to meet the required standards.
  - Credibly sourced NGO and/or news reports highlighting poor practice in a country, which may undermine the plausibility of documentary evidence regarding the country's permitting system.
  - Concerns regarding specific facilities that may undermine the plausibility of their inspection record, including evidence of:
    - The absence of appropriate perimeter fencing to ensure that only authorised persons enter the facility;
    - A lack of proper storage arrangements to prevent waste materials escaping the facility, e.g. as a result of wind or rain;
    - The use of uncontrolled burning at the facility;
    - Unabated discharges to the atmosphere from controlled combustion;
    - Discharges of chemical effluent to local watercourses; and

- The use of uncontrolled dumpsites or fly-tipping to dispose of residues and material removed from the recyclate through sorting.

Where concerns arise, it may be appropriate to undertake steps such as seeking additional information from the country or facility, or undertaking a site visit (if the facility or country is of particular importance in terms of scale).

If the evidence gathered provides good reason to believe that the receiving facility is not carrying out recycling operations under broadly equivalent conditions to those that apply within the EU, the Member State should ensure that no further exports to that facility are counted as recycled until evidence is obtained that broadly equivalent conditions have been reinstated reliably.

A.2.7.3 Guidance on common statistical issues

The following guidance relates to addressing common statistical issues.

- A Member State declaring that it does not export any recyclate outside the EU should provide an evidence trail that supports this claim – especially where recyclate may be transported to another Member State as an interim destination before being sent to its final treatment destination.
    - It remains the responsibility of the originating Member State to evidence that material it claims towards its recycling target has been recycled.
    - It is difficult to demonstrate conclusively a negative claim (i.e. that no exports took place). Therefore, such Member States should provide evidence that their material was sent to recycling operations within the EU, for example by providing a comprehensive list of the end destinations for each material stream, the approximate tonnage treated at each, and the means by which they validated that this was in fact the end destination.
- Where recyclable waste is transported between Member States prior to export outside the EU, this can give rise to tracking issues. A review of the implementation of the Waste Shipment Regulations[41] found that there was significant misreporting (for example, where one Member State's estimate of waste exports to another Member State did not match the latter's estimate of imports from the former). Poor traceability undermines the ability of Member States to demonstrate that exported waste is recycled under broadly equivalent conditions, and will need to be addressed for Member States to be able to demonstrate this in the future.

  Therefore, Member States will likely need to monitor the tonnage and destinations (both intermediate and end) of 'green list' wastes in order to demonstrate that such material is being recycled under broadly equivalent conditions.
- Wherever possible, Member States should obtain from exporters actual data on the quantity of material that is ultimately recycled. Where this is done, Member States should describe how they obtained these data from the overseas facilities receiving the material. However, where material passes through an intermediate destination, and perhaps becomes mixed with similar material from other sources, it can become

[41] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:02006R1013-20180101

more difficult to calculate the quantity of material originating in a particular Member State that is ultimately recycled.

- Where direct information on rejects, residues and losses cannot be obtained, Member States should adopt an approach to estimating losses. Any such approach should be based on a clear rationale which ensures that the proportion recycled is not overestimated.
- The loss rate for exported waste should not be:
    - Lower than the estimated percentage of contamination found in material of a particular type that is exported from the Member State; or
    - Lower than the loss rate for material reprocessed domestically, or in neighbouring Member States.
- Where an estimated or default loss rate is used, Member States should explain the basis on which it has been selected and provide a rationale for its use. Further guidance on applying average loss rates (ALRs) is provided in Appendix A.2.6.

A.2.7.4 Information sharing

In order to minimise duplication of effort, the sharing of information between Member States regarding broadly equivalent conditions is encouraged. In practice, some Member States already make use of assessments carried out by others.

While having regard to the commercial confidentiality of contracts that exporters may have entered into, Member States should publish their assessments of countries and facilities – including those deemed not to have broadly equivalent standards in place – and respond positively to requests from other Member States' authorities to share the evidence on which their assessments have been based.

The Commission may consider collating and publishing Member States' assessments, and may wish to highlight where there are inconsistencies between assessments so that Member States can review whether an appropriate assessment has been made. The Commission may also include details regarding the date on which assessments were made, so that other Member States can decide whether they are sufficiently up to date to be able to be relied upon. Further details will be provided in future if such a system of information sharing is established.

Appendix 3 Reference manual: Reporting of data on packaging reuse

This appendix provides Member States with additional information on reporting data on reusable packaging.

A.3.1 Definitions

Definitions related to reporting of reusable packaging data, taken from the relevant European legislation and standards, are given in Table A 3.

Table A 3: Glossary of definitions related to reusable packaging

Term	Definition
Auxiliary product	'products used to support the refilling/loading of reusable packaging' (EN Standard 13429:2004, ISO Standard 18603:2013)
Calculation period	'period over which the number of trips or reuse ratio is calculated NOTE This should be of adequate duration to smooth out the effects of seasonal variation, product lifetime, packaging inputs and other factors which can affect the calculation' (EN Standard 14520:2007)
Closed loop system	'system in which reusable packaging is circulated by a company or a co-operating group of companies' (EN Standard 13429:2004, ISO Standard 18603:2013)
Economic operators	'in relation to packaging shall mean suppliers of packaging materials, packaging producers and converters, fillers and users, importers, traders and distributors, authorities and statutory organizations' (Directive 94/62/EC, Article 3(11))
Emptier	'a person or entity who empties a package' (ISO Standard 18693:2013)
Grouped packaging	'or secondary packaging, i. e. packaging conceived so as to constitute at the point of purchase a grouping of a certain number of sales units whether the latter is sold as such to the final user or consumer or whether it serves only as a means to replenish the shelves at the point of sale; it can be removed from the product without affecting its characteristics' (Directive 94/62/EC, Article 3(1b))
Hybrid system	'system consisting of two parts: a) reusable packaging, remaining with the end user, for which there exists no redistribution system leading to commercial refilling; b) one way packaging, used as an auxiliary product to transport the contents to the reusable packaging' (EN Standard 13429:2004, ISO Standard 18603:2013)

Term	Definition
Lifetime	‘period from the first use of the packaging until it is no longer in use and becomes waste’ (EN Standard 14520:2007)
Measurement point	‘point in the rotation loop at which the information for the calculation is gathered’ (EN Standard 14520:2007)
Newly manufactured packaging	‘newly purchased packaging entering the system for the first time to increase the population or replace all types of losses’ (EN Standard 14520:2007)
Open loop system	‘system in which reusable packaging circulates amongst unspecified companies’ (EN Standard 13429:2004, ISO Standard 18603:2013)
Packaging	‘all products made of any materials of any nature to be used for the containment, protection, handling, delivery and presentation of goods, from raw materials to processed goods, from the producer to the user or the consumer. ‘Non-returnable’ items used for the same purposes shall also be considered to constitute packaging’ (Directive 94/62/EC, Article 3(1))
Packaging used for the same purpose	‘packaging which, having completed a rotation, is subsequently reused with the original intent, in a system for reuse’ (EN Standard 13429:2004, ISO Standard 18603:2013)
Population	‘total number of a packaging type, empty or filled, in that whole reuse system’ (EN Standard 14520:2007)
Preparing for reuse	‘means checking, cleaning or repairing recovery operations, by which products or components of products that have become waste are prepared so that they can be reused without any other pre-processing’ (Directive 2008/98/EC Article 3(16))
Reconditioning	‘operations necessary to restore a reusable packaging to a functional state for reuse purposes’ (EN Standard 13429:2004, ISO Standard 18603:2013)
Reusable packaging	‘packaging which has been conceived, designed and placed on the market to accomplish within its lifecycle multiple trips or rotations by being refilled or reused for the same purpose for which it was conceived’ (Directive 94/62/EC, Article 3(2a) ‘packaging or packaging component which has been conceived and designed to accomplish within its life cycle a minimum number of trips or rotations in a system for reuse’ (EN Standard 13429:2004)
Reuse	‘means any operation by which products or components that are not waste are used again for the same purpose for which they were conceived’ (Directive 2008/98/EC Article 3(13)) ‘operation by which packaging, which has been conceived and designed to accomplish within its life cycle a minimum number of trips or rotations, is refilled or used for the same purpose for

Term	Definition
	which it was conceived, with or without the support of auxiliary products present on the market enabling the packaging to be refilled: such reused packaging will become packaging waste when no longer subject to reuse' (EN Standard 13429:2004)
Rotation	'rotation means a trip performed by reusable packaging from the moment it is placed on the market together with the goods it is intended to contain, protect, handle, deliver or present, to the moment it is sent back for reuse in a system to reuse packaging with a view to its repeated placing on the market together with the goods' (Decision 2005/270/EC Article 2(1f) as amended by 2019/665)
	'cycle undergone by reusable packaging from filling/loading to filling/loading. A rotation will always contain a trip' (EN Standard 13429:2004, ISO Standard 18603:2013)
Sales packaging	'or primary packaging, i. e. packaging conceived so as to constitute a sales unit to the final user or consumer at the point of purchase' (Directive 94/62/EC, Article 3(1a))
Supplier	'entity responsible for placing packaging or packaged goods on the market' (ISO Standard 18603:2013)
System adjustment	'increase or decrease of population of a packaging type due to market fluctuation' (EN Standard 14520:2007)
System losses	'all types of losses of packaging from the system' (EN Standard 14520:2007)
Systems for reuse	'organisational, technical or financial arrangements which ensure that reusable packaging performs multiple rotations' (Decision 2005/270/EC Article 2(1g) as amended by 2019/665)
	'established arrangements (organizational, technical and/or financial) which ensures the possibility of reuse' (EN Standard 13429:2004, ISO Standard 18603:2013)
Transport packaging	'or tertiary packaging, i.e. packaging conceived so as to facilitate handling and transport of a number of sales units or grouped packaging in order to prevent physical handling and transport damage. Transport packaging does not include road, rail, ship and air containers' (Directive 94/62/EC, Article 3(1c))
Trip	'transfer of packaging, from filling/loading to emptying/unloading. A trip may be part of a rotation' (EN Standard 13429:2004, ISO Standard 18603:2013)

A.3.2 Legislative framework

Recent revisions to packaging waste legislation (both the Waste Framework Directive and Packaging Waste Framework Directive were updated in 2018), as well as the European

Green Deal, Circular Economy Action Plan and the Directive on the Reduction of the Impact of Certain Plastic Products on the Environment (Single Use Plastic Directive), have set a policy framework which is promoting actions on reuse by the Member States.

In line with the waste hierarchy, as laid down in Article 4 of Directive 2008/98/EC, Member States are encouraged to take measures that increase the share of reusable packaging placed on the market and to establish systems to reuse packaging. This includes use of deposit-return schemes, setting qualitative or quantitative targets, the use of economic incentives and setting a minimum percentage of reusable packaging that must be placed on the market every year for each packaging stream (as per Article 5(1) of the Directive).

There are currently no mandatory targets for the reuse of packaging. However, in order to encourage an increase in the share of reusable packaging placed on the market, and to encourage systems to reuse packaging, Member States may include reuse as a contribution towards their performance against recycling targets (without explicitly mandating reuse activities). Article 5(2) of the Directive states that:

> *"A Member State may decide to attain an adjusted level of the targets referred to in points (f) to (i) of Article 6(1) for a given year by taking into account* ***the average share, in the preceding three years, of reusable sales packaging placed on the market for the first time and reused as part of a system to reuse packaging****. The adjusted level shall be calculated by subtracting: (a) from the targets laid down in points (f) and (h) of Article 6(1), the share of the reusable sales packaging referred to in the first subparagraph of this paragraph in all sales packaging placed on the market, and (b) from the targets laid down in points (g) and (i) of Article 6(1), the share of the reusable sales packaging referred to in the first subparagraph of this paragraph, composed of the respective packaging material, in all sales packaging composed of that material placed on the market.* ***No more than five percentage*** *points of such share shall be taken into account for the calculation of the respective adjusted target level."*

By 31 December 2024, the Commission will examine data provided by Member States on reusable packaging, with a view to considering the feasibility of setting quantitative targets on the reuse of packaging (as per Article 5(5) of the Directive).

Another aspect of the legislative frameworks concerns standards related to reuse. In line with Regulation (EU) No 1205/12, compliance with European (EN) and international (ISO) standards is voluntary; however, standardisation has a leading role in creating the EU Single Market and Member States are mandated to transpose EN standards into national standards to avoid conflicts.

The European (EN) and international (ISO) standards related to reusable packaging are:

- EN Standard 13429:2004 Packaging – Reuse;

- EN Standard 14520:2007 Packaging – Reuse – Methods for assessing the performance of a reuse system; and
- ISO Standard 18603:2013 Packaging and the environment – Reuse.

A.3.3 Conditions for packaging to qualify as 'reusable'

Article 3(2)a of the Directive defines 'reusable packaging' as:

> "packaging which has been conceived, designed and placed on the market to accomplish within its lifecycle multiple trips or rotations by being refilled or reused for the same purpose for which it was conceived;"

Section 4.1 of EN Standard 13429:2004 provides the conditions a) – e) which packaging must meet in order to be classified as reusable under the standard:

> "a) that reusability of the packaging is a deliberate objective;
>
> b) that the design of the packaging enables the principal components to accomplish a number of trips or rotations in normally predictable conditions of use;
>
> c) that the packaging is capable of being successfully reconditioned *in accordance with the requirements of Annex B*;
>
> d) t*hat the packaging is capable of being refilled/reloaded;*
>
> *e) that an appropriate system, necessary to support reuse, is available in markets on to which the packer/filler is responsible for placing the packed product."*

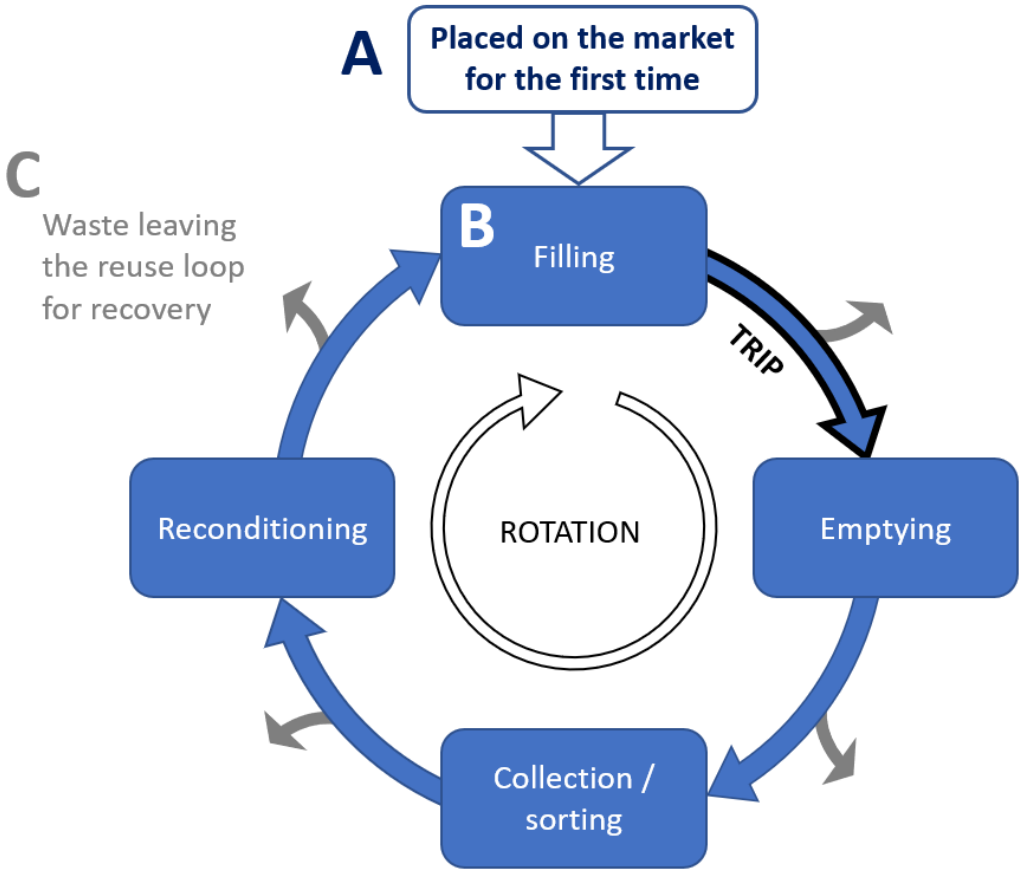
Further, in line with Section 5 of EN Standard 13429:2004, for each packaging type placed on the market, relevant entities[42] (e.g. packer, filler) should be able to demonstrate that:

1. The packaging is capable of reuse for the application for which it was originally intended under normal conditions of use;
2. A system for reuse, including reconditioning, exists (see below for information on reconditioning).

Figure A 19 presents an overall concept of systems for reuse, depicting a rotation that is a full cycle of reusable packaging from the moment it is placed on the market (together with the associated goods), to the moment it is used again after emptying, collection, sorting, reconditioning and refilling (if applicable).

[42] Packer, filler, packaging supplier, emptier or by reference to an established standard, recognised organisation, or commercial operator

Figure A 19: Reuse Process Flow Chart



During a rotation, after reusable packaging is used and subsequently collected, it may need reconditioning before it can be refilled and used again. Reconditioning includes operations necessary to restore reusable packaging to a functional state for reuse purposes, for example, checking, cleaning, drying, and relabelling.

It is important to note that reconditioning is not considered to be preparing for reuse.

In Article 3(16) of Directive 2008/98/EC, 'preparing for reuse' is defined as:

> *"checking, cleaning or repairing recovery operations, by which products or components of products that **have become waste** are prepared so that they can be reused without any other pre-processing"*

Article 3(1) of Directive 2008/98/EC defines 'waste' *as "any substance or object which the holder discards or intends or is required to discard"*. As such, an item does not become waste unless this definition is met. Because **only waste items can be prepared for**

reuse, a precondition of preparation for reuse is that the holder of the item discards it, intends to discard it, or is required to discard it.

Reusable packaging that undergoes reconditioning is not *"discarded"* in the manner described above, that is, the packaging doesn't become waste, and neither is there the 'intent or 'requirement' for it to become waste. Thus, packaging that is reconditioned during a rotation is not considered to be prepared for reuse.

Where packaging does become waste prior to any reconditioning / repair activities, this is preparation for reuse. This is discussed for the specific case of wooden packaging below.

A.3.3.1 Differentiation between Preparation for Reuse and Reuse of Wooden Packaging

Wooden packaging can either be reported as reusable packaging in Table 3 or under 'repair of wooden packaging' in Table 1.

Wooden pallets (or wooden packaging in more general) which are collected as waste / classified as waste, subsequently repaired and placed on the market again shall be reported under 'repair of wooden packaging' in Table 1.

Wooden pallets (or wooden packaging in more general) which are not collected as waste / not classified as waste (e.g. pallets in a closed-loop pooling system) but repaired (also if repaired by a service provider) and reused would be reported as reusable packaging in Table 3. A repair operation and subsequent reuse, without classification of waste before, shall be accounted as a normal rotation, regardless if the repair is done by the system or a third operator.

The vast majority of other types of reusable packaging (as discussed in Appendix A.3.3) will not be considered waste before being reconditioned, and so need to be reported as part of the rotation of reusable packaging in Table 3.

A.3.4 Reuse system types

Systems for reuse, as described in EN Standard 13429:2004, are established arrangements (organisational, technical and/or financial) which ensure the possibility of reuse, including closed and open loop systems. In both **closed loop** and **open loop systems** for reuse, as described in EN Standard 13429:2004, the process of rotation/circulation is operated by commercial actors.

A.3.4.1 Closed Loop Systems

In a **closed loop system**, reusable packaging is circulated by a company or a co-operating group of companies who provide the reusable packaging, collect it again after use and wash/refurbish the packaging for it to be used again. The ownership of the packaging is fixed. Hence, closed loop systems are able to collect detailed data on the lifecycle of each packaging unit, including the number of rotations per year and the total lifetime of the packaging.

An example of a closed loop system is a pallet pooling company. These companies own a shared ‘pool’ of pallets, which are then rented out to other businesses. Generally, pallet pooling companies will manage the delivery and collection of pallets, as well as any required reconditioning activities, and the disposal of pallets which are beyond repair.

Other examples include deposit-return schemes for certain beer barrels for consumers’ private use or beverage containers in specific contexts like festivals.

A.3.4.2 Open Loop Systems

In an **open loop system**, the ownership of the packaging changes at one or more points in the reuse process (see Figure A 19). For example, after a consumer has returned a beverage bottle, this may be sent to a reconditioning company, who then sell the packaging to a filler for refill prior to sale by wholesalers and retailers back to the consumer.

Hence, while businesses participating in open loop systems might know the number of new reusable packaging items placed on the market for the first time and the number of refills, but they may not be able to accurately track the number of rotations per year and the packaging lifetime. For open loop systems, this information must instead be estimated based on surveys and studies based on assumptions, and therefore the information tends to be less accurate.

Steel drums are another example of packaging which are commonly rotated via an open loop system. In this example, the process of emptying, collection, reconditioning and filling takes place via a series of market transactions, in which ownership of the packaging is transferred from one actor to the next.

Examples of open loop systems include the following:

- Deposit-return scheme for food containers (for example EcoBox in Luxemburg);[43]
- beverage containers in deposit return schemes (glass bottles for water, beer; plastic bottles for soft drinks)
- Gas tanks (CO2 for private sparkling drink preparation; methane, butane, other, for i.e. heating, barbecue).

A.3.4.3 Hybrid Systems

In **hybrid systems**, as described in EN Standard 13429:2004, reusable packaging remains with the end user, who is the owner of the reusable packaging. The end user is both the consumer and the refiller of the reusable packaging, and there is no redistribution system in place for commercial refilling.

Generic examples of hybrid systems include:

[43] EcoBox (2022)

- **Refill at home systems,**[44,45] in which users refill reusable packaging at home such as through pouring the product into the reusable packaging or placing a container inside the reusable packaging, or diluting a concentrated product in water inside the reusable packaging
- **Refill on the go, in which** customers use their own packaging in store or at dispensing systems in vending machines.

Some specific examples of these are as follows:

- Reusable shopping bags (composed of plastic or fabric);
- Fuel tanks for private use;
- Glass bottles (for oil or spirits, sold in the oil or spirit store);
- Coffee to go cups sold by stores;
- Spice mills sold with the product; and
- Tupperware.

In hybrid systems, the relevant data are the numbers of reusable packaging items sold and the numbers of refills over the calculation period. As the monitoring and validation of data for such hybrid systems is not feasible for most systems, hybrid systems are therefore excluded from the scope of reported reusable packaging.

A.3.4.4 Methodology for calculation of rotations

The average number of rotations of packaging in the system during the calculation period can be calculated based the total number of movements and the average population:

$$N_p = \frac{Q_{sp}}{P_t}$$

where

N_p is the average number of rotations during the calculation period;

Q_{sp} is the total number of movements of packaging through the measurement point during the calculation period;

P_t is the average population during the calculation period.

The total number of movements (Q_{sp}) can be recorded at different points during the rotation, for example point of refilling, completion of reconditioning. However, the average population (P_t) is rarely directly known and has to be calculated. A simplified version of the calculation is:

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[44] Ellen MacArthur Foundation (2019) *Reuse - Rethinking Packaging*, 2019, https://www.ellenmacarthurfoundation.org/assets/downloads/Reuse.pdf

[45] Coelho, P.M., Corona, B., ten Klooster, R., and Worrell, E. (2020) Sustainability of reusable packaging–Current situation and trends, *Resources, Conservation & Recycling: X*, Vol.6, p.100037

$$P_t = P_{in} + \frac{P_{new}}{2} - \frac{P_{loss}}{2} - \frac{P_{adj}}{2}$$

where

P_t is the average population during the calculation period;

P_{in} is the population at the start of the calculation period;

P_{new} is the total of newly manufactured packaging entering the system during the calculation period;

P_{loss} is the system losses during the calculation period;

P_{adj} is the adjustments during the calculation period – deliberately withdrawing from the system, for instance in case of a fall in demand.

P_{new} P_{loss} and P_{adj} are divided by two to give an approximate average over the calculation period. Where possible a more accurate average should be used. P_{new} and P_{adj} are often known, however P_{loss} generally has to be assessed. Under long-term steady state conditions, P_{loss} is approximately equal to P_{new}.

A.3.5 Suggestion for detailed questionnaire for reusable packaging to be sent by the Member States to the economic operators in the sector

Detailed disaggregated questionnaire to economic operators for data on reuse of packaging for a given year

1. General information on reporter

Reporting economic operator or EPR scheme

Company name	
Contact person	
Contact details	
Reporting period	

2. Detailed information

Index	Relation		Unit	
		Confidential	**Y/N**	
(a)		**System for reuse type**	**Select from given categories**	
(b)		**Packaging**	**Free text**	
(c)		**Packaging material**	**Select from given categories**	
(d)		**Category of packaging**	**Select from given categories**	
(e)		**Average specific weight per unit (kg)**	**Kg**	
(f)	**(h)/(k)**	**Reusable packaging placed on the market for the first time in the reporting period (reporting year)**	**Tonnes**	
(g)	**(i*)*(j)**	**Total number of uses in the system for the reporting year**	**Number**	
(h)	**(g)*(e)/1000**	**Reusable packaging filled or used in the reporting year**	**Tonnes**	
(h*)	**(g)*(o)/1000**	**Reusable packaging filled or used, other unit than tonnes e.g. 'packed volume' in the reporting year**	**e.g. 1000 litres**	
(i)	**(g)/(j)* (o)/1000**	**Population of reusable packaging (unit)**	**Tonnes**	
(i*)	**(g)/(j)**	**Population of reusable packaging (unit)**	**Number**	
(j)	**(g)/(i*)**	**Average number of rotations per year of a single packaging unit**	**Number**	

3. Possible additional information (e.g. relevant for life cycle assessment)

(k)	**(h)/(f)**	**Average number of rotations during lifetime of a single packaging unit**	**Number**
(l)	**((h)-(f))/(k)**	**Reuse ratio**	**%**
(m)		**More detailed description of the packaging material like specific plastic used (PE-LD, PE-LLD, PE-MD, PE-HD, PP, PET, …) or white/ green / brown glass**	**Free text**
(n)		**Average transport distance per rotation**	**Km**
(o)		**Volume of products/ transport provided by one single reusable packaging**	**Litre**

4. Comments to the table above:

(a) ‘System for reuse’: established arrangements (organisational, technical and/ or financial) which ensure the possibility of reuse including open-loop systems and closed-loop systems. Please select one out of the two different types:

1 ‘Open-loop system’: system in which reusable packaging is circulated among unspecified companies or
2 ‘Closed-loop system’: system in which reusable packaging is circulated by a company or a co-operating group of companies.
3 ‘Hybrid system’ shall not apply for consideration of reusable packaging.

(b) Please describe the kind of packaging. Typical types of reusable packaging include beer bottles; water and/ or soft drink bottles; milk bottles or other containers for dairy products; crates, boxes, and/ or containers for fruit and vegetables. These typical kinds of reusable packaging might have different characteristics, for instance regarding their specific weight or the number of rotations during their lifetime.

(c) Please select exclusively from the following materials: glass, plastic, paper/ cardboard, ferrous metal, aluminium, wood, others.

(d) Please select exclusively from the following categories: sales packaging, grouped packaging, transport packaging.

(g) ‘Number of uses’ is measured at the point of filling or packing by the claiming company. It includes the use of all reusable packaging passing the measurement point (CEN/TR 14520:2007: definition 2.7) regardless if newly manufactured (CEN/TR 14520:2007: definition 2.8) or reused. The claiming company (CEN/TR 14520:2007: Definition 2.4) is the packer / filler who makes a claim of ‘reusable’ for a type of packaging, in the circumstances of its intended use.

(h) This means the number of rotations that reusable packaging completes in a given year multiplied by its mass or, in other words, ‘the mass of reusable packaging filled with goods’ in one year. The definition is equivalent to that in reporting Table 3 columns #8 and #10 (see Section 4.4). The sum of the masses of the various kinds of reusable packaging filled with goods in one year as reported by the economic operators via the detailed questionnaire equals the aggregated value to be reported to the European Commission by the Member State (reporting Table 3 column #8; the same sum for only sales packaging equals the value in reporting Table 3 column #10).

(h*) Operators might have data available in units other than tonnes. Not all national reporting systems refer to tonnes of reusable packaging material. For instance, some Member States report on beverages only and report the unit as a ‘litre of packed beverage’. This reporting unit is most appropriate if the target is also in line with the unit, as the unit better reflects the environmental impact than the tonnage of packaging used. For instance, when conducting a life cycle assessment, the functional unit is the volume of packed beverage and not the tonnes of packaging material.

(i*) ‘population’: total number of a packaging type, empty or filled, in that whole reuse system (CEN/TR 14520:2007, definition 2.3).

(i) ‘population’, expressed in tonnes

(j) ‘rotation’: cycle undergone by reusable packaging from filling/ loading to filling/loading (CEN/TR 14520:2007, definition 2.2).

(l) The ‘reuse ratio of reusable packaging’ is the reused packaging filled divided by reusable packaging filled (the last including newly manufactured) at the measurement point, over the calculation period. With other words expressed: it is the effectively reused packaging in relation to the total reusable packaging (which included the newly produced reusable).

It is measured by the claiming company. The claiming company (CEN/TR 14520:2007: Definition 2.4) is the packer/ filler who makes a claim of ‘reusable’ for a type of packaging, in the circumstances of its intended use.

Some of the items in the detailed questionnaire above can in theory be calculated from other items, as displayed in the second column (‘relations’). However, a precondition for such calculations is a steady state system. Under conditions when a system is growing, the indicated relations might not be correct.

Depending on the operator and the reuse system in place, the quality of the data might vary. Therefore, we propose asking the economic operators to indicate if the figures result from monitoring/ counting, have been calculated/ derived using the formula for ‘relation’, or have been estimated from other sources.

Although the data for life cycle assessments are not yet required for the reporting, they will be relevant for the assessment and in particular, when targets for reuse are implemented. Therefore, we recommend that Member States aim to collect such information as well, in order to provide input for future assessments on targets for the reuse of packaging. Ideally, Member States might even derive national conclusions from this information that should be shared with other Member States and the European Commission.

As mentioned above, some Member States currently report on packed volume in litres for beverages only. This unit is more meaningful for comparing packaging for beverages than the weight of the packaging, as reusable packaging is typically heavier than one-way packaging. Recalculating between weight and volume would be advantageous, as with information on volumes the market share of total amounts of respective packaging streams can be better illustrated. This might be of special interest for the planned target setting on the reuse of packaging in the future.

However, as reporting of packaging currently needs to be in tonnes it is necessary to be coherent, especially since recycling targets are partly affected by amounts reported on the reuse of sales packaging according to Article 5(2) of the Directive.

Figure A 20: Example of how to complete the proposed detailed questionnaire by economic operators on data on reuse of packaging for a given year

Index	Relation		Unit	Reporter 1		Reporter 2		Reporter 3		Reporter 4		Reporter 5		Reporter 6	
		Confidential	Y/N	**Y**		**Y**		**Y**		**N**		**N**		**Y**	
(a)		System for reuse type	Select from given categories	**Closed loop**		**Closed loop**		**Closed loop**		**Open loop**		**Closed loop**		**Closed loop**	
(b)		Packaging	Free text	**Beer bottles**		**Beer/ soft drink crates**		**Beer casks**		**Pallet**		**Containers for vegetables and fruit**		**Gas bottles**	
(c)		Packaging material	Select from given categories	**Glass**		**Plastic**		**Aluminium**		**Wood**		**Plastic**		**Ferrous metal**	
(d)		Category of packaging	Select from given categories	**Sales**		**Sales**		**Transport**		**Transport**		**Transport**		**Sales**	
(e)		Average specific weight per unit (kg)	kg	**0.345**	**m**	**2.2**	**m**	**10**	**m**	**25**	**m**	**1**	**m**	**10**	**m**
(f)	(h)/(k)	Reusable packaging placed on the market for the first time in the reporting period (reporting year)	Tonnes	**3 680**	**m**	**460**	**m**	**235**	**m**	**120 000**	**m**	**900**	**m**	**500**	**m**
(g)	(i*)*(j)	Total number of uses in the system for the reporting year	Number	**266 428 000**	**m**	**12 000 000**	**m**	**1 560 000**	**m**	**48 000 000**	**e**	**52 000 000**	**m**	**3 000 000**	**m**
(h)	(g)*(e)/1000	Reusable packaging filled or used in the reporting year	Tonnes	**92 000**	**m**	**27 500**	**m**	**16 400**	**m**	**1 200 000**	**e**	**67 500**	**m**	**30 000**	**m**
(h*)	(g)*(o)/1000	Reusable packaging filled or used, other unit than tonnes e.g. 'packed volume' in the reporting year	1000 litres	**133 300**	**m**	**n/a**	**m**	**47 000**	**m**	**n/a**		**1 250 000**	**m**		
(i*)	(g)/(j)	Population of reusable packaging (unit)	Number	**63 435 238**	**c**	**2 643 135**	**c**	**120 000**	**m**	**9 600 000**	**e**	**3 465 000**	**e**	**750 000**	**m**
(j)	(g)/(i*)	Average number of rotations per year of a single packaging unit	Number	**4.2**	**e**	**4.5**	**e**	**13**	**m**	**5**	**e**	**15**	**e**	**4**	**e**

Index	Relation		Unit	Reporter 1		Reporter 2		Reporter 3		Reporter 4		Reporter 5		Reporter 6	
(k)	(h)/(f)	Average number of rotations during the lifetime of a single packaging unit	Number	**25**	**e**	**60**	**e**	**70**	**e**	**10**	**e**	**60**	**e**	**60**	**e**
(l)	((h)-(f))/(h)	Reuse ratio		**96.0%**	**c**	**98.3%**	**c**	**98.6%**	**c**	**89.6%**	**c**	**98.7%**	**c**	**98.3%**	**c**
(m)		More detailed description of the packaging material like specific plastic used (PE-LD, PE-LLD, PE-MD, PE-HD, PP, PET, …) or white/ green/ brown glass	Free text	**Brown glass**		**PP**		**Aluminium**		**Wood**		**PP**		**Steel**	
(n)		Average transport distance per rotation	km	**55**	**e**	**60**	**e**	**40**							
(o)		Volume of products / transport provided by one single reusable packaging	Litre	**0.5**				**30**				**24**			

m = monitored	
e = estimate	
c = calculated as mentioned in 'relation'	

Appendix 4 Balancing of approaches

Sometimes, Member States have implemented more than one method to calculate packaging waste generated. Specifically, for the plastic own resource, Article 3(2) of the draft Commission Implementing Regulation[46] specifies that two approaches are acceptable for calculating plastic packaging waste generation: placed on the market (PoM) and waste composition analysis (WCA).

The estimation of plastic packaging waste generated by using two approaches may not lead to the same result, as PoM may underestimate, while WCA tends to overestimate the real amount of packaging waste generated, which is therefore expected to lie somewhere between the two results. To ensure comparability, reliability and exhaustiveness of the national plastic packaging waste statistics, Articles 3(3) and 3(4) of the draft Implementing Regulation require that Member States produce estimates from both approaches, that the calculations are adjusted and a single estimate is produced by balancing the available results.

Balancing the results of both approaches will generate a figure which is supposed to be closer to the real value. The balancing decision should be taken based on a comparison of different factors that are drawn from the calculation processes of both methods.

A.4.1 A Balancing Approach

Balancing is a well-known statistical method used in national accounts. It is used to balance the three independent approaches, used to estimate the GDP, to get a single, more robust estimate. It is also used in supply-use tables to balance independent estimates of supply (i.e. production and imports) and use (i.e. consumption, investment and exports), at commodity group level.

It may be that those independent estimates have different degree of reliability, depending on the data sources and the methods used. Each estimate is given a qualitative score, and the differences at subcategory level are used together with the quality of each estimate to find a compromise.

Whenever one estimate (based on one approach) is of high quality for all its components, including the exhaustiveness of the total estimation, a second approach of lower quality will hardly have enough weight in a balancing decision; the second approach remains however useful to confirm the strength of the main approach by cross-checking.

This balancing of two independent estimates is not, in general, purely mechanical. It is not an arithmetic average. It is a more complex process that may involve expert judgment about the independent estimates, the size of their gap and finding reasons to explain the gap. It may be required to go back to the independent estimates and assess if there were

[46] Draft Commission Implementing Regulation on the form for the statement relating to the own resource based on non-recycled plastic packaging waste pursuant to Council Regulation (EU, Euratom) 2021/770.

biases or gaps, and it may be that revising those estimates closes the gap and ensures two estimates that are fully balanced or a residual, small gap can be balanced mechanically (e.g. with an average).

Similarly to the balancing used in national accounts, the principle for balancing PoM and WCA approaches is based on finding common subcategories in both estimates allowing linking and comparing them; this is combined with measuring the quality of the main components of all subcategories in each estimate.

This document presents two possible ways of balancing for the same fictitious country. The first is about balancing according to waste flows and second according to waste content.

Both methods are based on balancing at subcategories' level where links between both estimation approaches are identified. The links may be found in subcategories or totals of each calculation process that can be directly compared to each other. Examples can be the waste origin (e.g. households, industry, etc.), the waste flow (e.g. mixed municipal waste) or the plastic fractions (e.g. PET, PP, PE-LD). Countries should strive to identify as many of these links as possible in their existing data collections and procedures in order to facilitate comparing and balancing both methods.

Table A 1: Example of data quality assessment

Method 1 - plastic packaging waste generated based on PoM

Concept	Plastic packaging waste (kg)	Quality of the estimate	Quality justification
Placed on the market based on EPR scheme data prior to any adjustmen	200,000,000	1	Data from EPRs
household packaging	*132,000,000*		
commercial packaging	*50,000,000*		
industrial packaging	*18,000,000*		
Units below the threshold (de minimis)	20,000,000	2	Estimated based on surveys
Self-compliers	0	1	No self-compliers
Free-riders	10,000,000	3	Based on business register and similar NACE activities producing packaging
After-placed-on-the-market exports	-200,000	4	Based on EPR fees recovery scheme, probably underestimated
Online trade	0	1	Estimated under free-riders
Private imports	350,000	4	Estimated from data from consumers habits
Private exports	-600,000	5	Roughly estimated from tourism statistics
Reusable packaging placed on the market for the first time[1]	-400,000	1	Data from EPRs
Reusable packaging that became waste[2]	30,000	1	
Other adjustments made	0		
Total	**229,180,000**		

[1] Only to be deducted if reusable packaging is included in the total amount of packaging placed on the market or in any correction in this list. In this case, the figure is to be calculated as net value of in- and outflows.

[2] Includes reusable packaging placed on the market for the first time and from preceding periods that became waste in this perio

Method 2 - waste composition analysis

Concept	Total amount of analysed waste (kg)	Plastic packaging waste (kg)	Quality of the estimate	Quality justification
Mixed municipal waste - households	1,600,000,000	112,000,000	2	Based on waste composition analysis and total municipal waste generation
foreign drinking bottles		*200,000*		
Mixed municipal waste - commercial	400,000,000	20,000,000	4	Based on waste composition analysis and total municipal waste generation
Co-mingled collection	500,000,000	80,000,000	1	Based on waste composition analysis and total collection
foreign drinking bottles		*800,000*		
Industrial waste	18,000,000,000	36,000,000	5	Based on information reported by companies in the waste information system; amount of plastic packaging is roughly estimated based on on-site random inspections
Total		**248,000,000**		

In addition, it is recommended to assess the data quality of the identified subcategories of each of the approaches. An example of data quality assessment is given in Table A 1. The quality assessment may help decide which estimated components are more reliable and thus should be given priority/weight in the balancing decision. Ideally, the quality

assessment is available for every data source or total that has been taken into account in estimating the total amount of plastic packaging waste generated. However, establishing a quality assessment for the main aggregates in each method should suffice for a valid balancing.

For calculating the final balancing result, the estimation result of main method should be altered according to the balancing decisions taken. Example calculations are given in the sections below.

A.4.2 Balancing according to waste flows

The first step in balancing at subdivision level consists of identifying subcategories that are directly comparable across approaches. One type of subcategories can be the different flows of waste. To give a general example:

> *Data reported as PoM may be available within different categories: household, commercial or industrial plastic packaging. Likewise, in waste analysis, the total amount of household, commercial or industrial plastic packaging may have been separately identified. Thus, the total amount of household packaging reported as PoM can now be compared to the total amount of packaging analysed and identified as household packaging. Based on the assessed quality for both figures for household packaging, a balancing decision can be made.*

In the fictitious example given in Table A 1 above, data of a specific waste flow coming from private imports of household packaging has been identified in the PoM as well as in the WCA approach. The WCA results however were indicating a much higher amount of PET bottles, the majority coming from abroad.

Now, as a second step, the quality assessment of the subcategories is checked. The quality of the data obtained by WCA is assessed to be higher than the one for the PoM data as the PET bottles were clearly identified as foreign products by form and labels. Hence, for balancing it would be reasonable to use the WCA data to calculate the total amount of plastic packaging waste generated, revising the total waste generation by 680,000 tons due to private imports.

Table A 2: Balancing example according to waste flows

	assessed quality	Placed on the market approach	229,180,000	249,000,000	Waste analysis approach	assessed quality	
		household packaging	**154,695,000**	**158,000,000**	**household packaging**		
		reported PoM	132,000,000	112,000,000	*mixed municipal waste*		
				45,000,000	*co-mingled collection*		
		below de minimis	18,000,000	?	*mixed municipal waste*		
				?	*co-mingled collection*		
		free riders	5,000,000	?	*mixed municipal waste*		
				?	*co-mingled collection*		
		After-placed-on-the-market exports	0	-			
balancing possible	4	*Private imports*	320,000	800,000	*co-mingled collection*	1	
				200,000	*mixed municipal waste*	2	
		Private exports	-580,000	-			
		Reusable packaging PoM for the first time	-50,000	-			
		Reusable packaging that became waste	5,000	?	*co-mingled collection*		
				?	*mixed municipal waste*		
		commercial packaging	**54,768,000**	**55,000,000**	**commercial packaging**		
		reported PoM	50,000,000	20,000,000	*mixed municipal waste*		
				35,000,000	*co-mingled collection*		
		below de minimis	2,000,000	?	*mixed municipal waste*		
				?	*co-mingled collection*		
		free riders	3,000,000	?	*mixed municipal waste*		
				?	*co-mingled collection*		
		After-placed-on-the-market exports	-150,000	-			
		Private imports	30,000	?	*mixed municipal waste*		
				?	*co-mingled collection*		
		Private exports	-20,000	-			
		Reusable packaging PoM for the first time	-100,000	-			
		Reusable packaging that became waste	8,000	?	*mixed municipal waste*		
				?	*co-mingled collection*		
		industrial packaging	**19,717,000**	**36,000,000**	**industrial packaging**		
	1	*reported PoM*	18,000,000	36,000,000	*industrial waste*	5	balancing possible
		below de minimis	0	?	*industrial waste*		
		free riders	2,000,000	?	*industrial waste*		
		After-placed-on-the-market exports	-50,000	-			
		Private imports	0	0			
		Private exports	0	-			
		Reusable packaging PoM for the first time	-250,000	-			
		Reusable packaging that became waste	17,000	?	*industrial waste*		

Balancing the data on industrial packaging would follow the same approach, by using the assessed data quality to make a balancing decision in favour of the PoM data. Given that the method using PoM is the main method, this would lead to a balanced final estimation of 229,860,000 kg for plastic packaging waste generated.

A.4.3 Balancing according to waste content

Categories other than waste flows may be used for balancing. The next example is based on the use of the different types of polymers incorporated into plastic packaging. In the example, the producers of plastic packaging report the polymers they use in their plastic packaging products placed on the market. These amounts can then be compared to the polymers identified in the waste analysis, which also includes a breakdown by packaging and plastic polymers.

In Table A 3 below, the same fictitious country data from Table A 1 and Table A 2 is used. In this case however, the total plastic packaging waste generation is broken down by

types of polymers. The difference between PoM and WCA for the sum of the first two polymers (PP and PE-LD, -LLD) is around 16,850,000 tons, which corresponds very closely to the difference of roughly 16,300,000 tons in industrial packaging in Table 2: industrial packaging uses mainly these specific polymers.

Table A 3: Balancing according to polymer type

polymer type	assessed quality	PoM	WCA	assessed quality	
PP	1	44,839,565	52,318,261	5	balancing possible
PE-LD,-LLD	1	49,821,739	59,208,383	5	balancing possible
PE-HD,-MD		37,366,304	37,864,348		
PVC	4	10,064,348	10,843,478	4	balancing possible
PET	4	39,857,391	40,905,217	1	balancing possible
PUR		4,982,174	5,040,870		
PS, PS-E		28,647,500	29,030,000		
other plastics		9,864,348	10,029,009		
other thermoplastics		3,736,630	3,760,435		
total		**229,180,000**	**249,000,000**		

In the fictitious example in Table A 3, the quality assessment for industrial packaging data from WCA is very poor while data from PoM has a very high quality. As a result, the balancing decision would be to use the PoM data for industrial packaging to calculate the total amount of plastic packaging waste generated. The difference in PET can be explained by the much higher private imports of foreign PET bottles.

To balance the difference in PVC however, the quality assessment is of little help as it is equally low in both approaches. In such cases, it is recommended to balance both figures using the average, i.e. the sum of both estimates divided by two, which results in 10,453,913 kg in this example.

The final balanced amount of plastic packaging waste generated, as above assuming PoM as main method, would therefore be 230,617,390 kg.

Available categories depend on available data; both available categories and quality assessment may vary considerably across Member States. Thus, every Member State has to decide on its own which categories are suitable to use in their balancing decision making.

In addition, it might not be possible to identify all comparable categories. It is suggested to concentrate on the major ones and the categories with lower quality in order to profit from the balancing decision and improve the overall data.

Appendix 5 List of relevant documents

The relevant legal acts constitute:

European Parliament and Council Directive 94/62/EC of 20 December 1994 on packaging and packaging waste.

Commission Decision 2005/270/EC of 22 March 2005 establishing the formats relating to the database system pursuant to Directive 94/62/EC of the European Parliament and of the Council on packaging and packaging waste

Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain directives

Directive (EU) 2018/851 of the European Parliament and of the Council of 30 May 2018 amending Directive 2008/98/EC on waste (Text with EEA relevance)

Directive (EU) 2018/852 of the European Parliament and of the Council of 30 May 2018 amending Directive 94/62/EC on packaging and packaging waste

Commission Implementing Decision (EU) 2019/665 of 17 April 2019 amending Decision 2005/270/EC establishing the formats relating to the database system pursuant to European Parliament and Council Directive 94/62/EC on packaging and packaging waste (notified under document C(2019) 2805)