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 municipal waste according to Commission Implementing Decisions 2019/1004/EC and 2019/1885/EC, and the Joint Questionnaire of Eurostat and OECD

(Note: The Commission Delegated Decision on average loss rates has not yet been implemented; future versions of this guidance will contain further details on the published legal act.)

Version of

6th October 2023

Contents

1 Introduction

The purpose of this document is to provide guidance to Member States on the reporting of municipal waste data, pursuant to the requirements laid down in Commission Implementing Decisions 2019/1004[1] and 2019/1885[2], as well as, until 2025, Commission Implementing Decision 2011/753/EU[3]. In particular, this guidance highlights important considerations relating to the calculation of municipal waste generated and recycled according to these new legal acts, including the application of new calculation rules (as reported in the landfill and municipal waste reporting obligation questionnaires). In addition, the guidance supports the delivery of municipal waste statistics within the Eurostat and OECD Joint Questionnaire.

Guidance to support Member States in the completion of the quality check reports (hereafter referred to as the 'quality reports') can be found in the Quality Report templates themselves (which exist within each of the municipal waste questionnaires).

This guidance document will continue to 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 Scope and definitions

The reporting obligation is based on the implementing decisions described in the introduction for European Council Directives 2008/98/EC (the Waste Framework Directive [WFD], as amended most recently by Directive (EU) 2018/851) and 1999/31/EC (the Landfill Directive, as amended most recently by Directive (EU) 2018/850).

Municipal waste is defined in Article 3(2b) of European Council Directive 2008/98/EC on waste[4] as:

> *"mixed waste and separately collected waste from households, including paper and cardboard, glass, metals, plastics, bio- waste, wood, textiles, packaging, waste electrical and electronic equipment, waste batteries and accumulators, and bulky waste, including mattresses and furniture"*

and:

> *"mixed waste and separately collected waste from other sources, where such waste is similar in nature and composition to waste from households."*

The provision further clarifies what items the above definition does not include:

[1] https://eur-lex.europa.eu/legal-content/en/ALL/?uri=CELEX:32019D1004

[2] https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1595832235588&uri=CELEX:32019D1885

[3] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32011D0753

[4] For the consolidated version see https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:01994L0062-20180704&from=EN

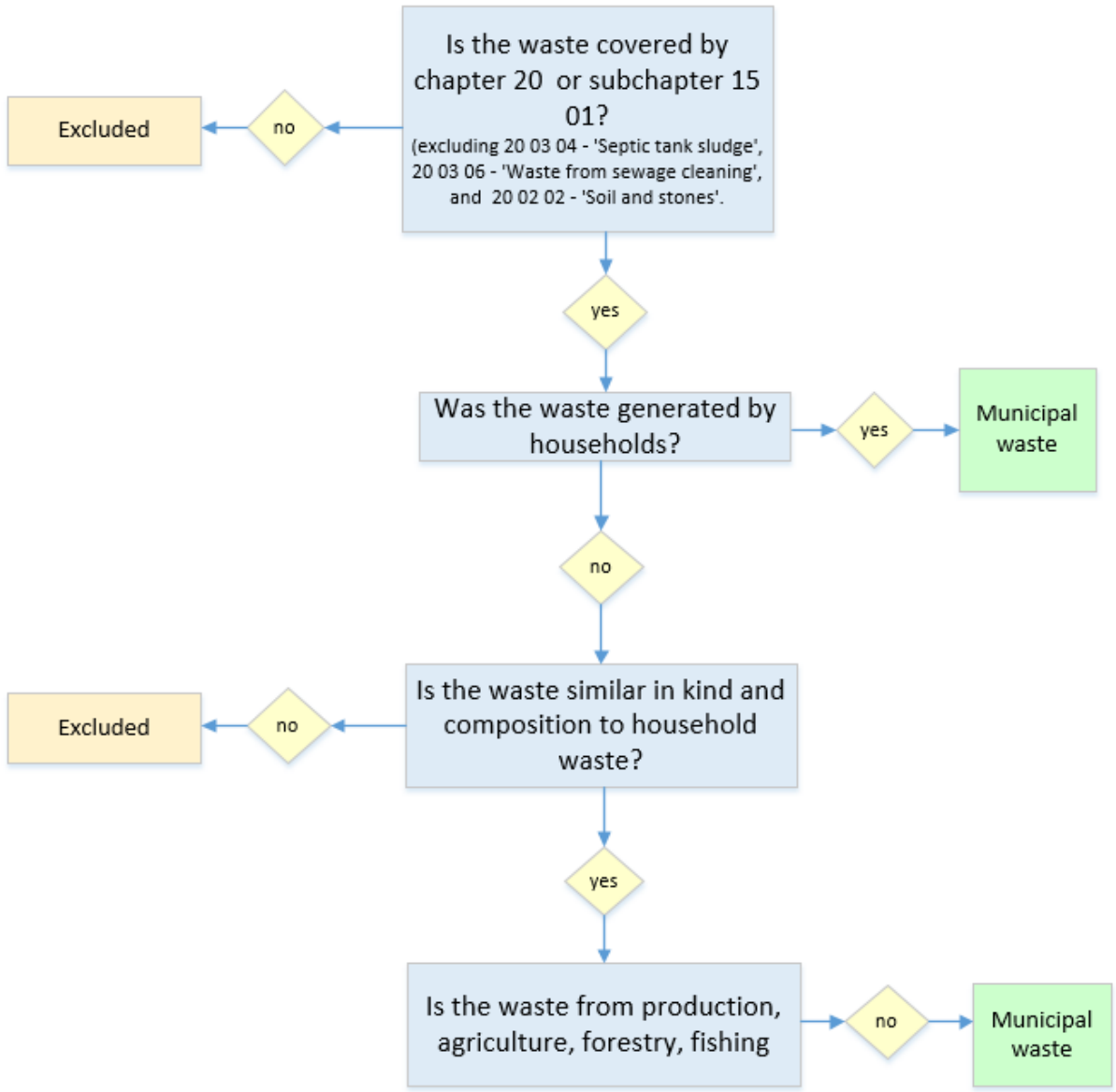
"Municipal waste does not include waste from production, agriculture, forestry, fishing, septic tanks and sewage network and treatment, including sewage sludge, end-of-life vehicles or construction and demolition waste."

Furthermore,

"the definition is without prejudice to the allocation of responsibilities for waste management between public and private actors".

In other words, waste from households and waste similar in nature and composition shall be included in municipal waste, no matter who collects this waste. These features do not all apply at the same time but in a hierarchical order. Figure 1 shows the order in that the definition should be applied.

Figure 1: Decision-tree for the attribution of waste to municipal waste



Further guidance on applying the definition of municipal waste is given in Section 4.1.1, and in Annex 1 of this guidance.

Other relevant definitions under Article 3 include:

- ‘bio-waste’ means biodegradable garden and park waste, food and kitchen waste from households, offices, restaurants, wholesale, canteens, caterers and retail premises and comparable waste from food processing plants;
- ‘separate collection’ means the collection where a waste stream is kept separately by type and nature so as to facilitate a specific treatment;
- ‘re-use’ means any operation by which products or components that are not waste are used again for the same purpose for which they were conceived;
- ‘treatment’ means recovery or disposal operations, including preparation prior to recovery or disposal;
- ‘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. Annex II of Directive 2008/98/EC on waste sets out a non-exhaustive list of recovery operations;
- ‘material recovery’ means any recovery operation, other than energy recovery and the reprocessing into materials that are to be used as fuels or other means to generate energy. It includes, inter alia, preparing for re-use, recycling and backfilling;
- ‘preparing for re-use’ 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 re-used without any other pre-processing. For example, the preparation on furniture, objects, books, clothes, electric and electronic devices (by means of repairing or refurbishing operations) prior to their reintroduction on the market;
- ‘recycling’ 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;
- ‘backfilling’ means any recovery operation where suitable non-hazardous waste is used for purposes of reclamation in excavated areas or for engineering purposes in landscaping. Waste used for backfilling must substitute non-waste materials, be suitable for the aforementioned purposes, and be limited to the amount strictly necessary to achieve those purposes;
- ‘disposal’ means any operation which is not recovery even where the operation has as a secondary consequence the reclamation of substances or energy. Annex I of Directive 2008/98/EC sets out a non-exhaustive list of disposal operations;

Further definitions regarding the application of the new calculation rules are given in Article 1 of Decision 2019/1004; here only the definition of the calculation point and the measurement point shall be repeated:

- 'calculation point' means the point where municipal waste materials enter the recycling operation whereby waste is reprocessed into products, materials or substances that are not waste or the point where waste materials cease to be waste as a result of a preparatory operation before being reprocessed;
- 'measurement point' means the point where the mass of waste materials is measured with a view to determining the amount of waste at the calculation point;

3 Due date for data submission and application of new calculation rules

3.1 Old calculation rules

Until the implementation of Directive (EU) 2018/851 and the associated Commission Decision 2019/1004, the reporting formats and rules for the 2020 preparation for reuse and recycling target implemented in 2008 by Directive 2008/98/EC in Article 11(2)(a) were set out by the following:

- Commission Decision 2011/753/EU (rules for the 2020 recycling target – referred to here as the "Old calculation rules").[5]
    - This is still in force and only becomes redundant beyond reporting of reference year 2024 data, after which the new targets for 2025 under the new rules will then apply. According to Article 11(2)(c) of Directive (EU) 2018/851, by 2025, the preparing for re-use and the recycling applies to a new strict definition of municipal waste defined in Article 3(2b) of this same Directive, and the rate shall be increased to a minimum of 55 % by weight. From reference year 2025, with regard to proving compliance with this target, of the four calculation methods given in Annex I of Commission Decision 2011/753, only method four will then be valid (using the new rules), meaning the approximation of municipal waste by the other three calculation methods will no longer be possible.
- Implementing Decision C(2012)2384 (establishing the Member State questionnaire).[6]
    - This was repealed and replaced by Article 8 of Decision 2019/1004. This updates the format of the questionnaire, as can now be found as the quality check report labelled "QR Table 3 - Recycling rate" within the Excel based annual reporting MWRO questionnaire,detailed in Section 4 below.

[5] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32011D0753

[6] https://ec.europa.eu/environment/archives/waste/reporting/pdf/C_2012_2384.pdf

Decision 2011/753 allows Member States to choose one of four calculation methods by which the target in WFD Article 11(2)(a) can be met, applying respectively to:

1. *the preparation for reuse and the recycling of paper, metal, plastic and glass household waste;*
2. *the preparation for reuse and the recycling of paper, metal, plastic, glass household waste and other single types of household waste or of similar waste from other origins;*
3. *the preparation for reuse and the recycling of household waste;*
4. *the preparation for reuse and the recycling of municipal waste.*

If a Member State reports under calculation method 4, then the amounts should be the same as reporting against the new calculation rules.

Regarding reporting on household and similar waste, Member States were required to set out how the reported data related to the data on household waste and other economic activities reported under Regulation (EC) No 2150/2002[7] (the Waste Statistics Regulation). Regarding municipal waste, reporting was voluntary under the Joint Questionnaire of Eurostat and the OECD – i.e. no legally binding requirements regarding the calculation rules were set.

3.2 New calculation rules

With the implementation of Directive (EU) 2018/851 of the European Parliament and of the Council of 30 May 2018 amending Directive 2008/98/EC, and the associated Commission Decision 2019/1004, Member States are required to meet and report on new targets from 2025 regarding municipal waste.[8] The updated directive sets out new calculation rules for these new targets in Article 11a. **The new rules require compliance with the new targets based on data for all municipal waste, and not from a subset of municipal waste as allowed under the old rules**.

[7] https://eur-lex.europa.eu/legal-content/en/ALL/?uri=CELEX%3A32002R2150

[8] WFD Article 11(2) is as follows. Paragraph (a) is governed by the old rules and (c) to (e) by the new rules:

> *"(a) by 2020, the preparing for re-use and the recycling of waste materials such as at least paper, metal, plastic and glass from households and possibly from other origins as far as these waste streams are similar to waste from households, shall be increased to a minimum of overall 50 % by weight;*
>
> *(b) by 2020, the preparing for re-use, recycling and other material recovery, including backfilling operations using waste to substitute other materials, of non-hazardous construction and demolition waste excluding naturally occurring material defined in category 17 05 04 in the list of waste shall be increased to a minimum of 70 % by weight;*
>
> *(c) by 2025, the preparing for re-use and the recycling of municipal waste shall be increased to a minimum of 55 % by weight;*
>
> *(d) by 2030, the preparing for re-use and the recycling of municipal waste shall be increased to a minimum of 60 % by weight;*
>
> *(e) by 2035, the preparing for re-use and the recycling of municipal waste shall be increased to a minimum of 65 % by weight."*

As these new targets only come into force from 2025, **until 2025 Member States must continue to prove compliance with the 2020 target under Article 11(2)(a) of the WFD.** While Member States may continue to prove compliance with the 2020 target using the allowable methods set out under Decision 2011/753, Article 7 of Decision 2019/1004 states that:

> *"1. Member States shall report the data and submit the quality check report concerning the implementation of points (a) and (b) of Article 11(2) of Directive 2008/98/EC in the format laid down in Annex IV.*
>
> *As regards the implementation of point (a) of Article 11(2) of Directive 2008/98/EC, Member States which report the data and submit the quality check report in the format laid down in Annex V shall be deemed to comply with the first subparagraph.*
>
> *2. Member States shall report the data and submit the quality check report concerning the implementation of points (c) to (e) of Article 11(2) and Article 11(3) of Directive 2008/98/EC in the format laid down in Annex V."*

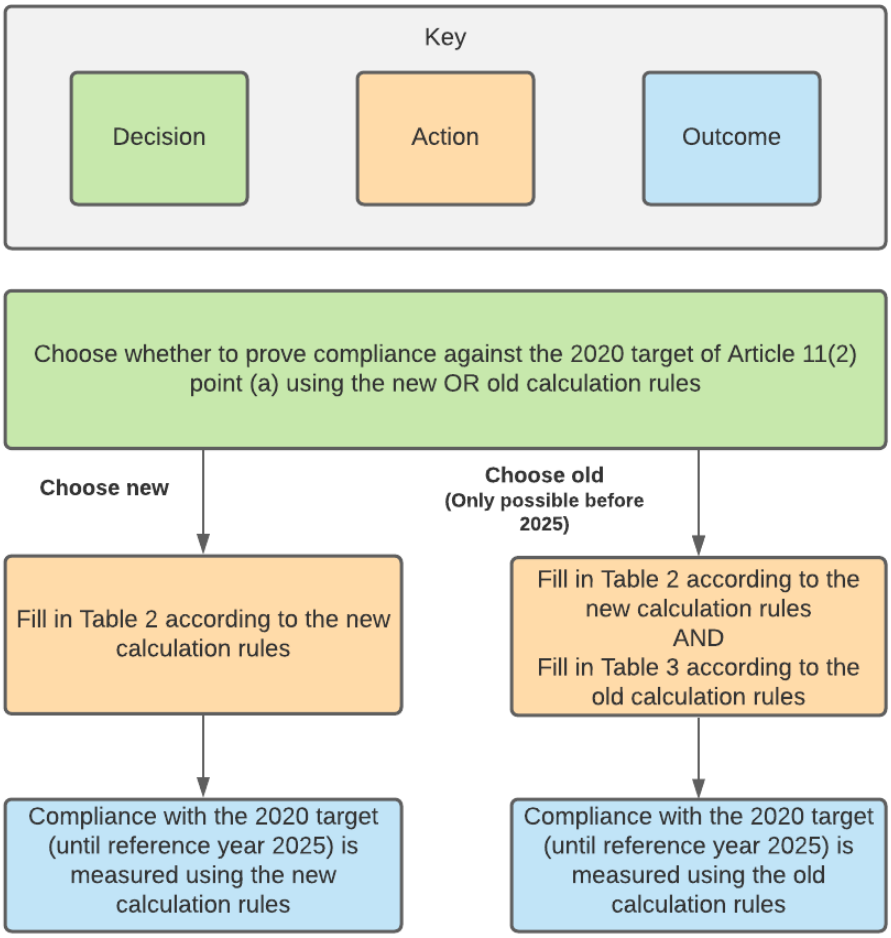
Therefore, according to paragraph (1), **Member States may choose to prove compliance with the 2020 target until reference year 2024 using the new calculation rules and format** (i.e. the rules and format required for the targets under WFD Article 11(2)(c) to (d), as set out through Decision 2019/1004, including Annex V).

If Member States choose to prove compliance against the 2020 target using the new calculation rules and format, then they do not need to complete the reporting table under Annex IV of Decision 2019/1004 (Table 3 within the MWRO Excel Questionnaire).

However, if Member States do not choose to prove compliance against the 2020 target using the new calculation rules and format then they are required to complete the reporting tables in both Annex IV and Annex V of Decision 2019/1004 (i.e. both Table 2 and Table 3 within the MWRO Excel Questionnaire).

Member States can use the flow chart presented in Figure 2 to help guide them through the process of completing Table 2 or Table 2 and Table 3. 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 2: Flow Chart Guide to Completing Table 2 or Table 2 and Table 3 (MWRO questionnaire)



In addition, Article 5(5) of the Landfill Directive requires that:

> *"Member States shall take the necessary measures to ensure that by 2035 the amount of municipal waste landfilled is reduced to 10 % or less of the total amount of municipal waste generated (by weight)."*

This target should be reported according to the format set out in Decision 2019/1885 (Table 4 in the separate 'landfill' Excel Questionnaire).

To maintain an unbroken time-series, the reporting in the format under the Joint Questionnaire will also be maintained.

For the first full calendar year after the adoption of Decision 2019/1004, Member States were able to report data voluntarily according to the new format, i.e. reporting for the first time in November 2020 for reference year 2019. In November 2021 and subsequent years, **Member States are mandatorily required to report data according to the new format and calculation rules for reference year 2020 and up (within Table 2 -** MWRO questionnaire**).** This is in addition to the option of reporting for compliance against the 2020 target, which can be done separately (within Table 3 **-** MWRO questionnaire) according to the old rules.

The annual reporting of municipal waste data under the Joint Questionnaire (Table 1) by mid-November (11 months after the reference year) will be maintained.

According to the agreement of the Directors group on sectoral and environmental statistics and accounts (DIMESA) of October 2019, reconfirmed in October 2020, Eurostat will collect municipal waste statistics from the countries, with a deadline for delivery at T+11 months within the limits of national data collection systems. Hence, municipal waste data are to be sent in month 11 after the reference period. Eurostat will validate the municipal waste data and publish them in months 12-13 after the reference year. An in-depth validation takes place in parallel over one to three rounds with the Member States and is finished in month 17 after the reference period. An update will be then published, just in time for meeting the legal deadline according to legislation, which is T+18 months.

The questionnaire asks for municipal waste data collected by Eurostat and OECD and for data required by the legislation:

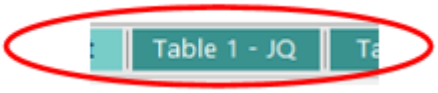
- For data reference years 2019, 2020 and 2021, both were collected in a single integrated data collection, though they may come from different institutions within a country (e.g. National Statistical Institutes and environmental agencies or ministries). Not all data may be available at T+11 months so that a re-submission of the questionnaire at T+18 has typically been expected, which would provide the detailed material breakdown and possibly revised summary indicators.
- For reference year 2022 and beyond, the joint questionnaire (Table 1) has been separated from the Waste Framework Directive reporting obligation data (Tables 2 and 3) and also from the Landfill Directive reporting obligation data (Table 4). This allows for the joint questionnaire to be submitted in November at T+11 months, and the other data to be submitted in June at T+18 months. Data between the reporting tables should align, so it may be necessary to also submit revised summary indicators within the joint questionnaire once the municipal waste and landfill reporting obligation data becomes available.

In summary:

- The ‘Joint Questionnaire’ table reporting is to be made using the ‘JQ’ Excel Questionnaire and submitted by **month 11** after the reference year; and
- The Waste Framework Directive and Landfill Directive reporting is to be made using the two separate Excel Questionnaires (the municipal waste reporting obligation [MWRO] questionnaire, and the landfill questionnaire) and submitted by **month 18** after the reference year. It will be validated by Eurostat and then submitted to the Commission, or updates requested through clarification exchanges, for submission thereafter.

4 Guidance for the completion of the reporting tables

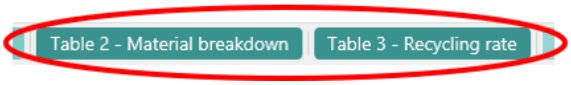
As mentioned above, the Excel “Annual reporting of municipal waste” questionnaire shall be submitted **11 months** after the reference year (mid November), with the Joint Questionnaire table completed. This is described in Section 4.1, and can be found in the ‘JQ’ questionnaire here:



In addition, the associated questions in the Table 1 Quality Report **must** also be completed:

The reporting tables required for compliance with the abovementioned Waste and Landfill Directive targets shall be completed and submitted by **Month 18** after the reference year (i.e. by the end of June). The completion of the tables is described below in Sections 4.2 to 4.4, and can be found in the questionnaires here:

and (in the separate file



In addition, the associated questions in the Quality Reports for Tables 2, 3 and 4 **must** also be completed within each respective questionnaire:

Elements of data validation are included directly in the questionnaires themselves. Where found, please use the “Validate questionnaire” button, and/or undertake your own checks to ensure that:

- Data is not negative.
- Figures are numeric.
- Mandatory cells are completed.
- Aggregated values are equal to the sum of components. (This will require that voluntary cells are completed where data omission would result in component waste materials not summing to the total).
- Subordinate values are smaller than the parent value. This applies to “of which” values within Table 1. Within Table 2, it also applies to the sum of recycling plus energy recovery plus other recovery, as compared to generated waste.

4.1 Generation and treatment of municipal waste (Eurostat/OECD Joint Questionnaire) ["Table 1" within the 'JQ' data collection questionnaire]

The reporting under the Joint Questionnaire shall be continued to ensure the time-series is maintained. An image of the reporting table from the questionnaire is provided in Figure 3.

Figure 3: Table 1 – Generation and treatment of municipal waste (Eurostat/OECD Joint Questionnaire)

Generation and treatment of municipal waste (Eurostat and OECD Joint Questionnaire)
(in this questionnaire, please only report those parts of waste that fall under the definition of municipal waste)

Country:						
Reference year:	**2021**					
Municipal waste	**WST_OPER**	**UNIT**	**DATA**	**Standard footnotes**		**Explanatory footnote**
Total municipal waste generated*	GEN	Tonnes				
Waste generated by households (OECD)	GEN_HH	Tonnes				
Waste generated by other sources (OECD)	GEN_OTH	Tonnes				
Separate collection (of total municipal waste generated)	COL_SEP	Tonnes				
Municipal waste treated (of the waste generated, no matter in which country)*	TRT	Tonnes				
Recovery	RCV	Tonnes				
Preparing for reuse	PRP_REU	Tonnes				
Recycling - material	RCY_M	Tonnes				
of which Metal recycling from incineration bottom ash	RCY_M_IBA	Tonnes				
Recycling - composting and digestion	RCY_C_D	Tonnes				
of which Separate collection and recycling of biowaste at source - e.g. home composting	COL_SEP_RCY_S	Tonnes				
Recovery - energy recovery (R1)*	RCV_E	Tonnes				
Recovery - other*	RCV_OTH	Tonnes				
Disposal	DSP	Tonnes				
Disposal - incineration (D10)*	DSP_I	Tonnes				
Disposal - landfill (D1, D5, D12)*	DSP_L	Tonnes				
Disposal - other (D2-D4, D6-D7); (OECD)	DSP_OTH	Tonnes				
Coverage of the collection system (share of population covered by the data)	COV	%				

*Mandatory from reference year 2020 onwards for **Reporting obligations** according to Commission Implementing Decisions 2019/1004 and 2019/1885

Cell shading:

White: Data provision is required.
Light orange: Footnotes (only to be filled-in when relevant)
Green: Variable collected only from OECD countries

The approach to producing the statistics, particularly the definition of municipal waste and recycling, should be aligned with the new reporting rules under the WFD (as set out above and described in detail in the Annexes). Note, the light grey cells sum relevant parameters automatically in the sheet. The waste types and related database codes are indicated in the first two columns.

The approach to producing the statistics, particularly the definition of municipal waste and recycling, should be aligned with the new reporting rules under the WFD (as set out in this guidance document and described in detail in its Annexes). Note, the grey cells sum relevant parameters automatically in the sheet. Waste generated by households and by other sources add up to total municipal waste generated. The variable separate collection is a subset of total municipal waste generated. The waste treatment operations and related codes are indicated in the first two columns. Note that Preparation for reuse, Recycling - material, Recycling - composting and digestion, Recovery - energy recovery, and Recovery – other, are subsets of total Recovery. Metal recycling from incineration bottom ash is a subset of material recycling. Separate collection and recycling of biowaste at source e.g. home composting is a subset of Composting and digestion. Total Disposal contains the subsets Disposal - incineration (D10), Disposal - landfill (D1, D5, D12) and Disposal - other (D2-D4, D6-D7).

4.1.1 Waste generation

Municipal waste is defined in Article 3(2) of European Council Directive 2008/98/EC on waste[9] as "mixed waste and separately collected waste from households, including paper and cardboard, glass, metals, plastics, bio- waste, wood, textiles, packaging, waste electrical and electronic equipment, waste batteries and accumulators, and bulky waste, including mattresses and furniture" and **"mixed waste and separately collected waste from other sources, where such waste is similar in nature and composition to waste from households."**

Waste that is similar in nature and composition to waste from households may also be collected from enterprises, and in such cases it is classed as municipal waste unless it originates from production, as stated in the same provision: *"Municipal waste does not include waste from production, agriculture, forestry, fishing, septic tanks and sewage network and treatment, including sewage sludge, end-of-life vehicles or construction and demolition waste."*

Furthermore, **the definition is without prejudice to the allocation of responsibilities for waste management between public and private actors**, i.e. it is irrelevant for the definition who collects the waste or on whose behalf the waste is collected.

Some further guidance on applying the definition of municipal waste is given in Annex 1 of this guidance.

[9] For the consolidated version see https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:01994L0062-20180704&from=EN

4.1.2 Separate collection

‘Separately collected waste’ refers to the amount of waste collected through separate waste collections at the initial point of collection (e.g., amounts collected for recycling through door-to-door collections, from 'bring site’ recycling points, from centralised recycling facilities, from take-back schemes, and other collection routes where the material is intended to be recycled). Separately collected wastes includes single materials collections (e.g., glass container collections, paper bank collections etc.), or multiple materials which are collected together for recycling (e.g., door-to-door mixed recycling collections where multiple materials are collected in one or more containers).

Separately collected waste is unlikely to be equal to the amount of waste at the calculation point sourced from separate collections, and the two should not be confused. Separately collected wastes are typically sorted (where contaminants are removed, and losses are incurred) and then often go through further processing before entering the final recycler.

It is important to note the difference between ‘waste generated’ and ‘separate collection’: separate collection is a sub-set of total waste generated, as not all waste is separately collected – some waste is collected mixed (i.e., residual waste). Separate collection is also not the same as total recovery, as waste can be recovered following treatment of mixed wastes. Separately collected waste may also contain waste that is not recoverable, so not all separately collected waste is necessarily recovered, some may be disposed of.

4.1.3 Preparation for reuse and recycling

It is important to reiterate the legal definitions of ‘preparing for re-use’ and ‘recycling’.

Article 3 (16) of the WFD states that ‘preparing for re-use’ 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 re-used without any other pre-processing*”. For example, textiles, furniture and WEEE may be prepared (by means of checking, cleaning or repairing recovery operations) to be reintroduced on to the market.

Article 3 (17) of the WFD states that ‘recycling’ 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.”*

In addition, Article 11 of the WFD states that:

> *“waste sent to another Member State for the purposes of preparing for re-use, recycling or backfilling in that other Member State may only be counted towards the attainment of the targets laid down in Article 11(2) and (3) by the Member State in which that waste was collected.”*

This emphasises that in municipal waste statistics the reporting of waste treatment concerns the treatment of waste generated in a given country no matter where it is treated – i.e.

whether treated in the country in which the waste was collected or in another country to which the waste was exported for treatment.

According to Article 11a(8) of the WFD, where waste is exported from the Union for preparing for reuse or recycling, it should only be counted as such where there is sound evidence that treatment was carried out under broadly equivalent conditions to those required under EU environmental law. Section A.2.12 of Annex 2 provides guidance on how such evidence should be obtained. Details regarding this evidence should be reported in the MWRO questionnaire under question 4.1.3 of the Table 2 Quality Report (on sheet "QR Table 2 - Material-breakdown"), within the T+18 month questionnaire submission.

4.1.4 Recovery

'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. Annex II of Directive 2008/98/EC on waste sets out a non-exhaustive list of recovery operations.

Recovery categories not stated above also comprise 'Recovery - energy recovery', and 'Recovery – other'. These are subsets of 'Recovery'. Regarding **energy recovery**, please fill in the table with the total weight of waste that has actually been subject to 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.

4.1.5 Disposal

'Disposal' means any operation which is not recovery even where the operation has as a secondary consequence the reclamation of substances or energy. Annex I of Directive 2008/98/EC sets out a non-exhaustive list of disposal operations.

Total disposal comprises Disposal - incineration (D10), Disposal - landfill (D1, D5, D12) and Disposal - other (D2-D4, D6-D7); (OECD). These are subsets of Disposal.

- Regarding **disposal - incineration**, please fill in the table with the total weight of waste that has actually been subject to disposal via incineration.
- Regarding **disposal - landfill**, please fill in the table with the total weight of waste that has actually been subject to disposal via landfill.
- Regarding **disposal - other**, please fill in the table with the total weight of waste that has actually been subject to disposal via other means that are not incineration or landfill.

For each of the three categories the amount of waste to be reported is the amount that enters the respective disposal operation / facility – e.g. the amounts entering all facilities with D10 codes would be counted as Disposal – incineration.

4.2 Generation, recycling and recovery of municipal waste: Annex V (Data on municipal waste referred to in Article 7(2)) ["Table 2" within the municipal waste reporting obligation {MWRO} data collection questionnaire]

Table 2 - Material breakdown (in the MWRO Excel questionnaire) requires data on waste generation, separate collection, preparing for reuse and recycling, energy recovery and other recovery to be completed for each municipal waste category. It is necessary to use waste composition data to provide the required breakdowns. Note that the 'other' waste category constitutes the remaining List of Waste (LoW) codes.[10] An image of the Table can be found in Figure 4. This table is occasionally referred to as "part A" within the questions within the Table 2 quality report, since this was how the table was referred to within Annex V of Commission Implementing Decision 2019/1004.

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

- Section 4.2.1 'Waste generation';
- Section 4.2.2 'Separate collection';
- Section 4.2.3 'Preparation for reuse and recycling';
- Section 4.2.4 'Recovery'.

Note, as indicated above, Table 2 - Material breakdown is a new mandatory format for reporting on municipal waste from reference year 2020 and beyond. Reporting Table 3 - Recycling rate (see Section 4.3) is only to be used if a Member State wants to prove compliance with the recycling target under point (a) of Article 11(2) of Directive 2008/98/EC until the reference year 2025 (and beyond)[11] using one of calculation methods 1 to 3 as described in Annex II of Decision 2011/753/EU. For calculation method 4 the required data is contained in Table 2 - Material breakdown, and thus Table 3 and the Table 3 quality report can be omitted if taking the method 4 compliance option (i.e., answering "Yes" to question 3.2 of the Table 2 Quality Report).

[10] 20 01 13*,20 01 14*, 20 01 17*, 20 01 19*, 20 01 21*, 20 01 23*, 20 01 26*, 20 01 27*, 20 01 28, 20 01 29*, 20 01 30, 20 01 31*, 20 01 32, 20 01 41, 20 01 99, 20 03 03, 20 03 99, 15 01 05, 15 01 10*

[11] In accordance with Article 11(3) of Directive 2008/98/EC, Member States may postpone this deadline by up to five years under certain conditions.

Figure 4: Table 2 - material breakdown – according to Implementing Decision (EU) 2019/1004/EU Annex V

Table 2 - material breakdown according to Implementing Decision 2019/1004/EC Annex V																							
Country:																							
Reference year:		**2020**																					
Codes	**Municipal waste**	**List of Waste codes (LoW) (for generated amounts only)**	**Municipal waste generated (tonnes)[1]**	**Standard footnotes**	**Explanatory footnote**	**Separate collection[5] (tonnes)**	**Standard footnotes**	**Explanatory footnote**	**Preparing for reuse (tonnes)**	**Standard footnotes**	**Explanatory footnote**	**Recycling (tonnes)**	**Standard footnotes**	**Explanatory footnote**	**Energy recovery (tonnes)[2]**	**Standard footnotes**	**Explanatory footnote**	**Other recovery (tonnes)[3]**	**Standard footnotes**	**Explanatory footnote**
			GEN			COL_SEP			PRP_REU			RCY			RCV_E			RCV_OTH		
TOTAL	**Total**																			
W063_122_MUN	**Metals**	20 01 40, 15 01 04, 15 01 11*																		
W063_122_MUN_INC	**Metals seperated after incineration of waste[4]**	20 01 40, 15 01 04, 15 01 11*																		
W071_MUN	**Glass**	20 01 02, 15 01 07																		
W074_MUN	**Plastic**	20 01 39, 15 01 02																		
W072_MUN	**Paper and cardboard**	20 01 01, 15 01 01																		
W091_092_MUN	**Bio-waste**	20 01 08, 20 01 25, 20 02 01																		
W091_092_MUN_S	**Bio-waste seperated and recycled at source[5]**	20 01 08, 20 01 25, 20 02 01																		
W075_MUN	**Wood**	20 01 37*, 20 01 38, 15 01 03																		
W076_MUN	**Textiles**	20 01 10, 20 01 11, 15 01 09																		
W082_84_MUN	**Electrical and electronic equipment**	20 01 21*, 20 01 23*, 20 01 35*, 20 01 36																		
W0841_MUN	**Batteries**	20 01 33*, 20 01 34																		
W1011_MUN	**Bulky waste[6]**	20 03 07																		
W1011_1021_MUN	**Mixed waste**	20 03 01, 15 01 06																		
MUN_OTH	**Other**	See below[7]																		

Notes:

Cell shading:

White: Data provision is required.
Light blue: provision of data is voluntary.
Light orange: Footnotes (only to be filled-in when relevant)
Black: Reporting is not applicable.

4.2.1 Waste generation

In order to fill in the amounts of waste generated for each category in tonnes, the total municipal waste generation, in tonnes, should be multiplied by the relevant proportion of each type of waste from Municipal Solid Waste (MSW) compositional analyses. To do this, the categories in the national waste compositional analysis for a given Member State may need to be aligned with the categories given here. For example, different categories of plastic waste (bottles, films etc.) should be grouped under plastics. Any assumptions made concerning the mapping of the national waste compositional analysis categories to the categories in this reporting table should be set out in the description under question 3.1.4 of the Table 2 Quality Report. The point here is that because total MSW waste compositional analyses are not produced to any harmonised standard, the categories may need grouping to higher levels (e.g. plastics).

The latest national MSW composition analysis should be used. The compositional analysis of all MSW should be used here, not the composition of residual / mixed waste. It is acceptable to use an analysis that does not correspond directly to the year of the reported data — analyses of this nature are not generally updated on a yearly basis. Use the latest available, and record the year of the analysis in the description under question 3.1.4 of the Table 2 Quality Report. In the unlikely event that a national waste composition is not available, this reason(s) should be explained in the footnotes, and the approach used should be identified. Major cities often conduct their own waste compositional analyses. Such data can be used to update the results of national compositional analyses when these are outdated, or may be used as proxies in cases where national analyses are not available. Suitable methods should be used to adapt the results from individual cities to the entire country.

If total municipal waste composition data is unavailable, but recent residual waste composition data is available, then the mixed/residual waste may be disaggregated into component materials and added to the amounts of separately collected wastes.

If compositional analyses are entirely unavailable for the reporting country, then please contact the municipal waste statistics team at Eurostat (estat-waste-statistics@ec.europa.eu) who may be able to provide usable waste compositional analysis data compiled by the Joint Research Centre.

Table 2 comes pre-loaded with LoW codes for each municipal waste type. Member States should not amend Table 2 by adding any codes of their own. Please note that the specified LoW codes refer only to generated amounts of municipal waste, and therefore include only Chapter 20 codes, while Chapter 19 codes (i.e. secondary wastes from waste management facilities etc.) are not included in the waste generation totals.

If the national waste compositional analysis does not have a separate category for some of the categories in the table, leave the corresponding rows blank.

Ensure that any bio-waste recorded under the row ‘Bio-waste separated and recycled at source’ is not included in the amount given in row ‘Bio-waste’, to ensure that double counting does not occur. If any waste is recorded under the ‘Other’ row, some qualitative explanation

of the main types of waste within this amount should be described in 3.1.4 of the Table 2 Quality Report.

Finally, please ensure that the total of all component rows in the waste generation column equal the total weight of municipal waste generated, as given in the 'Total' row at the top of the table. Error can be introduced if, for instance, rounding within the waste composition data means that the total municipal waste composition does not sum to 100%.

4.2.2 Separate collection

Definitions and important concepts relating to the term 'separate collection' is given in Section 4.1.2 above. In essence it intends to mean waste which is collected for recycling. This will include recycling which is collected in single material streams, which may directly relate to the component material categories within the questionnaire. It also includes mixed multi-material recycling collections; in these cases, the collected tonnages should be disaggregated into the component material categories using composition survey data of the mixed recycling collection stream.

The weight of waste reported under this column is the weight of waste at the point where it has been separately collected. This column records the amount that was initially collected, not the proportion of waste at the calculation point that was sourced from separate collections. Please ensure that the sum of all component materials in each applicable row equal the amount given in the 'Total' row at the top.

It is important to note the difference between the columns "Municipal waste generated" and "Separate collection" which are separate columns in the questionnaire. These are not the same amounts. Separate collection is a sub-set of total waste generated; some is separately collected and the remainder is mixed waste collections from various sources and collection routes (which can then be sorted to recover recoverable waste).

Also, separate collection is not the same as preparing for reuse and recycling. Losses are often incurred from collected quantities, resulting in lower tonnages of recycling compared to separately collected amounts. Furthermore, some material can be sorted for recycling from mixed wastes (i.e. waste which is not separately collected), resulting in potentially higher tonnages of [preparing for reuse and] recycling compared to separately collected amounts.

It is accepted that some contrary non-target (contaminant) material tends to be collected within most separate collection material streams. There is no need to make adjustments for non-target material within the separate collection data.

4.2.3 Preparation for reuse and recycling

It is important to note that Member State statistics on waste relate to the country in which the waste is generated Article 11a(7) states:

> *"waste sent to another Member State for the purposes of preparing for re-use, recycling or backfilling in that other Member State may only be counted towards the attainment of the targets laid down in Article 11(2) and (3) by the Member State in which that waste was collected."*

This emphasises that, in municipal waste statistics, data on the treatment of waste must always be attributed to the Member State in which the waste was generated no matter where it is treated. As such, Member States should only report tonnages of waste treated where they also generated those tonnages of waste.

4.2.3.1 Preparation for reuse

It is important to reiterate the legal definitions of 'preparing for re-use' and 'recycling'. 'Preparing for re-use' 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 re-used without any other pre-processing. For example, this includes furniture, objects, books, clothes, electric and electronic devices which are prepared (by means of cleaning, repairing or refurbishing operations) to be reintroduced in the market.

4.2.3.2 Recycling

Different from 'preparing for reuse', 'recycling' 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 or reprocessing into materials that are to be used as fuels or for backfilling operations, as defined by Article 11a(5):

> *For the purposes of calculating whether the targets laid down in points (c), (d) and (e) of Article 11(2) and in Article 11(3) have been attained, the amount of waste materials that have ceased to be waste as a result 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.*

Member States can count biodegradable waste entering composting or anaerobic digestion processes as recycling under certain circumstances, as stated in Article 11a(4):

> *For the purpose of calculating whether the targets laid down in points (c), (d) and (e) of Article 11(2) and in Article 11(3) have been attained, the amount of municipal biodegradable 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 total weight of waste recycled must be equal to the weight of waste at the calculation points[12]. Further information on the relevance of the calculation points to the location of recycling activities is provided in Annex 2 of this guidance. Some key considerations and best practice in identifying calculation points, the associated measurement methods that are allowable, and some options for obtaining data at each of the measurement points are also provided in Annex 2.

If any material is recorded as preparation for reuse or recycling under the 'Other' row, some qualitative explanation of the main recyclables within this amount should be described in 3.2.3 and 3.2.5 of the Table 2 Quality Report.

Reflecting on note #6 within the Table 2 spreadsheet which concerns the multi-material category 'bulky waste', it is generally expected that the amounts reported as bulky waste within the separate collection column should be disaggregated into component materials when recycled (e.g., recycled wood and metal from broken up furniture, or recycled electrical and electronic equipment etc.). Please ensure that any disaggregated bulky waste materials are not included in the amount given in row 'bulky waste', to ensure that double counting does not occur within the recycling data.

4.2.3.3 Metal packaging and incineration bottom ash

Member States can include ferrous metal or aluminium from incineration bottom ash (IBA) in the recycled amounts. Metals separated after incineration of municipal waste shall be reported separately and shall not be included in the row for metals and in the total amount of waste entering energy recovery operations. The amounts shall be included in the total amount of recycling. Further guidance on how to comply with the methodological requirements is given in Section A.2.6 of the Annex.

4.2.3.4 Bio-waste separated and recycled at source

Bio-waste separated and recycled at source shall be reported separately and shall not be included in the row for bio-waste to ensure that double counting does not occur.

Member States do not have to report any amount of bio-waste separated and recycled at source; however, if they choose not to do so, a zero should be reported in the table. For any amount >0, further guidance on how this figure should be calculated – including how the approach should vary depending on whether or not the amount is greater or less than 5% of total amount of municipal waste generated – is given in Annex 2.

A description of the Member State methodology used to calculate amounts separated and recycled at source should be given under question 3.2.10 of the Table 2 Quality Report.

[12] Commission Implementing Decision (EU) 2019/1004 of 7 June 2019 laying down rules for the calculation, verification and reporting of data on waste in accordance with Directive 2008/98/EC of the European Parliament and of the Council and repealing Commission Implementing Decision C(2012) 2384 (notified under document C(2019) 4114) (Text with EEA relevance.)

4.2.3.5 Average Loss Rates

Member States may apply Average Loss Rates (ALR) when measuring the amount of municipal waste recycled[13]. Article 11a(3) of the 2018 Waste Framework Directive states:

> *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 and shall be calculated on the basis of the calculation rules established in the delegated act adopted pursuant to paragraph 10 of this Article.*

This exemption rule allows Member States to report waste recycled at an early stage in the recycling process by calculating the losses which occur after first sorting operations. ALRs should only be used when no other reliable data on the weight of waste at the calculation point are available, such as in the context of shipment and export of waste.

If ALRs are applied, a full description of the approach used to calculate the ALRs should be provided in section 3.2.6 of the Table 2 Quality Report. This should include details of the sorted recyclable waste streams to which ALRs are applied, types of sorting plants to which different ALRs apply, the methodological approach to calculating ALRs at such point(s), including the statistical accuracy of any surveys used, and the nature of any technical specifications. See Section A.2.11 of the Annex for further guidance on ALRs.

4.2.3.6 Reporting of waste exported for recycling

Where waste is exported from the Union for recycling, it should only be accounted for where there is sound evidence that treatment was carried out under broadly equivalent conditions to those required under EU environmental law. Section A.2.12 of the Annex 2 provides guidance on how such evidence should be obtained. Details regarding this evidence should be reported under question 4.1.3 of the Table 2 Quality Report.

4.2.4 Recovery

Regarding **energy recovery**, please fill in the table with the total weight of waste of each material that type has actually been subject to energy recovery. As stated in the guidance note 2, compositional analyses of mixed waste entering energy recovery plants can be used to calculate the amounts of each material entering energy recovery plants — these amounts

[13] 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)

should be added to the amounts of already segregated waste (waste separated out from mixed waste in sorting operations) entering the plants.

If mixed waste compositional analyses are not available, the total amount of mixed waste entering energy recovery plants should be entered into the 'Mixed waste' column. However, any amount of waste sorted out of mixed waste should still be entered in the material specific rows.

The 'Total' row should be a sum of all the amounts given in the separate rows within the table. If any assumptions are made to correlate national categories of waste to the categories of waste given in the table these can be set out in the description under question 3.2.2 of the Table 2 Quality Report.

Regarding **other recovery**, please fill in the table with the total weight of waste of each material type that has actually been subject to other recovery. As highlighted in footnote 3 to the table, only recovery operations other than Energy Recovery and Recycling (which includes composting / digestion of biowastes as per the conditions set out in Article 11a of Directive 2008/98/EC) should be included in this column (i.e. do not include composting or digestion in the Other Recovery column, nor should inputs to pre-treatment or mixed waste treatment plants be recorded under this parameter either).

The use of biostabilised waste[14] as landfill cover requires particular attention. This waste typically contains plastic or hazardous items (e.g. from WEEE or batteries). Though it also contains an organic fraction, it must not be considered as compost due to the presence of the contaminants. Different reporting rules apply depending on how the biostabilised waste is used and on its quality:

- The use of biostabilised waste from municipal waste sources as daily cover in landfill cells should be classified as a disposal operation (D1 or D5 as defined within Annex I of the WFD), not a recovery operation (as are listed in Annex II of the WFD). Furthermore, however, Article 5(3f) of Landfill Directive 1999/31/EC identifies that separately collected wastes should not be landfilled other than in situations when this would represent the best environmental outcome, so in typical circumstances biostabilised wastes [from source segregated collections] are not suitable for daily coverage.
- Using biostabilised waste for landfill coverage is only to be counted as 'other recovery' if the waste is used as a backfilling operation for final cover and the material is compost of good quality, which means from composting and digestion of separately collected biowaste (without contaminants).
- Where biostabilised waste is not compost of good quality, coverage of used/closed landfill cells for restoration purposes cannot be counted as recovery, as this material would have been landfilled otherwise, and is still contaminated.

Fill in the total weight of waste of each material type into the table, where waste of that type has actually been treated through any other form of recovery. The 'Total' row should be a

[14] Biostabilised fines are fractions from MBT plants. After the stabilisation process (stablisation of the biological material, so bio-stabilised) the material is generally screened and a fines fraction is produced.

sum of all the amounts given in the separate rows within the table. If any assumptions have been made to correlate national waste categories to the categories of waste given in the table, these assumptions can be set out in the description under question 3.2.2 of the Table 2 Quality Report. The amounts under the material specific categories should include both the amounts of already segregated waste arriving at other recovery plants, and the amounts within mixed waste.

As is the case for energy recovery, compositional analyses of mixed waste entering other recovery plants can be used to calculate the amounts of each material entering other recovery plants — these amounts should be added to the amounts that are already segregated entering the plants. If mixed waste compositional analyses are not available the total amount of mixed waste entering other recovery plants should be entered into the 'Mixed waste' column. However, any amounts of segregated waste should still be entered in the material specific rows.

4.3 Generation and recycling of municipal waste: Annex IV (Data on Municipal Waste Referred to in Article 7(1)) ["Table 3" within the municipal waste reporting obligation {MWRO} data collection questionnaire] – Previously allowed methods

"Table 3 – Recycling rate" (reproduced in Figure 5) is only to be used if a Member State wants to prove compliance with the target under point (a) of Article 11(2) of Directive 2008/98/EC until the reference year 2025 (and beyond)[15] using one of the previously allowable calculation methods. Member States that wish to do so should complete the municipal waste generated and recycled columns in Reporting Table 3 – Recycling rate (a reproduction of this table is provided here in Figure 5). This table is referred to as "part A" within the questions within the Table 3 Quality Report, since this was how the table was referred to within Annex IV of Commission Implementing Decision 2019/1004.

[15] In accordance with Article 11(3) of Directive 2008/98/EC, Member States may postpone this deadline by up to five years under certain conditions.

Figure 5: Table 3 - Recycling rate - Recycling rate for measuring compliance with the policy target according to point (a) of Article 11(2) of Directive 2008/98/EC, according to the format set out in Annex IV of the Commission Implementing Decisions 2019/1004based on old calculation methods)

Table 3 - Recycling rate for measuring compliance with the policy target according to point (a) of Article 11(2) of Directive 2008/98/EC, according to the format set out in Annex IV of the Commission Implementing Decisions 2019/1004 - to be filled in only by the Member States wanting to prove compliance with the old targets until 2025 using the old rules						
Country:						
Reference year:	**2021**					
Calculation method[1]		*<= Select the calculation method here*				
	Municipal waste generated [2]	**Standard footnotes**	**Explanatory footnote**	**Preparing for re-use and recycling** [2]	**Standard footnotes**	**Explanatory footnote**
	GEN			RCY_PRP_REU		
Tonnes						

4.4 Landfilling of municipal waste: Annex II (Decision 2019/1885/EC))) [“Table 4” within the municipal waste landfill data collection questionnaire]

The following target under Article 5(5) of Directive 1999/31/EC on the landfill of waste[16] must be reported on:

> *Member States shall take the necessary measures to ensure that by 2035 the amount of municipal waste landfilled is reduced to 10 % or less of the total amount of municipal waste generated (by weight).*

This target should be reported according to the format set out in Decision 2019/1885.[17] An image of the reporting table in the landfill questionnaire is reproduced here in Figure 6.

[16] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:01999L0031-20180704&from=EN

[17] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32019D1885&from=GA

Figure 6: Table 4 - Landfill rate - Landfill rate - for measuring compliance with the policy target in accordance with Article 5(5) of Council Directive 1999/31/EC concerning the landfilling of waste according to the format set out in Annex II of Commission Implementing Decision 2019/1885 for the calculation of the landfill rate

Table 4 - Landfill rate - for measuring compliance with the policy target in accordance with Article 5(5) of Council Directive 1999/31/EC concerning the landfilling of waste according to the format set out in Annex II of Commission Implementing Decision 2019/1885 for the calculation of the landfill rate										
Country:										
Reference year:	**2021**									
Municipal waste generated[1] (tonnes)	**Standard footnotes**	**Explanatory footnote**	**Landfilling[2] (tonnes)**	**Standard footnotes**	**Explanatory footnote**	**Incineration disposal[3] (tonnes)**	**Standard footnotes**	**Explanatory footnote**	**Material recovery of waste from incineration disposal (tonnes)**	**Standard footnotes**	**Explanatory footnote**
GEN			**DSP_L**			**DSP_I**			**RCV_M_ID**		

It is important to note that for the purposes of monitoring compliance with the above target, landfilling includes:

> 'the weight of waste resulting from treatment operations prior to recycling or other recovery of municipal waste, such as sorting or mechanical biological treatment, which is subsequently landfilled.'

The landfilled output from such processes may be categorised under LoW chapter 19 (wastes from waste management facilities) not chapter 20 (municipal waste), so it is important to ensure the total municipal waste landfilled includes all relevant landfilled wastes from municipal sources (as per the previous Eurostat Guidance on municipal waste).[18]

In addition, the total amount of landfilling shall include the amount of waste entering incineration disposal operations, less the amount of material recovered from such operations (i.e. column 'Incineration Disposal' minus column 'Material recovery of waste from incineration disposal'). In this case, material recovery is any material recovery, not just metals extracted from IBA, and material recovery of the recovered IBA would also be deducted here (i.e. where recovered material is not finally landfilled). An example of how the data in the cells will be used to calculate the rate against which the target will be monitored is given in Annex A.2.5. of this document.

Using biostabilised waste for landfill coverage is only to be counted as 'other recovery' if it is used in land restoration for final cover **and** the material is compost of good quality– meaning from the composting and digestion of separately collected biowaste (without contaminants), as is detailed under 'Other Recovery' in Section 4.2.4.

[18] https://ec.europa.eu/eurostat/documents/342366/351811/Municipal+Waste+guidance

5 Guidance for the completion of the quality reports

Completion of the Quality Reports is mandatory and must be completed with as much detail as possible. Guidance notes for completing the quality reports are included alongside the relevant questions in the Excel templates. It is especially important that all relevant questions are answered with as much detail as possible, and there is need for detailed validation of data against targets.

Please refer to Section 6.1 for some examples of good practices in filling of certain Quality Report fields.

Certain questions ask for the level of confidence to be provided on the statistics. For an example of calculating the statistical significance (confidence intervals), please refer to the worked example shown for surveying of incinerators for metal concentrate in the bottom ash, as provided within the box in Annex A.2.6.2.

6 Good practice examples for collecting municipal waste treatment data

Best practice examples and key considerations related to identifying the calculation points for municipal waste (including metals from IBA), the allowable measurement methods associated with each of these, and some options for obtaining data at the measurement points are provided in Annex 2. This Annex also provides further detail on identifying the municipal proportion in multi-stream treatment plants, measuring the amounts of biowaste treated and biowaste separated and recycled at source, and examples of the average loss rates for municipal waste. Finally, the Annex 2 provides guidance on proving compliance with the requirement to ensure that all waste exported for treatment outside the EU is treated under broadly equivalent conditions, and the application of the average loss rate (ALR) methodology.

6.1 Good practice examples for completion of Member State Quality Reports

This section presents examples of good practice in completing the municipal waste Quality Reports. They illustrate the required level of detail and clarity in responses to allow an understanding of the methodologies utilised by Member States in their calculations.

Figure 5 is shown as an example response describing the relevant reporting obligations in a country, as well as the processes put in place to ensure data reliability and validity. Detail is also provided about processes implemented to deal with irregularities in data entry and reporting.

Figure 5: Response provided by Malta to question 2.3 in the Table 1 Joint Questionnaire Quality Report regarding the data validation process

2.3 Please describe the data validation process:
Waste generation - NSO collects data from WasteServ Malta Ltd., which is the major operator in the municipal waste sector. The data is provided as inputs and outputs per individual facility which WasteServ operates. WasteServ submits its annual data both to the Environment and Resources Authority (ERA) and the NSO, and both entities conduct their validation processes which consist of computational checks, consistency checks (comparing the data with previous years) and coherence checks (cross-checking the data of individual facilities for all cases where inter-facility waste transfers occurred). The Environment and Resources Authority also provides aggregated data (by EWC codes and R and D codes) that is sourced from all waste management facilities and waste brokers. NSO validates this data by performing computational and consistency checks and by comparing with WasteServ's data. Clarifications from WasteServ and ERA are sought whenever anomalous values or dubious entries are flagged. There are instances where such values are justified and other instances where data revisions need to be made. Whenever such revisions take place both NSO and ERA are notified so that both entities can work with the same datasets. Waste treatment - All data is sourced from the Environment and Resources Authority. The aggregated dataset includes waste that is treated at WasteServ and private facilities together with waste that is exported by waste brokers for final treatment in overseas facilities. NSO validates this data by performing computational and consistency checks, and by making comparisons with waste generation data.

The response shown in Figure 6 is shown as an example clearly outlining the scope of the primary data available to a Member State, as well as describing the assumptions made in order to account for the waste generated by the out-of-scope portion of the population.

Figure 6: Response provided by Croatia to question 1.2(c2) in the Table 1 Joint Questionnaire Quality Report

c2) How do you determine the un-covered population (number of residents / number of households / others) and how do you estimate the amount of waste generated?
In our national database (Environmental pollution register), there are data on the number of inhabitants covered by organized collection of municipal waste. From the total number of inhabitants in Croatia, the number of inhabitants covered by organized collection was subtracted. In that way, we got an uncovered population. In addition, we divided the collected quantities of municipal waste with the number of inhabitants covered by the organized collection. This gave us the collected amount of municipal waste per capita. In the end, the amount of waste collected per capita was multiplied by the non-covered number of inhabitants. Thus, we obtained the amount of waste related to the non-covered part of the population that we added to the total amount of waste collected in order to obtain the total amount of generated waste.

Annexes

Annex 1 Reference manual: Defining municipal waste

A.1.1 Overview of municipal waste definition

The definition of municipal waste is now fixed in Directive 2008/98/EC, as set out in the Scope and definitions section at the start of the main guidance document. Some further guidance is included here to provide more detail in certain areas. Member States using LoW codes should refer to Section A.1.2.

Municipal waste includes household waste and similar waste. It includes for example:

- paper and cardboard, glass, metals, plastics, wood, textiles;
- packaging;
- bio- waste (e.g. garden waste, leaves, grass clippings, street sweepings, the content of litter containers, and market cleansing waste);
- hazardous household waste (e.g. spent solvents, acids, alkalines, photochemicals, pesticides, used oils, paints, inks, adhesives and resins (partly haz.), WEEE (partly haz.), batteries and accumulators (partly haz.), detergents (partly haz.), hazardous medicines);
- waste electrical and electronic equipment, waste batteries and accumulators;
- bulky waste (e.g. white goods, furniture, mattresses etc);
- other waste: Edible oil and fat, rubber waste, ceramics, etc; and
- Mixed and/or undifferentiated wastes, garden waste, leaves, grass clippings, street sweepings, the content of litter containers, and market cleansing waste.

Municipal waste includes waste originating from the following (whether collected by municipal or by private collectors):

- Households (including recycling of biowaste at source, e.g. home composting - see Appendix A.2.10, but excluding sewage sludge and construction and demolition [renovation] waste);
- commerce and trade, small businesses, office buildings and institutions (e.g. schools, hospitals, government buildings);
- enterprises if it is similar in kind and composition to household waste and does not come from production;
- all small businesses should be included (including, for instance, waste from repair shops, handicraft, household scale businesses etc.). Excluding waste from certain NACE categories can lead to under reporting; and
- waste from selected municipal services i.e. waste from park and garden maintenance, waste from street cleaning services (e.g. street sweepings, the content of litter containers, market cleansing waste).

It includes waste from these sources collected:

- door-to-door trough traditional collection (mixed household waste);
- fractions collected separately for recovery operations (through door-to-door collection and/or through voluntary deposits / drop off locations e.g. container parks, civic amenity sites);
- wastes collected directly by the private sector (business or private non-profit institutions); not on behalf of municipalities (mainly separate collection for recovery purposes); and
- wastes originating from rural areas not served by a regular waste service, even if they are disposed of by the one generating the waste.

The definition is without prejudice to the allocation of responsibilities for waste management between public and private actors.

A.1.2 Scope of municipal waste based on selected LoW codes

When discarded items are handed over to the waste management system, they are classified as a certain waste type, ideally by 6-digit codes according to the List of Waste (LoW) or another (national) classification. The weight and the code are usually registered at the weighbridge of a waste management facility. Thus, the key to any definition of municipal waste is certainly the material classification of the waste, since it is this classification that best determines the similarity to household waste "in nature and composition".

The LoW-codes covering municipal waste are listed below.

Where the material classifications (LoW or other national codes) are not sufficient to cover certain desired waste streams or to exclude certain undesired waste streams, further information must be taken into account, namely:

- Types of packaging from the monitoring systems on packaging, in order to exclude at least transport packaging;
- Sources and/or types of WEEE from the monitoring systems on WEEE in order to exclude devices not used in households;
- Other waste categories where knowledge of the source is required in order to determine whether the code covers waste similar to household waste or rather production waste (e.g. paper);

Chapter 20: Municipal wastes (Household waste and similar commercial, industrial and institutional wastes) including separately collected fractions

20 01 separately collected fractions (except 15 01)

20 01 01	paper and cardboard
20 01 02	glass
20 01 08	biodegradable kitchen and canteen waste
20 01 10	clothes
20 01 11	textiles
20 01 13*	solvents
20 01 14*	acids
20 01 15*	alkalines
20 01 17*	photochemicals

20 01 19* pesticides
20 01 21* fluorescent tubes and other mercury-containing waste
20 01 23* discarded equipment containing chlorofluorocarbons
20 01 25 edible oil and fat
20 01 26* oil and fat other than those mentioned in 20 01 25
20 01 27* paint, inks, adhesives and resins containing dangerous substances
20 01 28 paint, inks, adhesives and resins other than those mentioned in 20 01 27
20 01 29* detergents containing dangerous substances
20 01 30 detergents other than those mentioned in 20 01 29
20 01 31* cytotoxic and cytostatic medicines
20 01 32 medicines other than those mentioned in 20 01 31
20 01 33* batteries and accumulators included in 16 06 01, 16 06 02 or 16 06 03 and unsorted batteries and accumulators containing these batteries
20 01 34 batteries and accumulators other than those mentioned in 20 01 33
20 01 35* discarded electrical and electronic equipment other than those mentioned in 20 01 21 and
20 01 23 containing hazardous components
20 01 36 discarded electrical and electronic equipment other than those mentioned in 20 01 21, 20 01 23 and 20 01 35
20 01 37* wood containing dangerous substances
20 01 38 wood other than that mentioned in 20 01 37
20 01 39 plastics
20 01 40 metals
20 01 41 wastes from chimney sweeping
20 01 99 other fractions not otherwise specified

20 02 garden and park wastes (including cemetery waste)
20 02 01 biodegradable waste
20 02 03 other non-biodegradable wastes

20 03 other municipal wastes
20 03 01 mixed municipal waste
20 03 02 waste from markets
20 03 03 street-cleaning residues
20 03 07 bulky waste
20 03 99 municipal wastes not otherwise specified

Chapter 15 Waste packaging; absorbents, wiping cloths, filter materials and protective clothing not otherwise specified

15 01 packaging (including separately collected municipal packaging waste i.e. also waste similar to household waste)
15 01 01 paper and cardboard packaging
15 01 02 plastic packaging
15 01 03 wooden packaging
15 01 04 metallic packaging
15 01 05 composite packaging
15 01 06 mixed packaging
15 01 07 glass packaging
15 01 09 textile packaging
15 01 10* packaging containing residues of or contaminated by dangerous substances
15 01 11* metallic packaging containing a dangerous solid porous matrix (for example asbestos), including empty pressure containers

Any waste marked with an asterisk (*) is considered to be a hazardous waste

Comments on the selection of LoW codes:

The heading of chapter 20 is: 'Municipal waste (household waste and similar commercial, industrial and institutional wastes) including separately collected wastes'. This implies that if a waste type is generated by households and the same waste type is also generated by commercial, industrial and institutional companies, this waste will be allocated to the same code.

For example, when a household generates kitchen waste or when a canteen belonging to an office or manufacturing activity generates kitchen waste, and the waste is separately collected, this waste has the same code according to the LoW (Biodegradable kitchen and canteen waste - 20 01 08). It will also have the same code if the generated kitchen waste is not separately collected but is a part of the mixed municipal waste bin (code 20 03 01).

However, if a company generates waste as a part of processing meat and other foods, this waste is not similar in its nature to household waste and will be allocated a code belonging to chapter 2 of the LoW (Wastes from agriculture, horticulture, aquaculture, forestry, hunting and fishing, food preparation and processing).

Not all waste types included in chapter 20 of the LoW are covered by the definition of municipal waste. The following codes are excluded:

- 20 03 04 - 'Septic tank sludge',
- 20 03 06 - 'Waste from sewage cleaning', and
- 20 02 02 - 'Soil and stones'.

Packaging waste, including packaging waste from households, is not covered by chapter 20 of the LoW. Packaging waste is covered by chapter 15 01 'Packaging (including separately collected municipal packaging waste i.e. household and waste similar to household waste from commerce etc)' and therefore this chapter also has to be considered for the definition of municipal waste. Not only household packaging but any packaging that is similar in nature and composition to household packaging should be included. For example, if cardboard boxes etc. used as transport packaging are similar in nature and composition they should be included, but as wooden pallets or plastic crates used for shipping vegetables are not used by households they should be excluded. Chapter 15 01 covers wastes of both sales packaging and transport packaging.

From a collection and data reporting perspective, it may be difficult to say whether certain types of packaging are sales or transport packaging. The EU Packaging and Packaging Waste Directive does not include any obligation to differentiate in the reporting between sales and transport packaging. Therefore, Member States should make estimates of the shares of the different kinds of packaging using other sources. Member States could, for example,. gather information from relevant producer responsibility organisations to approximate the proportion of packaging waste similar to household waste, by excluding transport packaging such as drums, crates, pallets, hooks, etc. Waste from certain NACE activities may be assumed to be predominantly transport packaging, e.g. waste from wholesale.

Annex 2 Reporting of data on municpal waste preparation for reuse and recycling

Preparation for re-use targets are mentioned together with recycling targets within Article 11(2) of the WFD. The two should be reported separately, however. The rules and considerations for each are set out below.

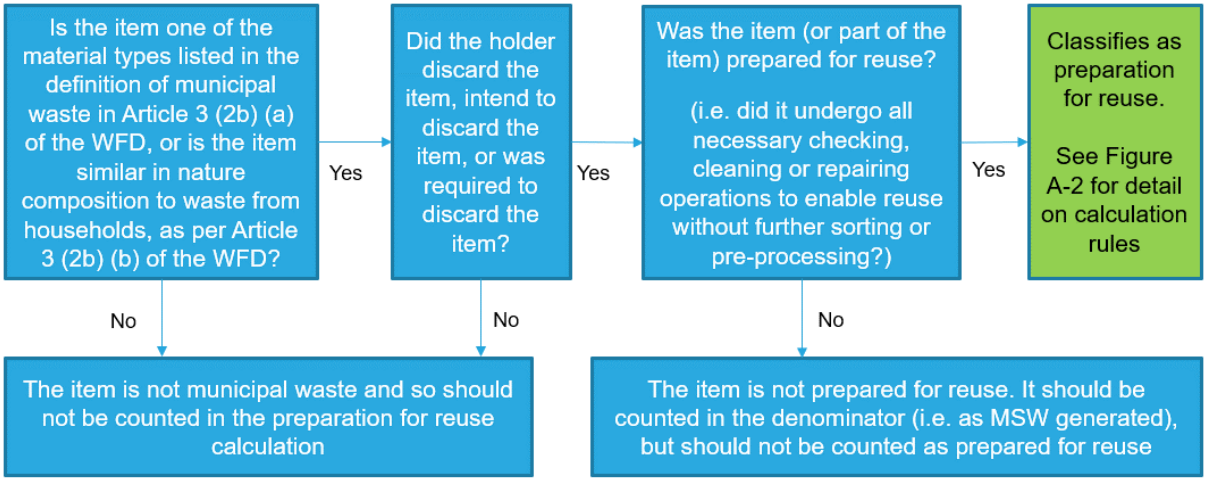
A.2.1 Preparation for reuse

A.2.1.1 Interpretation of definitions governing preparation for reuse

Article 3(1) of the WFD 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.

The main considerations here are outlined in the Figure A-1.

Figure A-1: Preparation for reuse decision tree



Where a holder deposits an item with the intention to donate to reuse (e.g. to a charity shop), the item is not discarded and may not be considered as municipal waste. Therefore, no preparation for reuse takes place. Such instances are reuse, not preparation for reuse, and are not to be included in municipal waste statistics.

Whether or not items are discarded as municipal waste or placed out as non-waste for reuse can be difficult to properly determine. Member States should be cautious about defining what constitutes municipal waste if items are put into bring banks (as well as other charity and informal collection systems), as it is not always clear whether the holder intended to discard such items.

For example, in a situation where a bring bank is generically labelled "Textile recycling", it is fairly evident that items are discarded, while some of them may be recycled, others disposed of, and some prepared for reuse. However, in a situation where a bring bank displays messaging such as "We need your clothes for reuse in our shop", it is less clear whether a

person depositing items has made a decision to discard them (so creating waste with the opportunity for preparation for reuse) or not.

Article 3(16) of Directive 2008/98/EC provides the following definition for preparation for reuse:

> *"'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 needing to take place."*

The specific requirement here is that the products or components are reused. Under the terms of the WFD, reuse applies only where the products or components are used again for the same purpose for which they were conceived. Items must therefore be returned to their original use. The types of municipal waste that are most likely to be prepared for reuse are:

- Textiles;
- Electrical and electronic equipment (EEE);
- Furniture;
- Household objects, books etc.

Article 11a(1)(b) of the WFD describes the rules on how preparation for reuse should contribute to the attainment of the targets from 2020 and beyond:

> *"the weight of the municipal waste prepared for re-use shall be calculated as the weight of products or components of products that have become municipal waste and have undergone all necessary checking, cleaning or repairing operations to enable reuse without further sorting or pre-processing;"*

Further detail on what constitutes preparation for reuse is added by Article 2 of Implementing Decision 2019/1004:

> *"The amount of municipal waste prepared for reuse shall only include the products or the components of products that, following checking, cleaning or repairing operations, can be re-used without further sorting or pre-processing. The parts of those products or of those components of products that have been removed during repairing operations may be included in the amount of municipal waste prepared for re-use."*

Concerning whole products, this article means that if a discarded product is returned to a condition by which it can be reused in its original form, then it is not necessary to deduct the weight of any parts which have been removed and disposed. To consider an example, the practical implication is that if a person disposes a bicycle at a civic amenity site / recycling centre, and it subsequently prepared for reuse (to the point where no further sorting or pre-processing is necessary), then the full weight of the bicycle would constitute preparation for reuse, even if parts and components (i.e. chain, cables etc.) were removed (and in this case

replaced in order to make the bicycle fit for reuse). This principle would also apply to zips or pockets of clothing, upholstery of soft furniture, broken panels on wooden furniture etc., in situations where these are removed or replaced as the item is prepared for reuse. However, in such cases, if the removed component is subsequently recycled, it is essential that the measurement method used accounts for removed components which are recycled in order to prevent double counting (and thereby overestimation of municipal waste prepared for re-use and recycled).

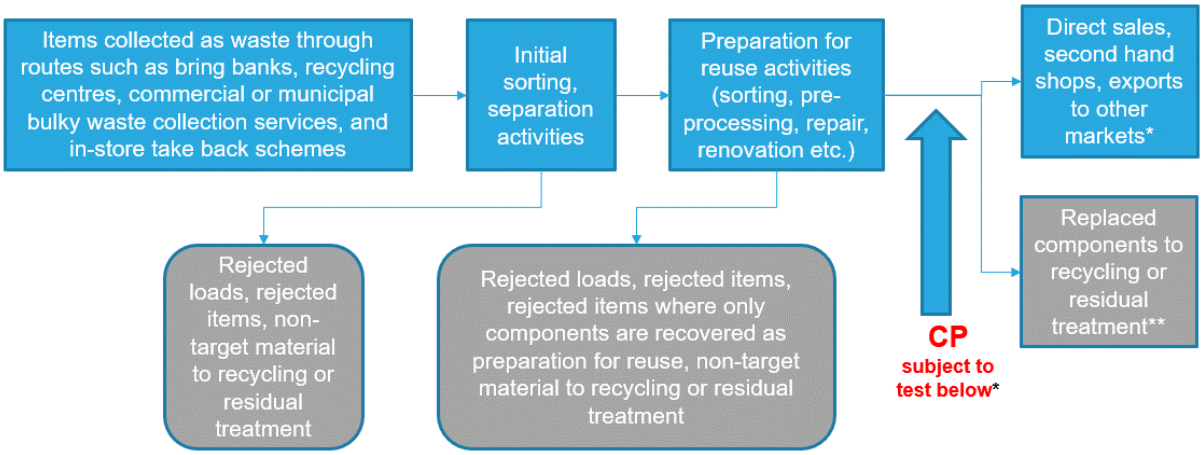
In cases where items are dismantled for reuse as spare parts, only the weight of the sub-components which are reclaimed and prepared for reuse can be counted. Other parts of the products which will not be reused are not to be included in the preparation for reuse figures. As an example, electronic components from computers (such as memory and hard drives etc.) which are removed and prepared for reuse can contribute to the statistics, whilst those components not prepared for reuse (cases, circuit boards etc) do not. Textiles which are not directly fit for reuse but which are cut into industrial rags and cleaning cloths, or other forms of upcycling, may be considered the same – i.e. only the parts which are prepared for a reuse outcome should be reported as preparation for reuse.

Note that the preparation for reuse activities listed in Article 2 of Implementing Decision 2019/1004 include ‘checking’. This could be a simple visual inspection, in which an item is checked for suitability for reuse. Such cases could then be counted as preparation for reuse.

A.2.1.2 Collecting data on Preparation for Reuse

The kinds of economic operators that control municipal waste prepared for reuse include sorting centres, repair centres, commercial operators, and social economy enterprises which take in waste products with the intention of returning them (of parts thereof) to secondary use through re-introduction to the market as second-hand products or components. Article 11a(1)(b) of the WFD, as quoted above, indicates that the measurement point for preparation for reuse occurs after all sorting, pre-processing, checking, cleaning and repairing operations. The weight of products or components which have been brought back to the condition that enables reuse without further pre-processing can be measured and reported as prepared for reuse. The effective Calculation Point (CP) for preparation for reuse activities is shown in Figure A-2.

Figure A-2: Preparation for reuse calculation point



*Data on preparing for re-use and recycling […] is to be underpinned by an effective system of quality control and traceability of waste material streams. Member States should therefore be required to take measures to ensure high reliability and accuracy of the data collected, in particular by collecting data directly from economic operators and by increasingly using electronic registries for recording data on waste

**In cases where the weight of any replaced components are small, these may be considered as an inherent loss within the preparation for reuse activity, and should be excluded from recycling (or recovery/disposal) to avoid double counting within overall preparation for reuse and recycling statistics. In cases where losses are more significant, it is preferable that they are accounted within the relevant recycling, recovery or disposal route.

Recital 9 of Decision 2019/1004 requires that Member States must collect data on waste directly from economic operators (i.e. those who control the waste), including for waste that is prepared for reuse:

> *"The data on preparing for re-use and recycling […] is to be underpinned by an effective system of quality control and traceability of waste material streams. Member States should therefore be required to take measures to ensure high reliability and accuracy of the data collected, in particular by collecting data directly from economic operators and by increasingly using electronic registries for recording data on waste."*

In practice, examples of preparation for reuse (covering the material flows from the discarding of an item as waste to preparation for reuse activities) could include:

- Clothing discarded at a textiles bring bank that is subsequently sorted / graded / cleaned / repaired etc., ready for resale or charitable donation.
- WEEE (e.g. white goods and consumer electronics) collected through take back schemes in-store under retailer and distributor obligations under the WEEE Directive that is subsequently remanufactured or used for parts.
- Furniture or other items collected as waste through recycling centers or bulky waste collections, which are subsequently refurbished.

In practice, re-use operators may process products that have at some point been waste (by merit of having been disposed through common collection routes, or returned as waste items through take back schemes), but also process products which have been sold or donated

without ever becoming waste. As a result, data gathering must distinguish between waste and non-waste items processed.

In addition, re-use operators may process both municipal and non-municipal waste (for example construction materials). Again, data gathering must distinguish between municipal and non-municipal wastes prepared for reuse.

Detail on how the amounts calculated for preparation for reuse should be described under 3.2.3 of the Quality Report to Table 2 within the annual reporting questionnaire. Data gathering may take into account registries of preparation for reuse operators / sites, data reported through electronic registries, surveys or other means. Data should cover:

- The thresholds with regard to size for organisations covered within the data;
- The number of reporting organisations;
- Detail on measures taken to assist reporters in their reporting to ensure robustness of data; and
- Conversion metrics that have been used to convert data received from reporters to the final data (for instance, in cases where preparation for reuse operations receive wastes on a per item and not weight basis).

A.2.2 Correctly identifying the calculation points for recycling of certain waste materials

A.2.2.1 Plastics waste

A.2.2.1.1 Mechanical recycling

The calculation rules below are defined in Decision 2019/1004, and aligned with the wording of Article 11a of Directive 2008/98/EC.

The calculation point for plastic municipal waste is defined in Annex I of Decision 2019/1004 as follows:

- Plastic separated by polymer that does not undergo further processing before entering pelletisation, extrusion, or moulding operations;
- Plastic flakes that do not undergo further processing before their use in a final product.[19]

As illustrated below in Figure A-3, the definition sets the calculation point to measure the weight of a product that has been:

- ground/flaked (necessary for adequate sorting and washing processes);
- sorted (so that the product does not include the weight of materials that are not the required resins (polymers) to be recycled);

[19] 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.

- 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”).

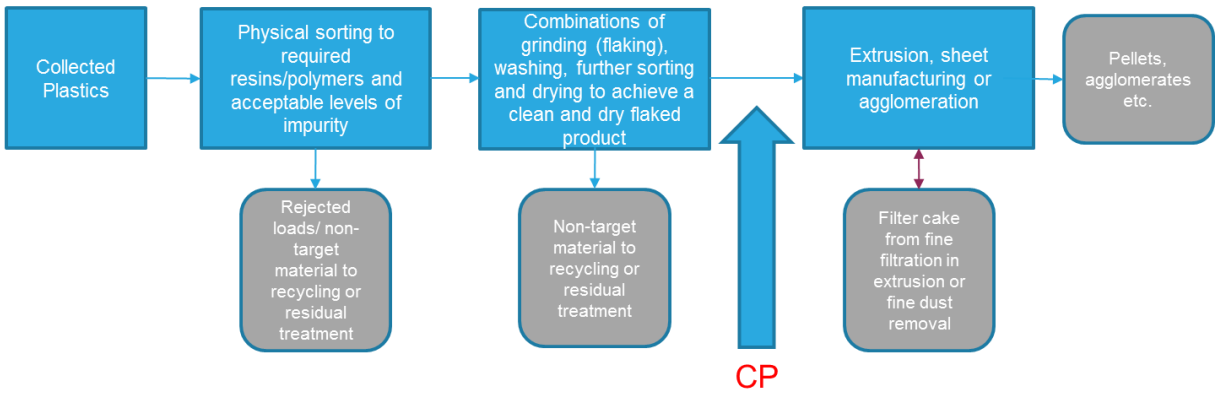
As regards whole loads of material that are rejected from entering a recycling process, they cannot be counted as recycled for the purposes of the recycling calculation.

In some cases, specific preliminary and recycling operations are integrated into a single facility whereas in other cases they might be located at different facilities, within the same company or operated by another company. Where plastics are recycled within an integrated system, the calculation point may therefore need to be identified between key operations, such that it is consistent with the calculation points identified in the Commission Implementing Decision – this may correspond with the production of secondary raw materials at certain industry specifications.

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 filter cake or fine dust that are 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 municipal waste recycled). The calculation point for plastic municipal waste is identified in Figure A-3.

Figure A-3: 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 before any further processing step prior to the material entering pelletisation, extrusion, or moulding operations. These processing steps include all types of washing e.g. cold washing, hot washing, and any combination thereof. Although a 'cold wash only' process may give rise to both lower quality (i.e. more contaminated) material and a higher contribution towards the recycling rate (due to the mass of the contaminants being included in the material counted as recycled), there is no specific provision in law for hot washed plastic to be subject to an earlier (pre-hot wash) calculation point. However, 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 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 counts as energy recovery and not recycling.

A.2.2.1.2 Chemical recovery

Chemical recovery, commonly referred to as 'chemical recycling', is the process of breaking down collected plastics into their constituent monomers and other basic chemical elements ("depolymerisation"). It makes it possible to replace other materials which would have been used to fulfil a particular function.

There are three broad categories of chemical recycling technologies:

- **Solvent Purification** uses the principle of solubility to selectively separate plastic polymer from any other materials contaminating the plastic waste. Plastic waste is shredded and dissolved in a solvent in which the target polymer has high solubility, but in which the contaminants have low solubility. The contaminants remain solid and can be separated off from the solution to purify the polymer. Once the purification process is complete, the target polymer is re-solidified using a non-solvent for

extraction from the solution in a process known as precipitation, and so can be recovered.

- **Chemical Depolymerisation** covers a range of processes (e.g. chemolysis and solvolysis) 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.
- **Thermal Depolymerisation**, also known as thermal cracking and thermolysis (and sometimes referred to by the trade as feedstock recycling), breaks down polymer chains using heat treatment. 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. As a result, the resulting pyrolysis oil is usually composed of a variety of hydrocarbon products, and requires further energy intensive purification before it can 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, mainly due to the physical characteristics of the product — for example, when several types of plastics have been combined for optimal performance (i.e. composite municipal waste), or plastics with adhering residues (e.g. food residues on municipal waste). Equally, the technology is 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).

Whilst chemical recycling has been in the R&D phase for many years (e.g. studied by the European Commission with respect to PVC in 1999) [20], the technology is still not available at commercial scale for use in recycling mixed polymer MSW or plastic municipal waste. Companies such as BASF have pilot projects ongoing such as ChemCycling, which describes the process as[21]:

> *"Through thermochemical processes, plastic waste is broken down to oil or gaseous products as raw materials for the chemical industry. These raw materials can replace fossil feedstock to produce new products, especially plastics."*

[20] TNO Institute of Strategy, Technology and Policy (1999) *Chemical Recycling of Plastics Waste (PVC and other resins)*, Final Report for the European Commission, http://ec.europa.eu/environment/waste/studies/pvc/chem_recycle.pdf

[21] BASF (2019) *Chemical recycling of plastic waste*, Accessed 13th February 2019, https://www.basf.com/global/en/who-we-are/sustainability/management-and-instruments/circular-economy/chemcycling.html

However, not all of the plastic waste may be recycled back into new plastic products. Some monomers may be utilised for fuels, which would clearly not be considered as recycling according to the Waste Framework Directive:

> *"'recycling' 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"*

In such circumstances, it would not be appropriate to count the total input of plastic waste feedstock into a chemical recycling process 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.

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 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 input material from which were derived those chemical feedstocks that were used in making new non-fuel materials, products or substances only 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.

Member States should outline the full details of the mass balance approach used to identify any municipal waste reported as recycled from chemical processes as part of the quality report (under question 2.1). 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.2.2.2 Paper / board waste

The calculation point for paper and board municipal waste is defined in Annex I of Decision 2019/1004 as follows:

- Sorted paper *[and board]* that does not undergo further processing before entering a pulping operation

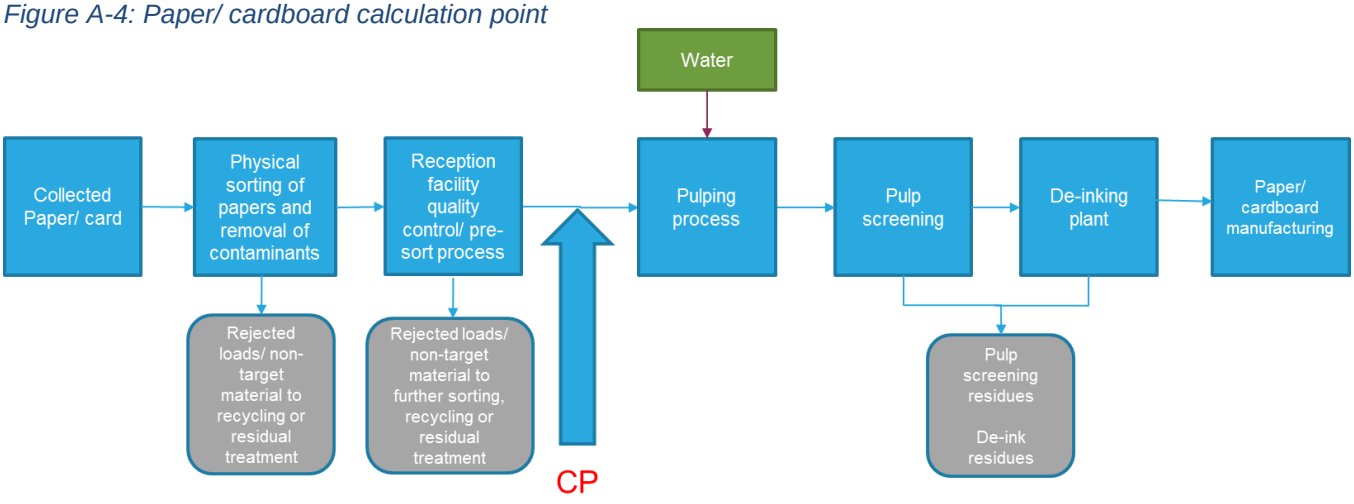
The calculation point for paper and board municipal waste is indicated in Figure A-4.

Paper and board are typically reprocessed into similar materials through a pulping process; the calculation point has been set as the weight of material entering this process, on the basis that this material meets the EN643 standard. Compliance with this standard ensures that the requirement for recycling to be 'high quality' in Article 11a(1)(c) of the WFD is met. If material with higher levels of non-fibre contamination than allowed for under the EN643 standards is introduced to a pulping process, this will result in an overstated recycling rate and, in such cases, there should be a corresponding deduction from the mass of the material introduced to the pulping operation.

Paper may also be recycled by processes that differ from a pulping process.

Certain fractions of the mass of material introduced into the pulping process do not yield fibres for remanufacturing but instead result in material sent for disposal or energy recovery, such as screened material from pulp screening or chemicals/inks from the de-inking process. On the assumption that material introduced to the pulping operation complies with EN643 standards, the loses 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 amount of recycling reported.

Figure A-4: Paper/ cardboard calculation point



A.2.2.3 Glass waste

The calculation point for glass municipal waste is defined in Annex I of Decision 2019/1004 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 municipal waste is indicated in Figure A-5.

Collected end of life glass municipal waste items require sorting treatment before the material can be introduced to a glass furnace or any of the other production processes stated

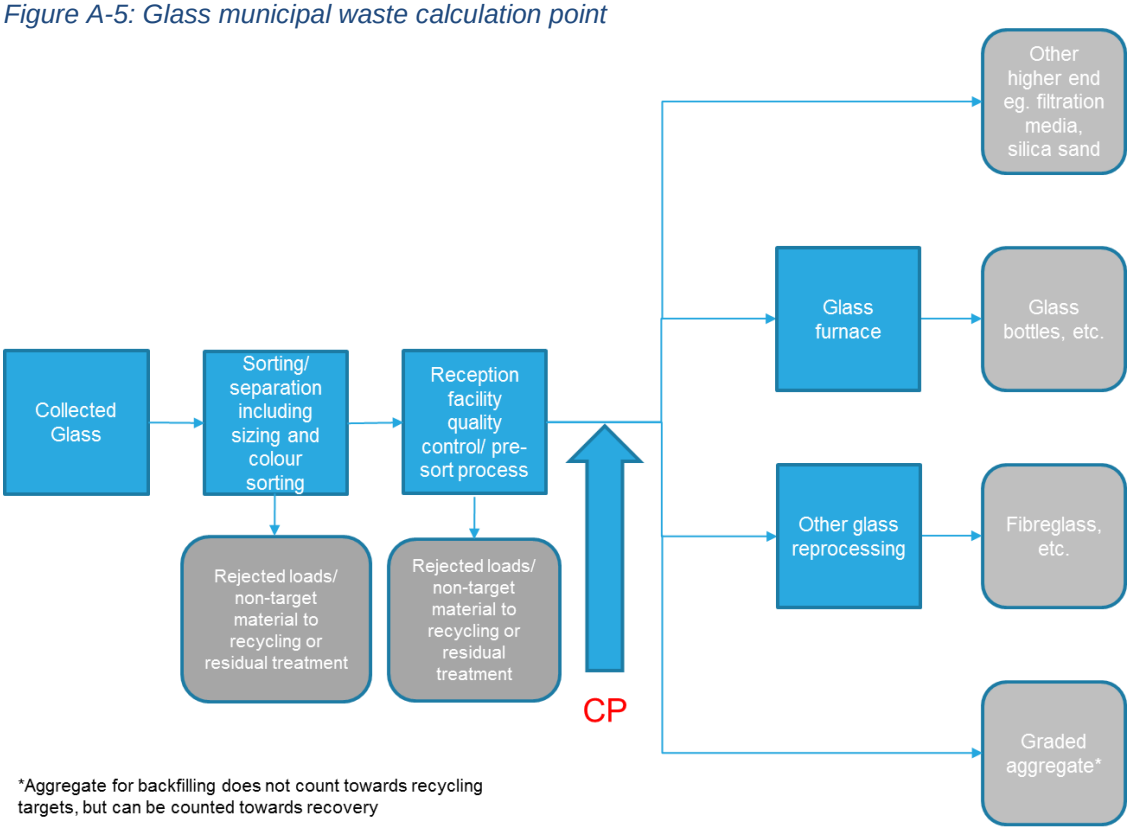
in the definition. The calculation point is set to account for the material entering the glass furnace or other relevant processes after unwanted material is removed through sorting processes.

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, but should be captured under the metal calculation point (see below).

Further, please note that the production of glass aggregate for backfilling or landfilling does not count towards recycling targets, as set out in Article 11a(5) of the WFD:

- (…), 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.

Figure A-5: Glass municipal waste calculation point



A.2.2.4 Metals waste

The calculation point for metal municipal waste is defined in Annex I of Decision 2019/1004 is as follows:

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

The calculation point for metal municipal waste is indicated in Figure A-6 (for ferrous metals) and Figure A-7 (for aluminium).

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 the

metal furnace or other relevant processes after unwanted material is removed through sorting processes.

For the purposes of the calculation rules, tinned steel packaging (e.g. food cans, biscuit tins etc.) is acceptable to the operation of the furnace, and so should not be deducted from the weight of steel counted as recycled.

Note that preliminary treatment of metals (shown in Figure A-6 and Figure A-7 below 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 municipal waste reported by that facility. This is set out in Article 3(5) of Decision 2019/1004:

> *"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 municipal 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 MSW and metal municipal waste. As the output of the above-mentioned specialised operation 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 municipal 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 to the smelter as well.

Figure A-6: Steel calculation point

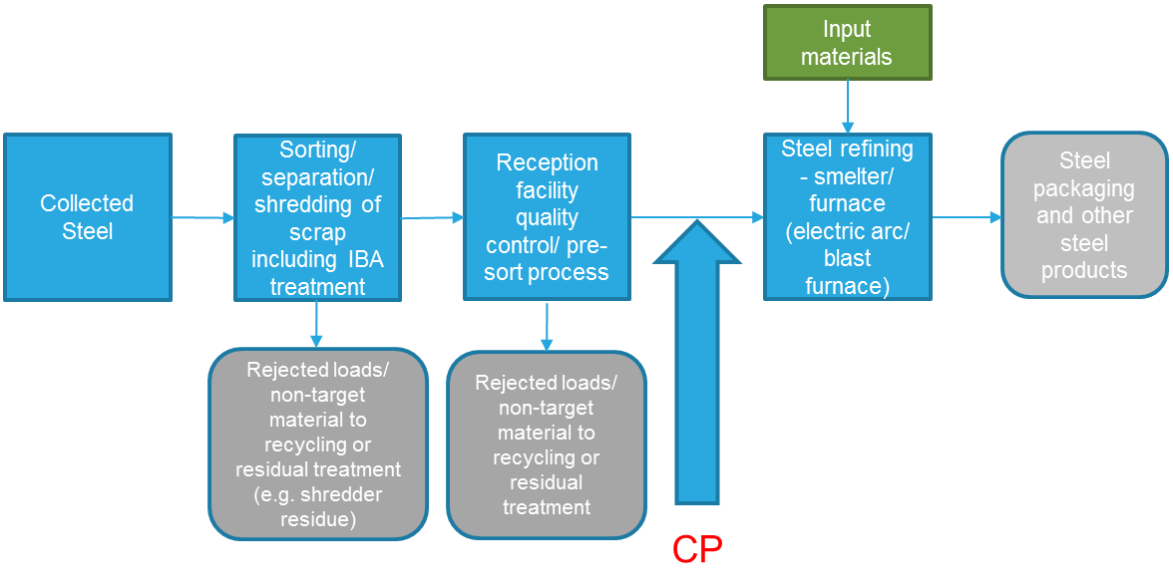
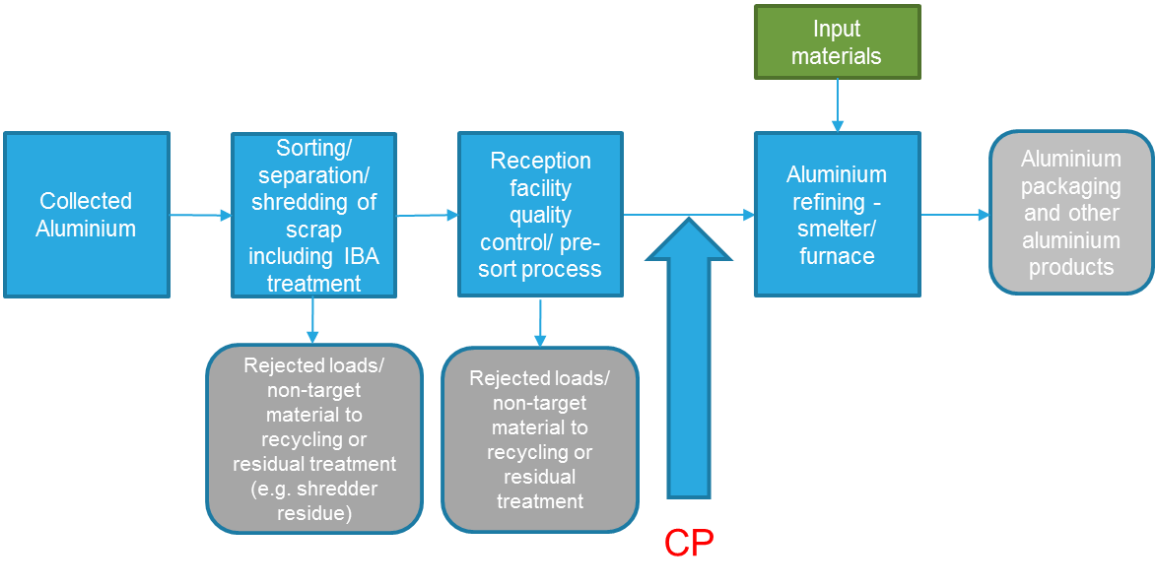


Figure A-7: Aluminium calculation point



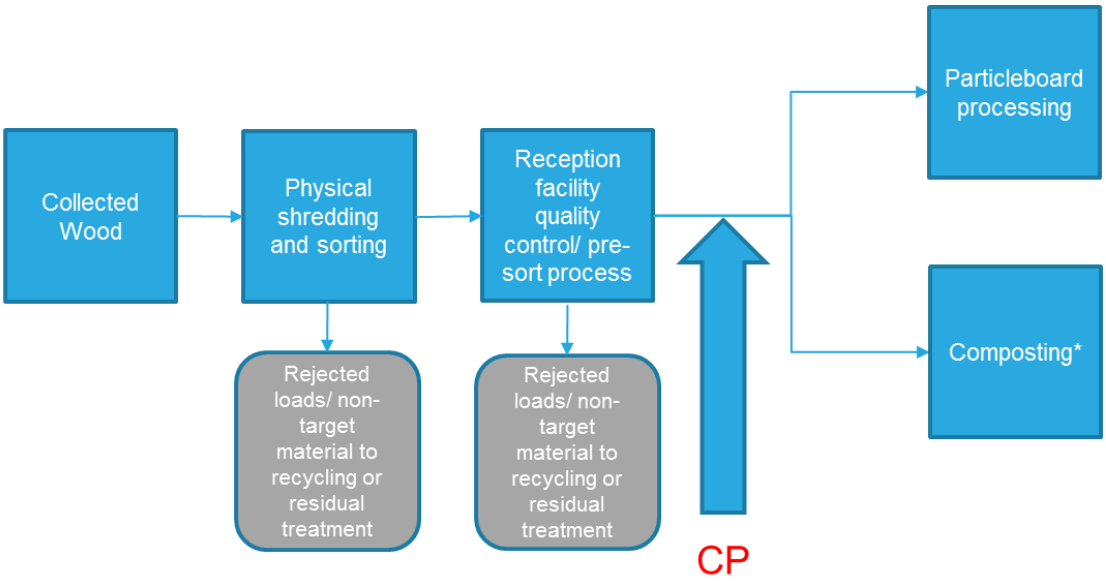
A.2.2.5 Wood waste

The calculation point for wood municipal waste is defined in Annex I of Decision 2019/1004 as follows:

- Sorted wood that does not undergo further treatment before utilisation in particleboard manufacture.
- Sorted wood entering a composting operation.

The calculation point in this case may either be the amount of fine material sent off for recycled board manufacture or the input waste minus non-target material extracted for recycling, disposal or thermal recovery, as shown in the figure below.

Figure A-8: Wood calculation point



*****Note: For wood undergoing composting to qualify as recycling, it needs to satisfy the requirements that apply to municipal biodegradable waste entering aerobic or anaerobic treatment (i.e. outputs must be used as a recycled product, material or substance; and, if used on land, this must result in benefits to agriculture or ecological improvement). Due to the outputs of composting being intertwined with biodegradable waste, and to maintain a separation of composting from recycling within the statistics, wood which is composted should be reported as biodegradable waste. Detail on the split should be provided in the quality report.

As described in the footnote to the figure above, wood that is composted should be recorded as biodegradable waste in Table 2 (row code 'W091_092_MUN_S'), and the conditions described in Appendix A.2.9 (for composting or digestion of biowaste) should apply. Furthermore, biodegradable waste resulting from the composting of wood is subject to the same quality standards that apply to other types of biowaste, as described in Appendix A.2.9 (i.e. outputs must be used as a recycled product, and where the output is used on land, it must result in benefits to agriculture or ecological improvement).

It should be noted that construction and demolition waste is not municipal waste, and therefore wood from such sources should not be included, even if it is from households (as a result off renovation work etc.).

Municipal wood waste is expected to largely constitute the following:

1) Woody garden waste;
2) Some bulky wastes (furniture etc.); and
3) A myriad of smaller items such as wooden spoons, chopsticks, ice cream sticks, barbeque skewers, wooden household food packaging and wooden toys etc..

It is expected that material stream '1' above when collected for composting or digestion, would naturally be accounted with garden waste within data collection systems, and will be recorded as biowaste in national data systems by default. Although there is the possibility that some of material streams '2' and '3' may enter biowaste treatment, this is not target

material for these technologies, and it is not expected that this will lead to complications in designation between wood and biodegradable waste for tonnages reported as recycled.

Member States should provide details of the measurement points applied in question 3.2.4 of the Quality Report.

Energy recovery of wood waste does not count as recycling.

A.2.2.6 Textiles waste

The calculation point for recycling of textile municipal waste is defined in Annex I of Decision 2019/1004 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.

It should be noted that, while preparation of textile municipal waste for reuse counts towards the targets, reuse of textile municipal waste (such as cotton/ jute carrier bags, direct sales and donations to second-hand organisations) do not involve the item becoming waste and thus should not (please refer to Appendix A.2.1 for further information).

Under WFD Article 11(1), Member States shall have set up separate collection for textiles by 2025. In addition, the European Commission is developing a comprehensive EU strategy for textiles with the aims of achieving high levels of separate textile waste collection by 2025 and boosting textile sorting, reuse and recycling. This strategy is anticipated to improve how data on textile recycling is gathered and reported in the future, as well as increasing preparation for reuse and recycling. For example, the strategy is set to encourage the use of extended producer responsibility (EPR) as a regulatory measure, which would entail formal reporting of how textile waste is managed (such as already occurs under the EPR policy for end-of-use clothing, linen and shoes in France [22]).

It should be noted that, while this section focuses on recycling, textiles are one of the key waste streams which may be prepared for reuse. Guidance on preparation for reuse is provided in Appendix A.2.1.

Eurostat is not expecting Member States to report data on chemical recovery at this time, but should this be implemented at a commercial / industrial level in future years, chemical recycling of textiles should also be accounted for as per the conditions set out for plastics in Section A.2.2.1, in which a mass balance approach is used, and the calculation point becomes the point where chemicals from the process are used as the basis for manufacturing new plastics/textiles (and not as fuel).

[22] EEA (2019) Textiles and the environment in a circular economy, Eionet Report - ETC/WMGE 2019/6

A.2.2.7 Waste electrical and electronic equipment

The reporting rules under the WEEE Directive[23] regarding what shall be counted as 'recycled' should be used. The amount of municipal WEEE, i.e. WEEE that fulfils the definition of municipal waste, must be calculated, or approximated as best as possible, to ensure the amounts of WEEE generated and/or treated are not overestimated in the statistics.

WEEE is a key waste stream which may be prepared for reuse. Guidance on preparation for reuse is provided in Appendix A.2.1.

A.2.2.8 Waste batteries

The reporting rules under the Batteries Directive[24] regarding what shall be counted as 'recycled' shall be used. The amount of batteries must be calculated, or approximated as best as possible, to ensure the amounts of batteries generated and/or treated are not overestimated in the statistics.

A.2.2.9 Bulky waste

Bulky waste generated and treated comprises wastes that are not further disaggregated into constituent components, and are therefore not captured under the material specific calculation points mentioned above. Note that if the material components of bulky waste items were to be also counted under material specific calculation points this would be double counting, and this should be avoided.

Bulky waste treatment may include, for example, preparation for reuse of furniture (see the guidance on preparation for reuse in Appendix A.2.1) or the recycling of mattresses. An indication of what waste types are included in the bulky waste fraction should be provided in the quality reports.

A.2.3 Allowable measurement methods

The measurement method is the approach(es) taken to calculate the amount of recycling at the calculation points defined in Annex I of Implementing Decision 2019/1004, as detailed in Appendix A.2.2 of this guidance. These 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, as well as biowaste. With regards to biowaste, it is important to note that it differs characteristically from the other waste types, being composed of up to 90% water and not being an inert waste. As such, the different

[23] (2012) Directive 2012/19/EU of the European Parliament and of the Council of 4 July 2012 on waste electrical and electronic equipment (WEEE) (recast)

[24] Directive 2006/66/EC of the European Parliament and of the Council of 6 September 2006 on batteries and accumulators and waste batteries and accumulators and repealing Directive 91/157/EEC (OJ L 266 of 26.9.2006)

characteristics of biowaste impact the way it should be measured at the calculation points. See Appendix A.2.9 for information on measuring amounts of biowaste specifically.

A generalised multi-stage recycling value chain is shown in Figure A-9. 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:

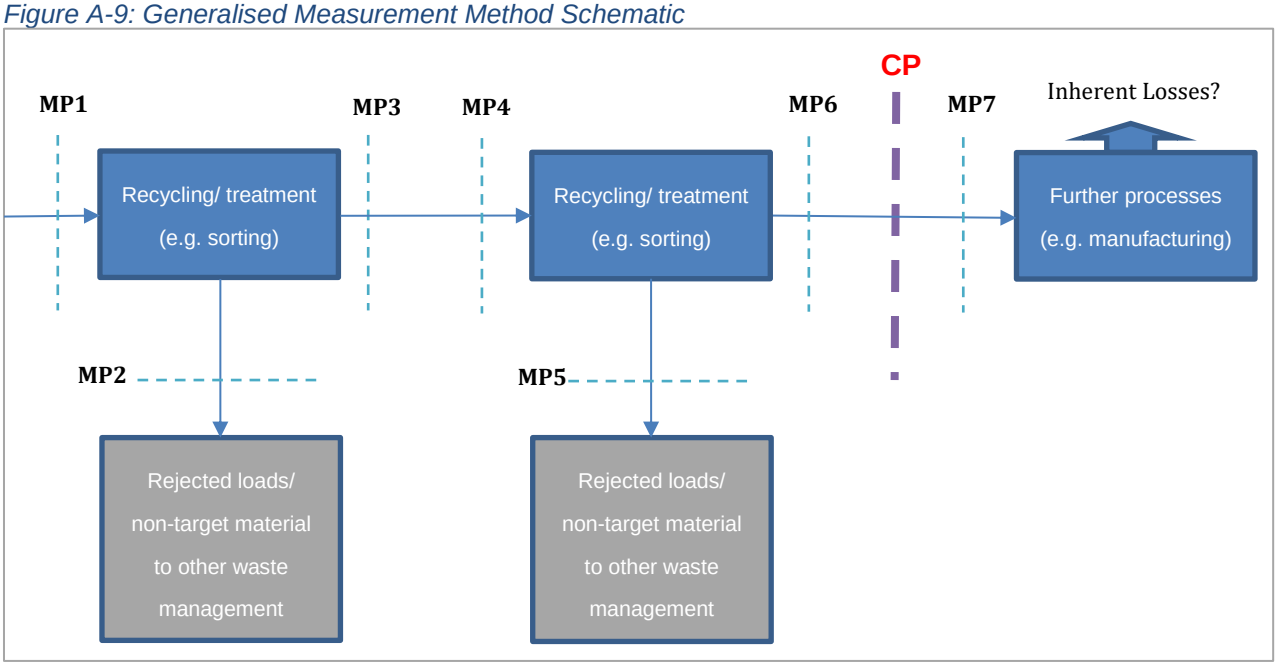
- Some amount of moisture added to the waste after any point at which that waste or product is weighed for inclusion in the denominator (e.g. waste generated) may need to be adjusted for within the amounts reported at the calculation point (see Section A.2.4 below for further detail on this).
- In most 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 if they provide the more practicable points for measurements. In these cases, it is not necessary to deduct inherent loses (losses in weight of materials or substances due to physical or chemical transformation processes inherent in the recycling operation where municipal 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 municipal waste materials are provided in the table below:

Table A-1: 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
Items prepared for reuse	Replaced minor parts and components

Figure A-9: 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 (only if there are no inherent losses before 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. Example flow diagrams are given in Section 0 above.

In this regard, consideration will have to be given to composite municipal waste (i.e. municipal waste composed of more than one material), which, as per Decision 2005/270, shall be calculated and reported per material contained in the municipal waste, except where a given material constitutes an insignificant part of the municipal waste unit, and in no case more than 5% of the total mass of the municipal waste unit.

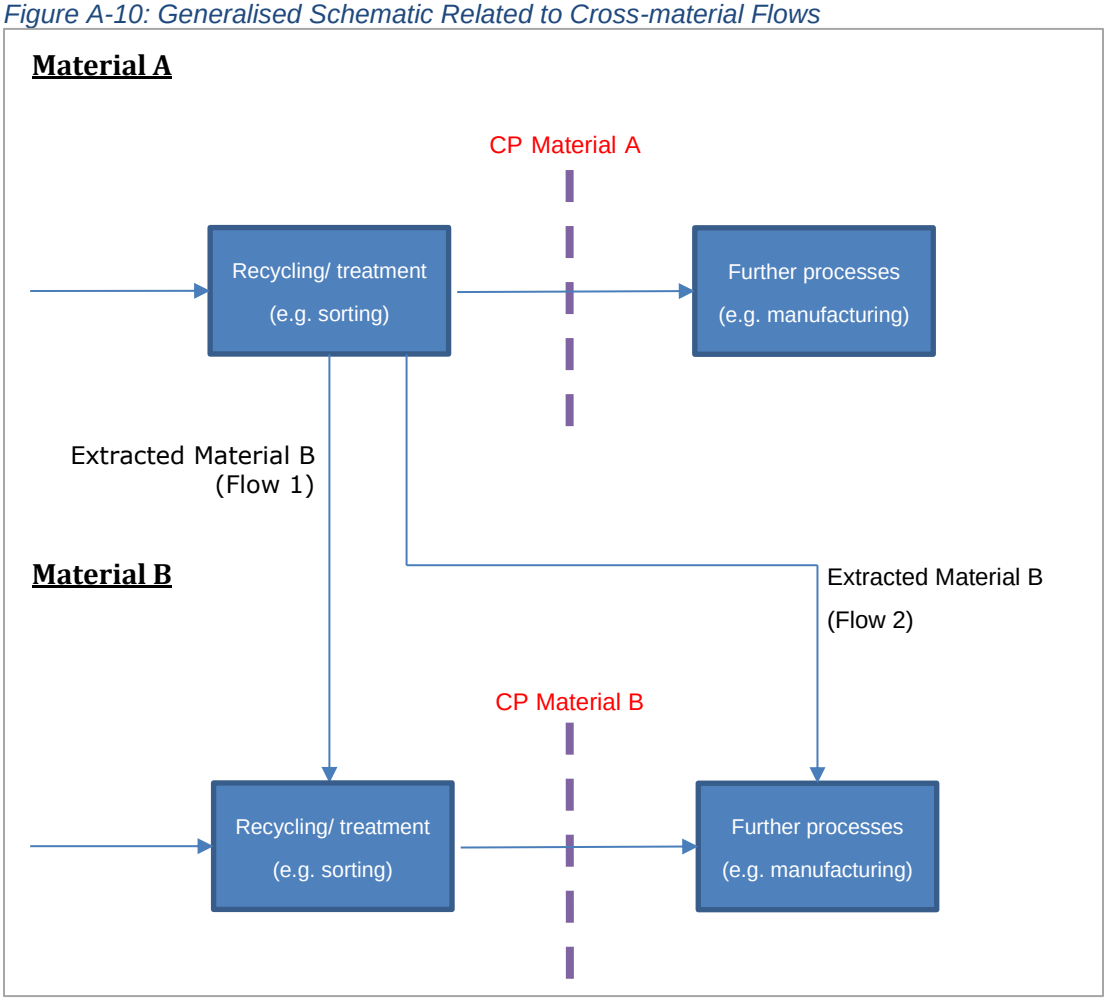
In addition, consideration should be given to the flows of materials from a given recycling process that are sent for further recycling, but are not the primary target material of the recycling process. Member States should consider the different recycling flows on a national level to ensure that such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

The key consideration is that these non-target output flows may, or may not, pass the calculation point for the target material(s). This is exemplified in Figure A-10. 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-10: Generalised Schematic Related to Cross-material Flows



A.2.4 Obtaining data at the measurement points

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

The preferred measurement point for municipal waste is the total output weight of targeted material(s) (i.e. the material which the recycling operation is targeting to be sold as a secondary raw material, or item which has been prepared for reuse, and which undergoes no further processing). This will generally be a known quantity, as financial transfers (gate fees or payments for materials) will generally be related to the amount, in tonnage, of material quantities purchased or sold. These data could be submitted by plant operators to provide actual weight data for this type of measurement point, which corresponds to the calculation point (see MP 6 in Figure A-9).

Note that any loads rejected after this measurement point as a result of downstream quality checking procedures would have to be deducted from the reported amount to be consistent with Decision 2019/1004, as failure to make such reductions will cause the amounts reported as recycled to be overestimated.

Alternatively, the total reprocessing plant input (i.e. the weight of material received at the reprocessing plant) can be used as a measurement point. This is, once again, 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 reprocessing 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 municipal waste is the total output weight of non-targeted material (i.e. the material which the recycling operation is not targeting). This is very 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. These data could be submitted by plant operators to provide actual weight data for this type of measurement point. Note, that 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 (see Figure A-10 above).

The European reprocessing industry (particularly for plastic municipal waste) has confirmed that plant operators will hold data relating to the amount at the calculation points (or relevant measurement points). Member State authorities will need to ensure they have the legal means in place to request these data, as well as 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 implementing electronic registries, in order to gather data directly from the various operators in the recycling value chain. This is supported by Article 11a(3) of the WFD):

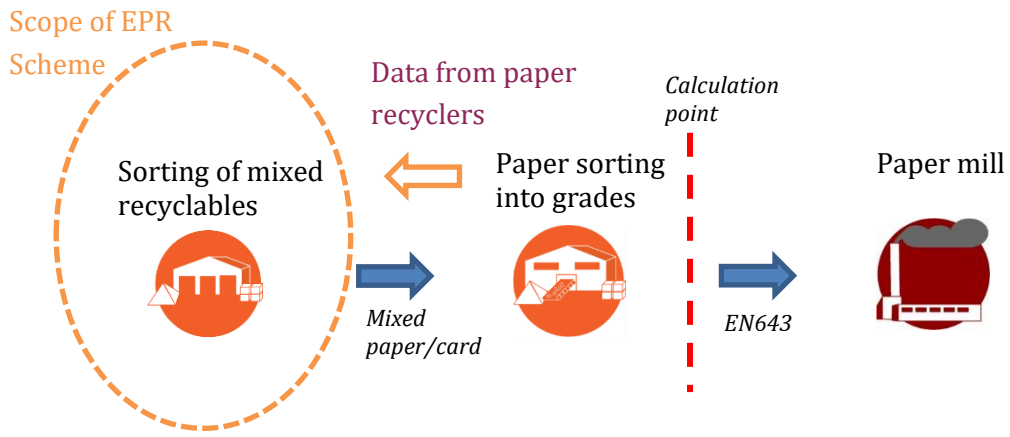
> *"3. Member States shall establish an effective system of quality control and traceability of municipal waste to ensure that the conditions laid down in point (c) of paragraph 1 of this Article and in paragraph 2 of this Article are met. To ensure the reliability and accuracy of the data gathered on 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 and shall be calculated on the basis of the calculation rules established in the delegated act adopted pursuant to paragraph 10 of this Article."

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 are reliable) or surveys of recycling operators and the development of statistical models.

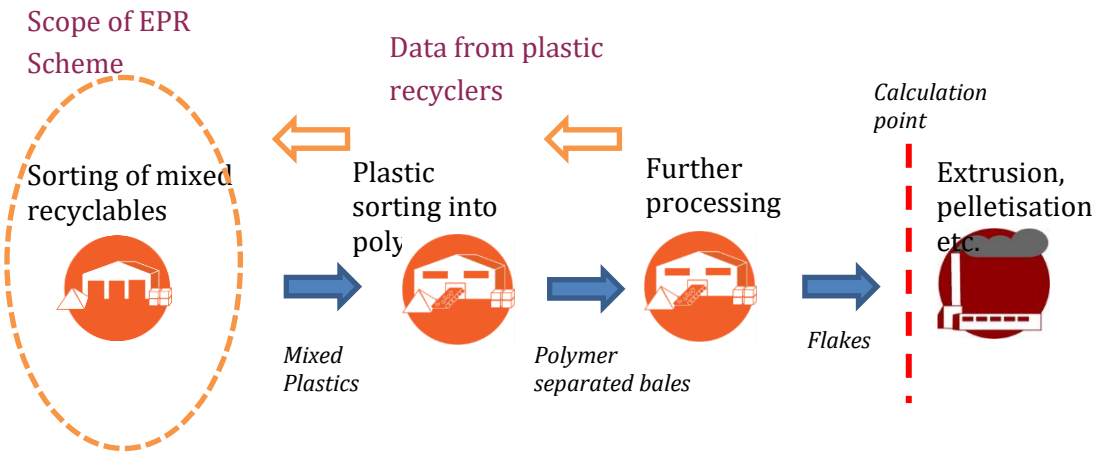
The current scope of reporting from EPR schemes can be limited, as downstream recycling/ treatment operations may not be under the control of EPR schemes. Therefore, if data are to be gathered through EPR schemes in the short term, these EPR schemes would most likely need to obtain data from operators 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-11, 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-11: 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-12. 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-12: Potential Data Flows via EPR Schemes for 3-stage Process



A.2.5 Target rate calcuation examples

In this section, two example calculations are given to demonstrate how Member State performance against the WFD and LFD targets will be calculated.

Figure A-13: Example of calculation of municipal waste recycling target calculation – New Rules

Implementing Act 2019/1004/EC Annex V - Format for the reporting of data

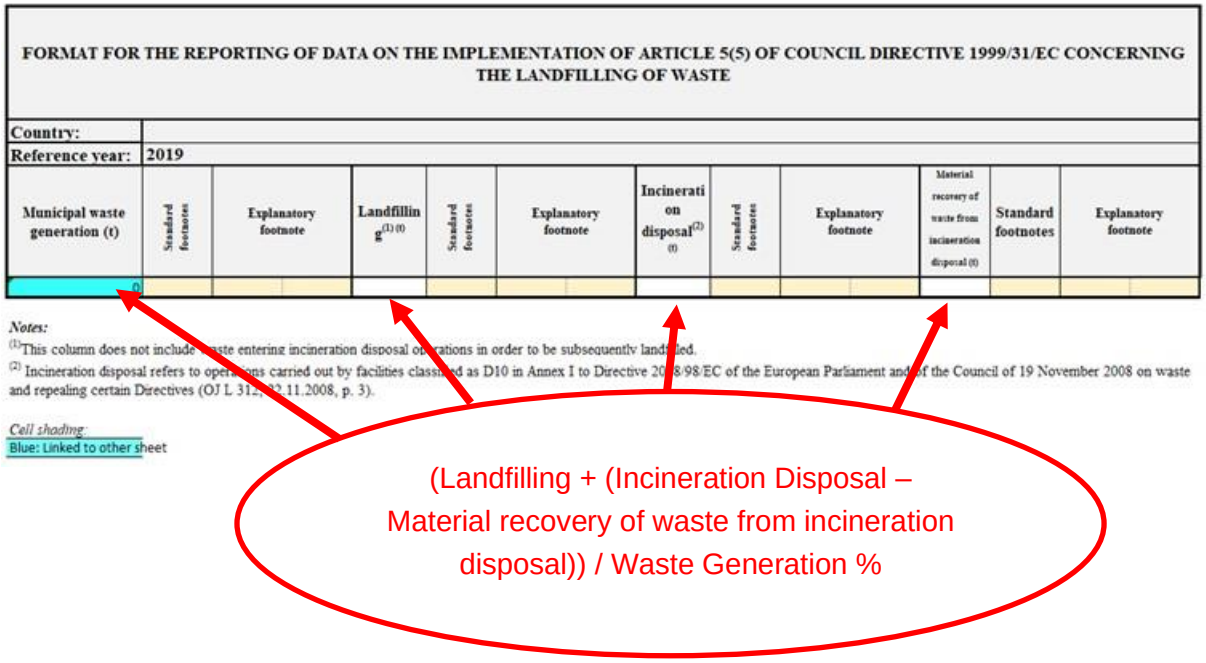
Country:												
Reference year:	2019											
Municipal Waste	List of Waste code (LoW)	Waste Generation (t)[1]	Standard footnotes	Explanatory footnote	Separate Collection (t)	Standard footnotes	Explanatory footnote	Preparing for reuse (t)	Standard footnotes	Explanatory footnote	Recycling (t)	Standard
Total												
Metals	20 01 40, 15 01 04, 15 01 11*											
Metals seperated after incineration of waste[4]												
Glass	20 01 02, 15 01 07											
Plastic	20 01 39, 15 01 02											
Paper and Cardboard	20 01 01, 15 01 01											
Bio-waste	0 01 08, 20 01 25, 20 02 01											
Bio-waste seperated and recycled at source[5]	0 01 08, 20 01 25, 20 02 01											
Wood	20 01 37*, 20 01 38, 15 01 03											
Textiles	20 01 10, 20 01 11, 15 01 09											
Electrical and electronic equipment	20 01 21*, 20 01 23*											
Batteries	20 01 33*											
Bulky waste[6]	20 03 07											
Mixed Waste	20 03											
Other												

(Preparation for reuse + Recycling) / Total Municipal Waste Generation %

Notes:
Cell shading:
Light grey: Reporting is voluntary except for metals separated and recycled after incineration of [illegible] recycled at source where Member States take those waste streams
Light orange: Footnotes (only to be filled-in when relevant)
Black: Reporting is not applicable.

[1] The amount of generated waste per material may be
[2] This includes incineration with energy recovery and the reprocessing of waste to be used as fuels or other means to generate energy. The weight of waste subject to energy recovery per material may be bas
municipal waste. Where no such surveys are available, the category of mixed waste may be used.
[3] This excludes preparing for reuse, recycling and energy recovery, and includes backfilling.
[4] Metals separated after incineration of municipal waste shall be reported separately and shall not be included in the row for metals and in the total amount of waste entering energy recovery operations.
[5] Bio-waste separated and recycled at source shall be reported separately and shall not be included in the row for bio-waste.
[6] This includes large dimension waste items which require specific collection and treatment such as furniture and mattresses.

Figure A-14: Example of calculation of municipal waste landfilling target calculation



FORMAT FOR THE REPORTING OF DATA ON THE IMPLEMENTATION OF ARTICLE 5(5) OF COUNCIL DIRECTIVE 1999/31/EC CONCERNING THE LANDFILLING OF WASTE

Country:	
Reference year:	2019

Municipal waste generation (t)	Standard footnotes	Explanatory footnote	Landfilling (1) (t)	Standard footnotes	Explanatory footnote	Incineration disposal (2) (t)	Standard footnotes	Explanatory footnote	Material recovery of waste from incineration disposal (t)	Standard footnotes	Explanatory footnote
0											

Notes:

(1) This column does not include waste entering incineration disposal operations in order to be subsequently landfilled.

(2) Incineration disposal refers to operations carried out by facilities classified as D10 in Annex I to Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives (OJ L 312, 22.11.2008, p. 3).

Cell shading:

Blue: Linked to other sheet

(Landfilling + (Incineration Disposal – Material recovery of waste from incineration disposal)) / Waste Generation %

A.2.6 Metals from incinerator bottom ash (IBA)

Article 11a(6) in the WFD states that recycled metals separated after incineration of municipal waste can be included in the reporting of performance against the metal municipal waste recycling targets:

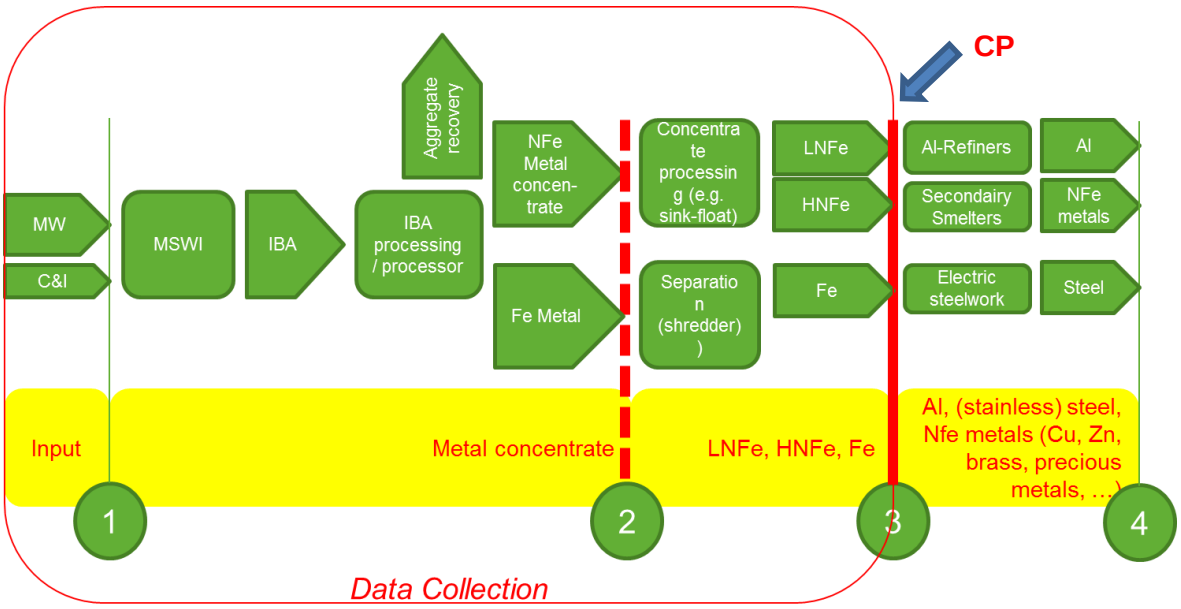
> *"For the purposes of calculating whether the targets laid down in points I, (d) and I of Article 11(2) and in Article 11(3) have been attained, Member States may take into account the recycling of metals separated after incineration of municipal waste provided that the recycled metals meet certain quality criteria laid down in the implementing act adopted pursuant to paragraph 9 of this Article.."*

This section provides further guidance on the use of the relevant calculation methodology, as set out in Annex III of Decision 2019/1004.

A.2.6.1 Correctly identifying the calculation point

Figure A-15 shows the key flows of metals.

Figure A-15: Key Metal Flows in IBA Processing, and the Calculation Point (CP)



Source: CEWEP

Wastes from a range of sources (municipal, commercial and industrial) are input to municipal solid waste incinerators 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 the incinerator 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, and so 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 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 a Nfe concentrate, the latter including light and heavy Nfe metals and StS. The Fe fraction is further processed 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 a metal concentrate. The processes used result in a large number of different fractions, of different metals and particle sizes. The light Nfe fraction is almost exclusively aluminium. The heavy Nfe fraction includes StS, brass, zinc and other metals.

Based on this material flow, and in-line with the calculation points for other metals (see Section A.2.2.4), 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-15, at which only the weight of metal that is actually recycled is measured, therefore taking any losses into account. Examples of losses are discussed in the next section.

A.2.6.2 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 2019/1004. 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 note that, for the aluminium and steel packaging waste recycling 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 under the following steps.

1. Gather data on the annual tonnages of metal concentrates from facilities that separate metal concentrates from raw IBA. Ferrous fractions can be reported under the 'Steel' municipal waste fraction – along with StS – and the aluminium fraction in the metal concentrate under the 'Aluminium' municipal waste fraction.
2. Use the formula in Paragraph 4 of Annex III of Decision 2019/1004 (shown below) to calculate the concentration of metals needed to adjust the total metal concentrate figures captured under point 1 above, which will approximate the concentration of ferrous metals and aluminium resulting from the processing of metal concentrates extracted from facilities that separate metal concentrates from IBA 'C' means concentration and 'm' means mass (see Annex III of Decision 2019/1004 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%.

3. As per Annex III of Decision 2019/1004, concentrations shall be calculated using data collected through regular surveys of 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 total plant inputs and total metallic content. These can be determined by studies, spot sampling or purity data available at the treatment plants based on metal concentrate sales (e.g. metal concentrate sales as a proportion of total plant input). According to stakeholders, metal concentrates data should be available at the plant level for the three main fractions: Fe, Nfe and StS. At the Member State level, a mean 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 $\pm$ 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.

4. Apply the coefficients under step 3 to the total amounts of metal concentrate captured under step 1 to estimate the total amount of steel and aluminium recycled from IBA.
5. Use the formula under Paragraph 5 of Annex III of Decision 2019/1004 to estimate the mass of recycled metals originating from municipal waste in all recycled metals separated from IBA. This effectively applies a further coefficient (proportion of municipal waste) to the figures calculated under step 4. The coefficient should be

calculated at the Member State level; however, it may be derived from weighted coefficients sourced from specific facilities.

6. As per Annex III of Decision 2019/1004, the concentration of metals in the incinerated waste shall be determined through sampling surveys of the waste that enters the incineration operation, which shall be carried out at least every five years and whenever there are reasons to expect that the composition of the incinerated waste has significantly changed.
7. 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 incinerator operators are required to sample 4 times per year to determine the proportion of biodegradable wastes as relate to national renewable energy support schemes. Therefore, input sampling surveys can be carried out without critical impact on incinerators; however, some stakeholders have indicated 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 for reporting 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 municipal 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.
8. The consequence of not carrying out these surveys is that the proportion of municipal waste is inaccurate, and either over or understates the amount recycled.
9. 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 Section A.2.6.3 below). Therefore, if the input to an incinerator alone is used in the calculation, this would not take such effects into account and may over or underestimate the amount of material counted for under the recycling targets. This may be particularly relevant for the aluminium municipal waste target, where thin municipal waste foils are more subject to these issues, thereby reducing the relative proportion of the recovered light Nfe metals that are from municipal waste sources compared to the input. Member States should seek to assess the significance of such losses through reviewing relevant evidence and making the necessary adjustments.

A description of the methodological approach(es) taken should be provided under question 3.2.11 of the Quality Report. Where sampling has been used to determine the metallic

element of the concentrate or the proportion of municipal 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, or).
- How the sample sites were selected.
- The number of samples taken at each site and across all sites.
- 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).[25]

A.2.6.3 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 (such as high temperatures and varying levels of oxygen) to which they are exposed during the incineration process. These transformations are important to consider in the context of metal municipal waste 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 municipal waste and non-municipal waste streams (where relevant material-specific recycling rates apply).

This could have implications for the calculation of the recycling rate for metal municipal waste 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 so is commonly found in municipal waste, 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 processes. There is still, however, a degree of uncertainty around the exact way losses may occur in the incinerator. The main transformations that aluminium can undergo are as follows:

- 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

[25] 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 melt often gains an aluminium oxide skin that encloses it, protecting it from further oxidation. [26] 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 air pollution control residues (APCR). [27]
- Some aluminium will react with nitrogen in the air to form aluminium nitride, occurring at around 900°C. [28] 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. [29]

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 municipal waste 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.
    - 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). [30]
    - Composition of the municipal waste (i.e. how much aluminium as compared to other materials such as paper). This can affect the level of oxidation as non-aluminium material can 'protect' the aluminium from oxidation.[31, 32]
- The conditions in the incinerator:

[26] 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

[27] 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.

[28] 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

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

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

- 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. [33]
- PH value and salt contamination are also thought to affect oxidation.[34]

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 in 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 to 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 municipal 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 municipal waste types, with average oxidation levels for aluminium in the residues of the incineration process equal to 9.2% for cans, 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 to the other materials, due to the reduction in exposed surface area.[35]

Additional studies looking at oxidation rates for different municipal waste types report that oxidation never exceeds 17%[36], and that the oxidation of aluminium limits the recycling factor

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

[34] 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.

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

[36] 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.

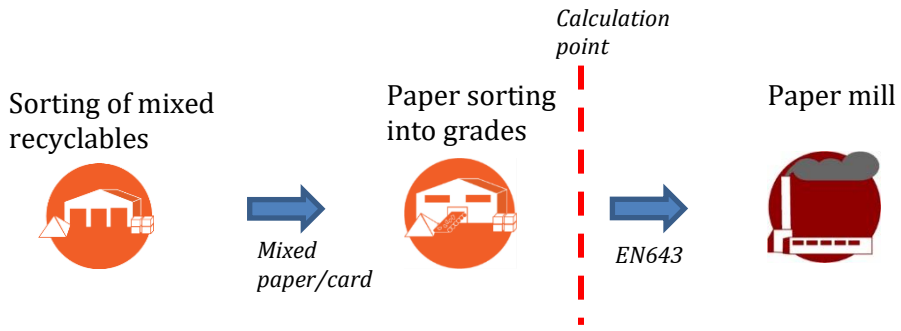
to a maximum of 82.5 %,[37] though another study reports a third of the mass of aluminium being lost to oxidation. [38]

The only available estimation of how much aluminium is lost to APCR puts this at 10 wt.% from municipal waste.[39] However, this loss is likely to vary according to different waste compositions and incineration technologies, as well as the nature of the flue gas treatment.

A.2.7 Identifying the municipal waste proportion in multi-stream treatment plants

Figure A-16 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 municipal waste). In this case, the total weight of recycling at the calculation point can be counted under the respective target.

Figure A-16: Example with total plant input being municipal waste



However, in some cases, waste from different sources may become mixed at measurement points along the value chain (for example, if paper from non-municipal sources is mixed with paper from municipal sources during the process of sorting paper into grades). This means that the weight of material at the calculation point may not wholly relate to municipal 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 municipal waste.

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

[38] 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

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

If plant operators cannot easily determine whether the entirety of the waste entering their plant is municipal 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.

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

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 a municipal waste stream, in isolation. However, in cases where the losses associated with municipal waste 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-17 below depicts a situation in which waste is mixed prior to a subsequent sorting/treatment phase, and the proportion of non-target material is different between the 'in-scope' and 'out of scope' waste streams. In the diagram 'in-scope' waste refer to municipal waste, and 'out of scope' waste refers to non- municipal waste. 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 derivable from the national waste statistical system (or from improvements to it) in a straightforward way based on sorting plant operators submitting total inputs to the system from both in and out scope sources. However, in some situations, in and out scope waste might have been collected together or mixed prior to arrival at the site. In such cases, periodic surveys of upstream waste handling processes may need to be carried out in order to determine the factor. For municipal waste, including biodegradable plastic municipal waste, sampling of the waste stream may need to be carried out to determine the proportion at the input (sampling methodologies are discussed in more detail below).
- SF2: is a factor that would be applied to the total stream of non-target material leaving a 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 those 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 were accurate to within +/- 10%).

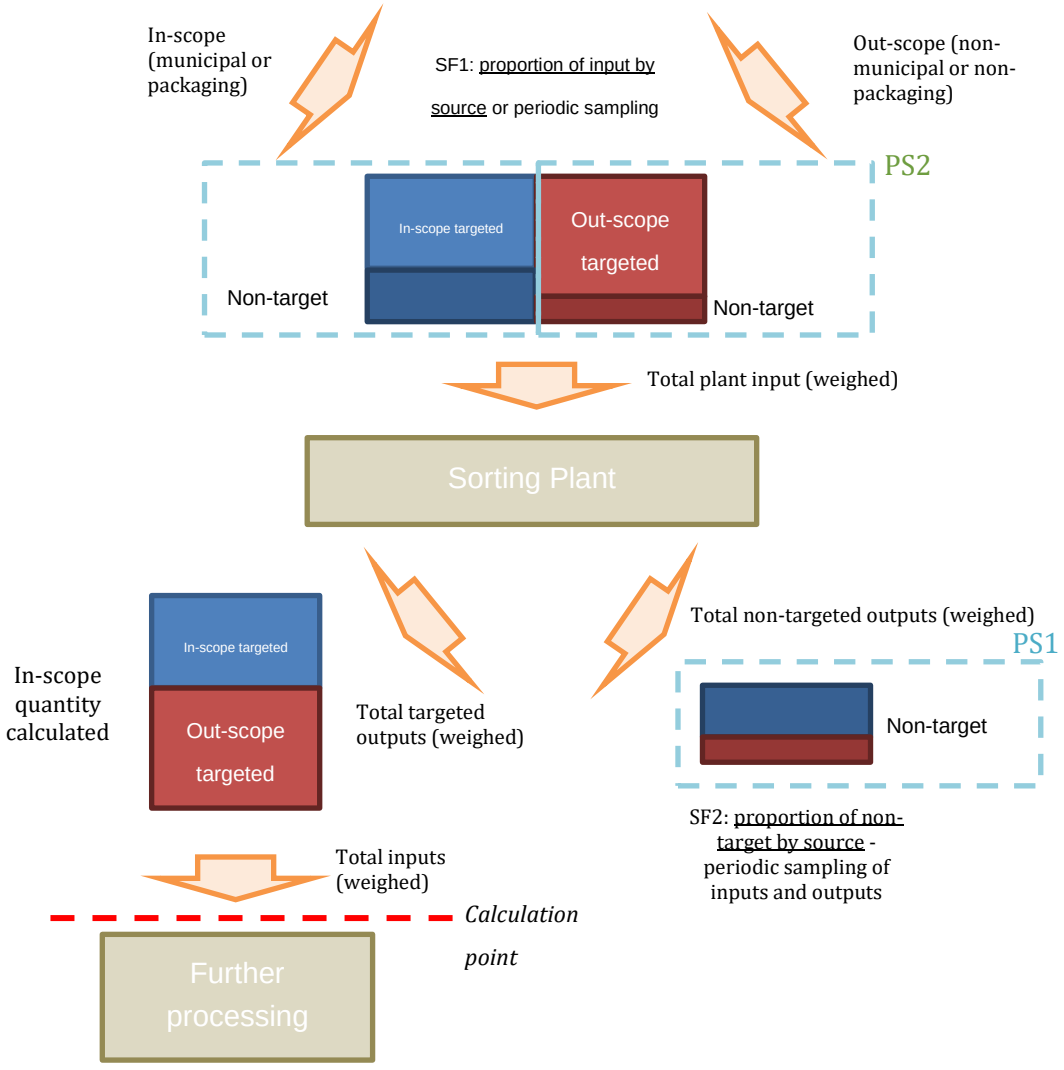
If it were not possible to accurately identify the type of waste (municipal waste) in the waste streams, batch sampling of each type of waste may have to be carried out to estimate the relative proportions of non-target material in each type; i.e. a batch of waste from a known source, which was wholly municipal waste, 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 municipal waste targets:

Recycling (in scope) = Weight plant input × SF1-(Weight non-target × SF2)

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

Figure A-17: Concept Diagram for Source Calculations



A.2.7.1 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 an EU level regarding 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 the methodology. The aim of the handbook 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, etc. (in order to understand the level of not-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.

A.2.8 Preparatory operations / temporary storage

Preparatory operations include preparatory activities prior to any recovery or disposal operation, such as blending, mixing, repackaging, temporary storage, etc. that change the characteristics of the waste in order to reduce its volume or hazardous nature, facilitate its handling or enhance recovery. These operations are not reported. Instead, Member States

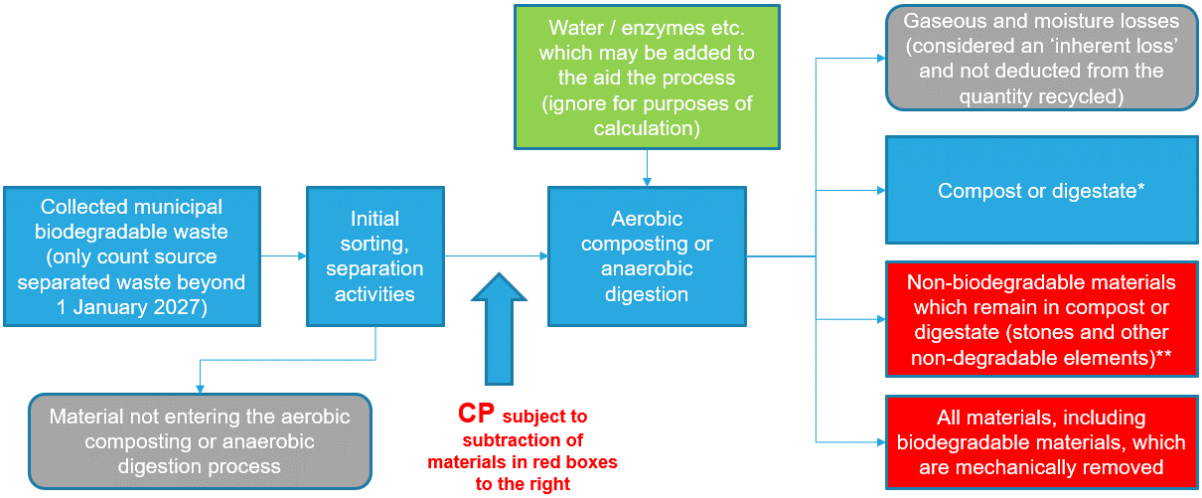
with significant amounts of wastes temporarily stored are asked to report the amounts in storage as of 31st December of the reference year in the quality report (under question 3.2.13 of the Table 2 Quality Report [sheet “QR Table 2 - Material-breakdown”]). The treatment of these stored wastes should be reported under the respective operation in the actual year of treatment.

A.2.9 Measuring the amounts of municipal biowaste composted / digested

A.2.9.1 Correctly identifying the calculation point

The calculation rules for biodegradable municipal waste (here abbreviated as biowaste) are covered across a number of requirements detailed in Decision 2019/1004 and Directive 2008/98/EC. The detail concerning the legal requirements are discussed further below, which together set the calculation point for biowaste recycling as illustrated in Figure A-18.

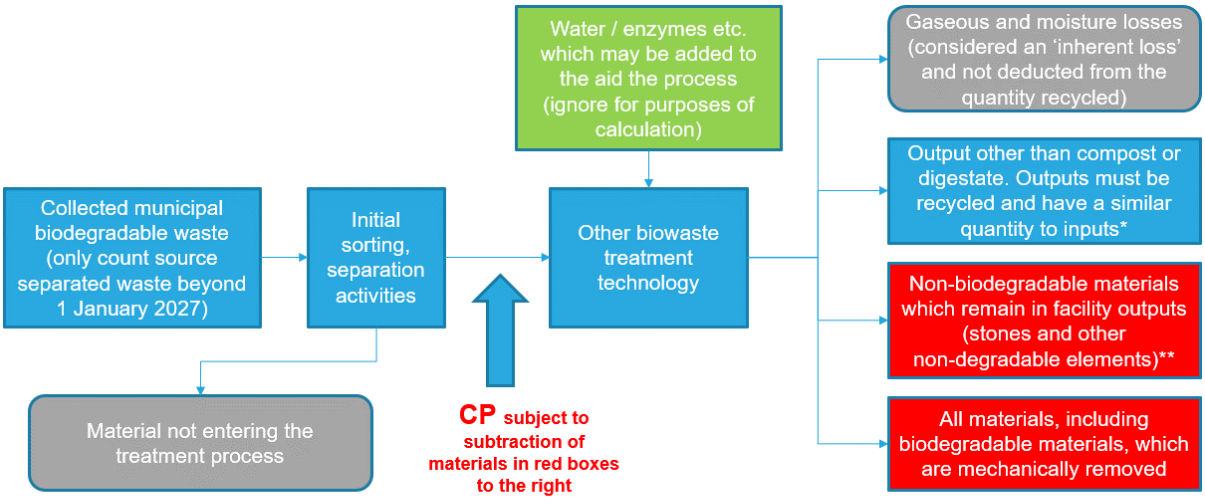
Figure A-18: Biowaste composting or anaerobic digestion recycling calculation point



*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-19: Biowaste treatment which is not composting or anaerobic digestion recycling calculation 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 11a of the WFD, biodegradable municipal waste entering composting or anaerobic digestion processes can be counted as recycling under certain circumstances:

> *"4. For the purpose of calculating whether the targets laid down in points (c), (d) and (e) of Article 11(2) and in Article 11(3) have been attained, the amount of municipal biodegradable 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.*
>
> *As from 1 January 2027, Member States may count municipal bio-waste entering aerobic or anaerobic treatment as recycled only if, in accordance with Article 22, it has been separately collected or separated at source."*

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

1) Firstly, consider the following element of Article 11a(4) of the WFD (emphasis added):

> *"... the amount of municipal **biodegradable** 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 MSW) of the municipal 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 <u>not</u> removed** within or after the composting/ anaerobic digestion (AD) process should also be subtracted from the amount of municipal waste measured at the input to the process. Therefore, the calculation point should subtract non-biodegradable materials which remain in facility outputs (stones and other non-degradable contaminants) 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, 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 municipal waste to link this to the term 'compostable' as currently indicated in CEN 13432, thereby discounting material that does not meet the standard.

2) Secondly, consider the following element of Article 11a(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 "*

- Which 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 WFD 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. […]* ***<u>Losses</u> in weight of materials or substances <u>due to physical or chemical transformation processes inherent in the recycling operation</u> whereby waste materials are actually reprocessed into products, materials or substances <u>should not be deducted</u> from the weight of the waste reported as recycled****"*

- However, while inherent losses or changes are allowable, any material (including biowaste) removed either at the input or from the outputs of a process should not be counted as recycled. This principle is confirmed within Article 4(1) of Implementing Decision 2019/1004, which says (emphasis added):

*"The amount of recycled municipal bio-waste entering aerobic or anaerobic treatment shall only include materials that actually undergo aerobic or anaerobic treatment and shall **exclude all materials, including biodegradable material, which are mechanically removed** during or after the recycling operation."*

- In effect, all material mechanically removed from the compost/digestate (including biodegradable material) does not contribute to amounts recycled (except in the instance that it is counted under a different recycling process).
- A further condition of Article 11a(4) specifies that where outputs (typically compost or digestate) are used on land, then ecological or agricultural benefits must be derived (this is considered separately in point 4 below):

"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."

3) Thirdly, consider the following element of Article 11a(4) (emphasis added):

*"... the amount […] that enters aerobic or anaerobic treatment may be counted as recycled **where that treatment generates […] other output with a <u>similar quantity</u> of recycled content in relation to input, which is to be used as a recycled product, material or substance**."*

- Which means **quantities entering <u>a specific process that produces outputs which are not compost or digestate</u> only count as recycling where the quantities of outputs are similar to the input quantities and where these outputs are used as a recycled product** (also subject to the other rules discussed above and below). This aligns with WFD recital 48 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.). The implication here is that if these technologies produce recycled outputs which are less than the amount of input biodegradable waste, then the amounts to be reported as recycled should be scaled downwards accordingly.
- Recital 48 continues with the following qualification that other processes (such as pellet fuel production facilities) which do not recycle either compost, or digestate, or other recycled materials where the amount recycled is similar to the input quantity, then this 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 preparing for re-use and recycling, should not be counted towards the attainment of the recycling targets."

4) Fourthly, relating to **the condition requiring benefits to agriculture or ecological improvement**, the use of compost standards or end of waste criterion could be used to establish the conditions under which these requirements are satisfied. The source of the compostable municipal waste could also be considered. For example, compostable municipal waste from source segregated sources would be much more likely to lead to higher quality outputs. Indeed, WFD article 11a(4) reproduced above requires that only recycling of source segregated biowaste should be counted under the targets after 2027.

A.2.9.2 Rules concerning compostable plastics

Concerning compostable plastic municipal waste (which is sometimes used in packaging applications, most typically), Article 22(1) of the WFD 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.[40] Overall, the abovementioned rules (detailed in Appendix A.2.9.1) provide the basis for whether compostable municipal waste can be counted under the recycling targets or not. **If Member States include any compostable plastic municipal waste in the amounts recycled, evidence of benefits to agriculture or ecological improvement where the output is used on land must be provided along with the Quality Report**. The amounts of compostable plastic municipal waste 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 3.2.3.

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 municipal waste in the waste stream may change over time, particularly

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

given the increase in the use of compostable plastic municipal waste. Properly accounting for compostable plastics 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 plastic municipal waste entering such facilities. Given the rapid changes in the amount of compostable plastics on the market, as driven by changes in trends in packaging, the surveys should be carried out on a relatively frequent basis. Indeed, Article 6c(d) of Commission Decision 2005/270 as amended by Commission Implementing Decision 2019/665 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."*

The above relates to the municipal proportion of compostable plastic packaging, and indeed, other compostable municipal plastic wastes.

For example, a survey in Italy carried out by the Italian Composting Association (CIC), in cooperation with the PRO for plastics (COREPLA), has included a comprehensive sampling programme of input materials at compost sites. This survey programme was able to identify: a) the amount of fossil-derived plastics (and how much thereof was bags or municipal waste); and b) the amount of compostable plastics ending up in compost 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%.

Additionally, it is important that compostable plastic municipal waste that is not fully composted is not included in the amounts recycled. This is consistent with Article 6c(d) of Decision 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.2.9.3 Processes where 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 (including combined heat and power generation, or, after further cleaning, use as vehicle fuel, or 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 is identified in the discussions

on of Article 11a(4) of the WFD in Appendix A.2.9.1 above, this applies for biowaste in 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.

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. 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 Directive 2008/98/EC (Article 11a(5)) to count material as being recycled where end-of-waste materials are used as fuels or as 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 biodegradable municipal waste is concerned, therefore, it is clear that sending residues from biological treatment to incineration (including pyrolysis and gasification) **is not to be considered as recycling**.

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.2.10 Measuring the amounts of biowaste separated and recycled at source (e.g. home composting)

A.2.10.1 Introduction

The following section outlines the methodology for calculating municipal bio-waste separated and recycled at source.

There are two different methodologies that can be used depending on the share of municipal bio-waste separated and recycled at source in all municipal waste generated; see Figure A-20 for a flow diagram setting out which method should be used.

When the share of municipal bio-waste separated and recycled at source in all municipal waste generated is less than 5 % at national level, the simplified methodology outlined in section A.2.10.2 (method 1) should be used.

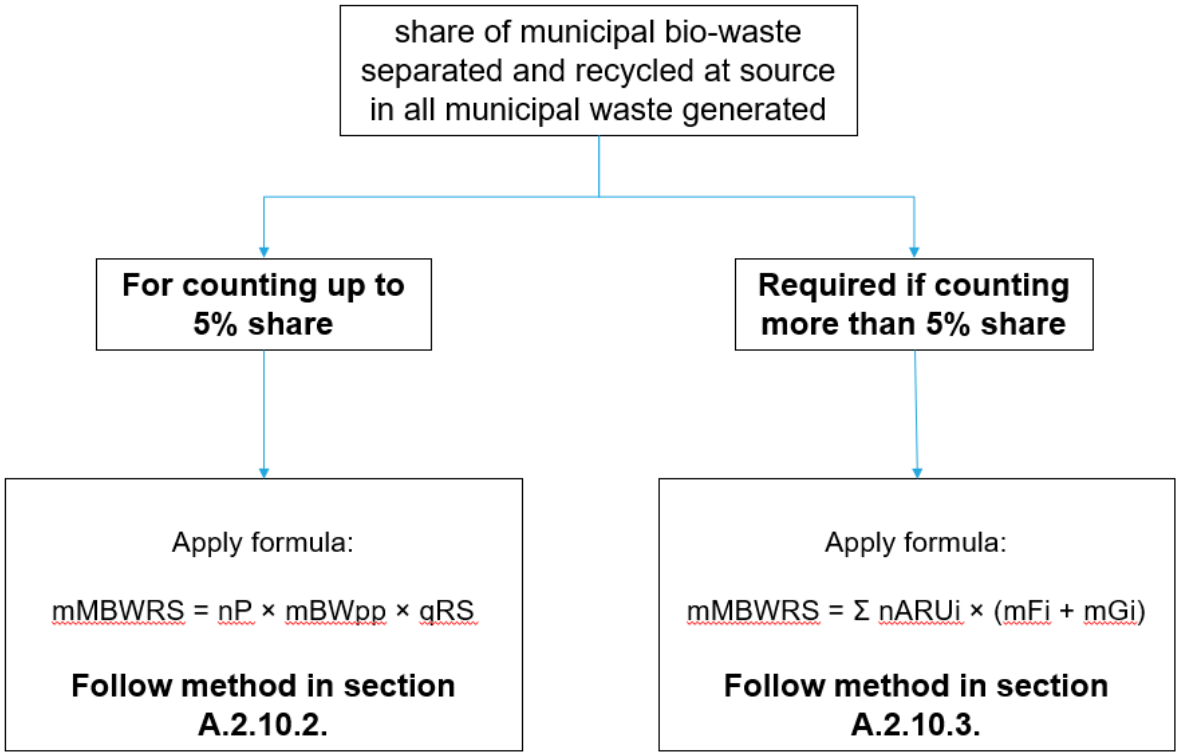
When the share of municipal bio-waste separated and recycled at source in all municipal waste generated is more than 5 % at national level, the methodology outlined in section A.2.10.3 (method 2)may be used.

As method 2 is more involved than method 1, Member States may therefore prefer to follow the simplified method 1 the first time they calculate municipal bio-waste separated and recycled at source , and then consider whether there would be benefit in following method 2 in future years. However, **if a Member State follows method 1 and gets a result higher than 5%, they may only claim a maximum of 5%** in this case. **If method 2 is followed and returns a result lower than 5%, the returned result must be reported as calculated** (i.e. even if under 5%).

The surveys used to collect data for the purposes of applying the formulas laid down in this section should be carried out for the first year of reporting on municipal bio-waste separated and recycled at source. Thereafter, they should be carried out at least every five years, and for other years whenever there are reasons to expect significant changes in the amount of municipal bio-waste separated and recycled at source.

Member States may update the reported amount of municipal waste recycled at source for the years for which data is not collected by using appropriate estimates.

Figure A-20 Methodologies for calculating municipal bio-waste separated and recycled at source



A.2.10.2 Less than five percent share of municipal bio-waste separated and recycled at source

Where the share of municipal bio-waste separated and recycled at source in all municipal waste generated is less than 5 % at national level, Member States may use a simplified methodology to calculate municipal bio-waste separated and recycled at source by applying the following formula:

mMBWRS = nP × mBWpp × qRS

where:

mMBWRS means the mass of municipal bio-waste separated and recycled at source;

nP means the number of persons involved in municipal bio-waste recycling at source;

mBWpp means the mass of generated municipal bio-waste per capita; and

qRS a coefficient representing the share of municipal bio-waste generated that is likely to be separated and recycled at source in the total amount of municipal bio-waste generated.

The following sections describes each of the parameters in more detail.

A.2.10.2.1 Np

The number of persons actively involved in the separation and recycling of municipal bio-waste at source may be obtained through registries (e.g. public sector data) on composting units (CUs) (but ensuring to account for persons on the register not actively separating and recycling their bio-waste), or should be derived from surveys identifying active individuals. Ideally, the survey would ask how many people are involved in CUs.

In the event that Member States only have data on CUs, they should multiply this by the average number of people per household. However, this is assuming that there is 1 CU per household. For neighbourhood composting, if this is licensed then it should not be considered as municipal biowaste recycling at source.

Registers or surveyors are advised to collect and record the following information:

- Contact details of the households running CUs (subject to GDPR[41]).
- Basic features of the CU: volume, model, individual/collective, etc.
- Fiscal benefits related to owning a CU, if applicable.
- Starting year of activity.
- Training received.
- Number of people per household in the case of individual CUs.
- Number of households contributing to collective CUs.

This information should be updated yearly, including the monitoring of a sufficient number of CUs from which an overall dropout rate should be estimated. Dropouts would re-enter the

[41] GDPR = General Data Protection Regulation, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:02016R0679-20160504

database only after confirmation based on visits or any other reliable information (e.g. pictures, etc.). The number of new CUs coming from former dropouts should be accounted for separately.

A.2.10.2.2 mBWpp

The total amount of biowaste separated and recycled at source in a Member State should be subtracted from the total amount of municipal biowaste generated. The resulting number should then be divided by the population of the country, giving the mass of generated municipal bio-waste per capita.

A.2.10.2.3 qRS

To calculate the coefficient representing the share of municipal bio-waste generated that is likely to be separated and recycled at source in the total amount of municipal bio-waste generated, a survey should be undertaken.

Member States should survey different types of municipalities where active recycling is taking place. The sampling strategy and stratification should take into account the following factors:

(a) The size and type of households that use an active recycling unit in the case of food and kitchen waste.

(b) The size and management of gardens and parks served by an active recycling unit in the case of garden and park waste.

(c) The available collection system, in particular the complementary use of waste collection services for bio-waste and mixed municipal waste.

(d) The level and seasonality of municipal bio-waste generation.

The data collection surveys should be based on representative samples and appropriate sub-samples. The survey results must be statistically significant according to scientifically accepted statistical techniques. To ensure statistical significance of analysis, Member States should report relevant data as required by Table 4.1.3 of Annex V (see Figure A-21) such as confidence intervals, the margin of error and the sample size – as bio-waste is a component of municipal waste.

There are documents that can be followed in determining the sampling criteria and stratification strategy to ensure that the surveys are statistically significant. These include the European Commission report on the Methodology for the Analysis of Solid Waste (SWA-Tool) User Version[42], United Nations report on Designing Household Survey Samples:

[42] European Commission (2004) *Methodology for the Analysis of Solid Waste (SWA-Tool) User Version*, 2004, https://www.wien.gv.at/meu/fdb/pdf/swa-tool-759-ma48.pdf

Practical Guidelines[43] and Zero Waste Scotland's report Guidance on the Methodology for Waste Composition Analysis[44]

Figure A-21 Table 4.1.3. in Annex V to Implementing Decision 2019/1004

4.1.3. Statistical surveys used regarding municipal waste generation and treatment

Component of Municipal Waste	Year	Percentage of population surveyed	Data (tonnes)	Confidence level	Error margin	Details of adjustments from the survey year to the current year	Other details

Add rows as appropriate

A.2.10.3 More than five percent share of municipal bio-waste

Where the share of municipal bio-waste separated and recycled at source in all municipal waste generated is more than 5 % at national level, the amount of municipal bio-waste separated and recycled at source shall be calculated by using the following formula:

mMBWRS = Σ nARUi × (mFi + mGi)

where:

mMBWRS means the mass of municipal bio-waste separated and recycled at source;

nARUi means the number of active recycling units for the recycling of municipal bio-waste at source in subsample i;

mFi means the mass of food and kitchen municipal bio-waste recycled at source per active recycling unit in subsample i; and

mGi means the mass of garden and park municipal bio-waste recycled at source per active recycling unit in subsample i.

The following sections describes each of the parameters in more detail.

A.2.10.3.1 nARUi

This parameter is similar to the number of persons involved in municipal bio-waste recycling at source, as discussed in section A.2.10.2.1. However, nARUi refers to the number of active units. The number of active recycling units for the recycling of municipal bio-waste at source shall include only those recycling units that are used by waste producers. That number shall be retrieved from registers of such units or shall be obtained through surveys of households. Surveys should take into account the factors set out in section A.2.10.2.3 and follow the guidance on ensuring surveys are statistically significant in that section.

[43] United Nations Department of Economic and Social Affairs (2008) *Designing Household Survey Samples: Practical Guidelines*, 2008, https://unstats.un.org/unsd/demographic/sources/surveys/Series_F98en.pdf

[44] Zero Waste Scotland (2015) *Guidance on the Methodology for Waste Composition Analysis*, 2015, https://www.zerowastescotland.org.uk/sites/default/files/WCAMethodology_Jun15.pdf

A.2.10.3.2 mFi and mGi

There are two different ways of calculating these parameters, through direct measurement and through indirect measurement (see box 1).

Direct Measurement

Direct measurement involves individuals measuring the actual compost being produced and the amount of food and garden waste inputted into this. Direct measurement means that either qualified personnel from public authorities or external professionals (i.e. in no case the measurement will be carried out by householders) should establish a methodology for weighing and recording the inputs to the CU, for example, employing weight scales, establishing a sampling method and frequency, etc.

Direct measurement requires measuring the input to the active recycling unit or its output under the following conditions:

(a) the measurement shall be carried out, where feasible, by or on behalf of public authorities;

(b) where the measurement is carried out by the waste producers themselves, Member States shall ensure that the reported amounts are subject to plausibility checks and are adjusted to the effect that the amount of bio-waste separated and recycled at source per person in no case exceeds the average amount per capita of municipal bio- waste collected by waste operators at national, regional or local level;

(c) where the output of an active recycling unit is measured, a reliable coefficient shall be applied in order to calculate the amount of the input.

Indirect Measurement

Indirect measurement requires measuring the following amounts through composition surveys of collected municipal waste, which take account of municipal bio-waste that is separately collected and of municipal bio-waste that is not separately collected:

(a) the amount of bio-waste contained in collected municipal waste that is generated by households or in areas where waste is separated and recycled at source;

(b) the amount of bio-waste contained in collected municipal waste that is generated by households or in areas with characteristics that are similar to the characteristics of households or areas referred to in point (a), where waste is not separated and recycled at source.

The amount of municipal bio-waste that is separated and recycled at source shall be determined based on the difference between the amounts specified in points (a) and (b).

Surveys should take into account the factors set out in section A.2.10.2.3 and follow the guidance on ensuring surveys are statistically significant in that section.

Box 1: Calculating Amounts of Bio-waste Home Composting through Statistical Modelling: the Case of the UK

The measurement of the amounts of bio-waste home composted in the UK were studied through statistical modelling in the early 2000s and validated later in 2009.[45, 46, 47, 48]

The methodology comprised two complementary approaches, one at district level and one at household level.

In the household-level approach, the dependent variable was the amount of bio-waste diverted from landfill. It was measured through onsite waste composition studies of waste arisings at households with and without composting units, so the differences between these were assumed to be amounts of bio-waste home composted (i.e. the amounts that were composted were estimated, not directly measured). The independent variables included:

- Total garden area;
- Household size (number of occupants);
- Number of dry recyclable materials collected by separate kerbside collection;
- Use of separate kerbside garden waste collection; and
- Residual waste container (wheeled bin or sack).

In the district level approach, the variations in waste arisings (dependent variables) between districts were modelled in relation to independent variables such as participation in home composting, average household size, garden size and other relevant variables. The differences in waste arisings attributable to participation in home composting were statistically calculated.

By mixing the results of both models, the authors concluded that 150 kg of biowaste per person per year was diverted from landfill through home composting. By multiplying this figure by the total number of households home composting, an overall figure for amounts home composted could be calculated. This example illustrates how to estimate the amounts of biowaste home composted through statistical modelling, without the direct measuring of the amounts of biowaste entering the composting units.

Source: Own elaboration based on the references cited in the box

A.2.11 Applying the average loss methodology

A.2.11.1 Application of average loss rates (ALRs)

Under Article 11a(3) of the WFD, ALRs may be applied in certain circumstances:

[45] Parfitt, J. (2005) Home composting diversion models. WRAP report. WRAP.

[46] Parfitt, J. (2009) Home Composting Diversion : District Level Analysis. WRAP.

[47] Hyder, S. (2006) WRAP composting report (Project DV53041). WRAP.

[48] Andrew Davey, Clist, S. and Godley, A. (2009) Home composting diversion: household level analysis. Final report. Oxon: WRAP.

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 and shall be calculated on the basis of the calculation rules established in the delegated act adopted pursuant to paragraph 10 of this Article."

Recital 46 of the Waste Framework Directive provides further guidance:

"(46)[…] 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 whereby waste materials are 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 such cases, further conditions as specified under section A.2.11.2 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 municipal waste 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, which 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 municipal waste should ideally only be applied after the plastics are separated into different polymer types.

Annex V of Implementing Decision 2019/1004 (paragraph 3.2.6.) provides a table for reporting use of ALRs, as shown in Figure A-22. 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.

Figure A-22: Table for Reporting Use of ALRs

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

A.2.11.2 Approaches to calculating ALR

The average loss rate is calculated as the weight of the average losses from sorted municipal waste up until the calculation point, in relation to the weight of the sorted municipal waste.

ALRs can be defined and calculated in different ways. For instance, they may 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 in other Member States.

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

- Sampling of the input and output of preliminary treatment of batches of sorted municipal waste originating from a Member State in waste treatment facilities.
- Representative samples from 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 operation.

A.2.11.3 Tracking ALRs through the recycling chain

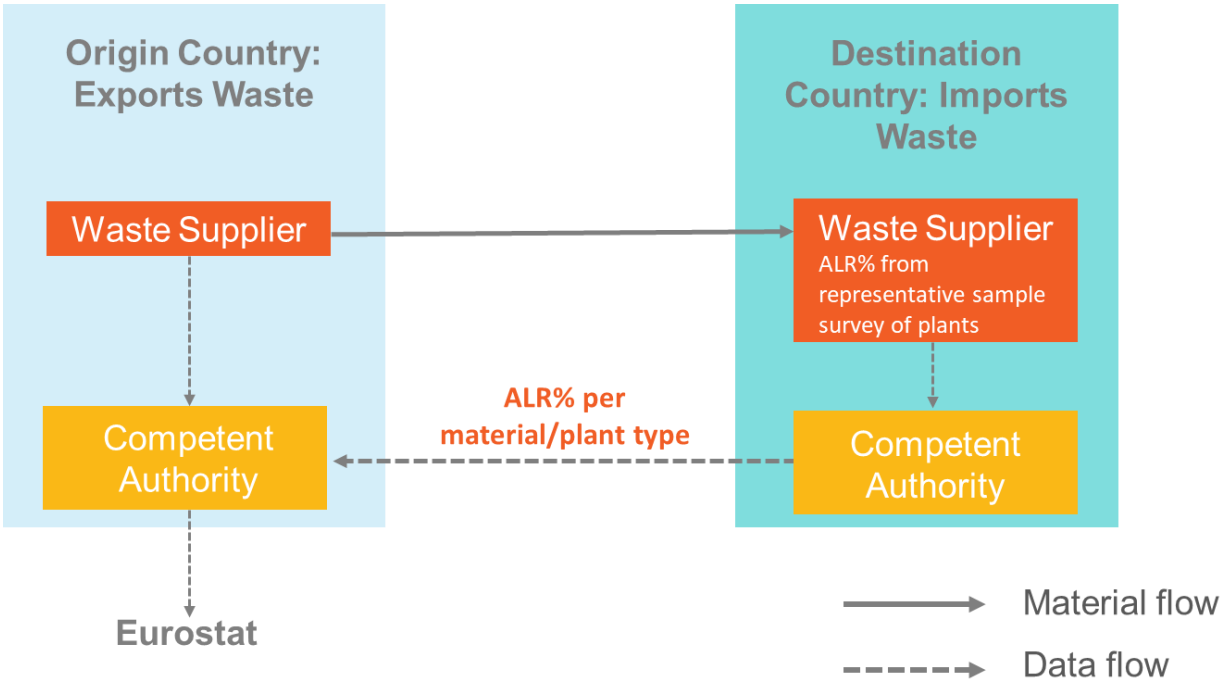
Where ALRs are to be applied to municipal waste sent for further treatment in another country, an appropriate mechanism needs to be defined in order to transfer ALRs from the destination country back to the country of origin. This is necessary in order to report the total weight of municipal waste exported,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

Figure A-23 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, 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 municipal waste are exported for recycling.

Figure A-23: ALR Reported between Competent Authorities



A.2.11.4 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 ALR 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 within their annual compilation of data.

A.2.12 Guidance on proving compliance with requirement to ensure all waste outside the EU is treated under broadly equivalent conditions

Article 8 of Directive 2008/98/EC states that:

> *"Waste exported from the Union for preparing for re-use or recycling shall count towards the attainment of the targets laid down in Article 11(2) and (3) of this Directive by the Member State in which it was collected only if the requirements of paragraph 3 of this Article are met and if, in accordance with Regulation (EC) No 1013/2006, the exporter can prove that the shipment of waste complies with the requirements of that Regulation and that the treatment of waste outside the Union took place in conditions that are broadly equivalent to the requirements of the relevant Union environmental law."*

In considering how Member States can provide evidence that waste is being exported to facilities where broadly equivalent conditions apply, it should be 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 receiving countries) and produce greater harmonisation. However, there was also concern regarding whether this was an appropriate role for the Commission, whether the Commission was resourced to undertake such assessments, and whether an EU-wide approach might give rise to problems in relation to 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 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.2.12.1 A definition of "broadly equivalent conditions"

An appropriate definition might be as follows:

> *"A receiving facility that operates under 'broadly equivalent conditions' to those in place 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 requirements that:

- 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[49] 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), 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, in particular the Best Available Techniques (BAT) Reference Document for Waste Treatment[50] 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[51];
- Iron and Steel[52]; and

[49] 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)

[50] European Commission (2018) Best Available Techniques (BAT) Reference Document for Waste Treatment, 2018, http://eippcb.jrc.ec.europa.eu/reference/BREF/WT/JRC113018_WT_Bref.pdf

[51] DG JRC (2015) Best Available Techniques (BAT) Reference Document for the Production of Pulp, Paper and Board, 2015, http://eippcb.jrc.ec.europa.eu/reference/BREF/PP_revised_BREF_2015.pdf

[52] Joint Research Centre (2013) Best Available Techniques (BAT) Reference Document for Iron and Steel Production, January 2013, http://eippcb.jrc.ec.europa.eu/reference/BREF/I&S/IS_Published_0312.pdf

- Non-ferrous Metals[53].

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. 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.

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

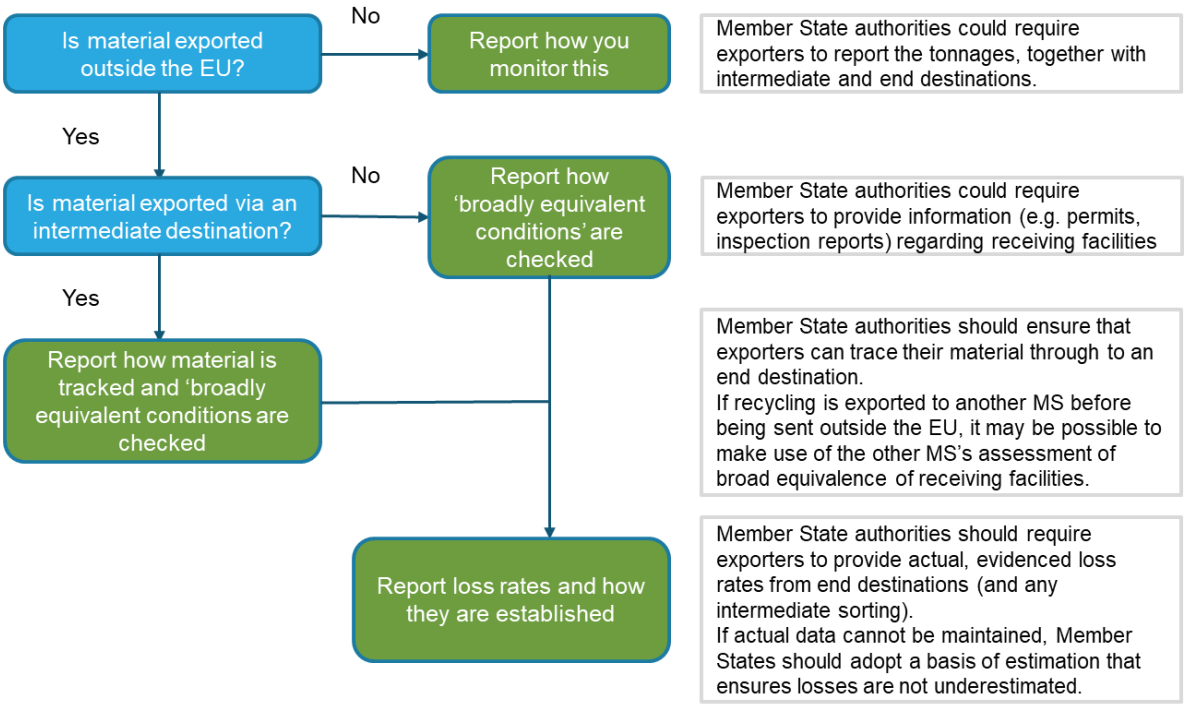
There is a separate point, which relates to processes that may handle residues from recycling operations that receive waste from EU Member States. Any recycling operation leads to the generation of some, hopefully small, quantities of residues, and these may be subject to treatment / disposal operations as opposed to recycling operations. There is an argument that the ‘broadly equivalent conditions’ should extend not only to the receiving facility itself, but also those facilities used to deal with residues. Indeed, there are reasonable economic and environmental arguments for requiring this, and Member States may wish to do so.

A.2.12.2 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 currently done in practice. A proposed process for doing so is shown in Figure A-24.

[53] Joint Research Centre (2017) Best Available Techniques (BAT) Reference Document for the Non-Ferrous Metals Industries, 2017, http://eippcb.jrc.ec.europa.eu/reference/BREF/NFM/JRC107041_NFM_bref2017.pdf

Figure A-24: Outline Monitoring and Reporting Process



This process is supplemented by the following guidelines:

- Regarding materials that may be of greater or less significance from the point of view of 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 focussed 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 for emissions 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, in particular, 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.
- On the use of 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 that indicate 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.2.12.3 Guidance on common statistical issues

The following guidance relates to addressing common statistical issues.

- A Member State that asserts 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). So, 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[54] found that there had been significant misreporting (for example, where one Member State's estimate of exports of waste 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 if Member States are to be able to do so in future.

  Therefore, Member States are likely to 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 actual data from the overseas facilities receiving the material was obtained. However, where material passes through an intermediate destination, and perhaps becomes mixed with similar material from other sources, it can become 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 that ensures that the proportion that is 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. Guidance on applying average loss rates (ARLs) is provided in Section A.2.11

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

A.2.12.4 Information sharing

In order to minimise duplication of effort, the sharing of information 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 setup.

A.2.13 Calculating Statistical Significance (confidence intervals) of Surveys / Sampling

Please refer to the worked example for IBA metals, provided within the box in Annex A.2.6.2.

Annex 3 List of relevant documents

The relevant legal acts constitute:

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)

Commission Implementing Decision (EU) 2019/1004 of 7 June 2019 laying down rules for the calculation, verification and reporting of data on waste in accordance with Directive 2008/98/EC of the European Parliament and of the Council and repealing Commission Implementing Decision C(2012) 2384 (notified under document C(2019) 4114) (Text with EEA relevance)

Commission Implementing Decision (EU) 2019/1885 of 6 November 2019 laying down rules for the calculation, verification and reporting of data on landfill of municipal waste in accordance with Council Directive 1999/31/EC and repealing Commission Decision 2000/738/EC (notified under document C(2019) 7874)

Directive (EU) 2018/850 of the European Parliament and of the Council of 30 May 2018 amending Directive 1999/31/EC on the landfill of waste (Text with EEA relevance)

Annex 4 Index for Key terms used in this Guidance