‘What to count as recycling & recovery?’

Based on the often-discussed question within WF-RepTool users what to count to recycling and recovery and a Commission Implementation Decision from December 2019 applicable soon (depending on adoption by member state e.g. in 2021 or 2022) for the calculation and reporting of treatment results of WEEE, we summed up this paper on the on legal background for the calculation of recycling and recovery rates and a cross-check if applicable rules are fulfilled in the WF-RepTool.

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I. WEEE Directive and definitions by Directive on waste

With 24th July 2012 the **WEEE Directive 2012**[1] has been published (replacing WEEE Directive 2002) in the Official Journal of the European Union which should have been implemented by the member states before **February 2014**.

In the WEEE Directive 2012 the **minimum targets** are set (see Article 11 referring to Annex V) for the **recovery rate** and the **prepared for re-use and recycling rate**. Since August 2018 the third and – up to now - last level of minimum targets have to be met.

For all **definitions** regarding treatment, recycling and recovery of WEEE the WEEE Directive 2012 refers to (see WEEE Dir. Article 3, point 2) the **Directive on waste**[2]**,** the so-called **Waste Framework Directive 2008** (short as WFD 2008) Article 3.

The WFD 2008 has been **amended** by the **Waste Framework Directive 2018**[3] (short as WFD 2018) with one of its objectives to make definitions more clear – see remarks and footmarks on definitions in point II, starting with page 4.

In June 2019 a **Commission Implementing Decision**[4] (short as **CID 2019 waste**) was published laying down the **rules** for calculation and reporting of data on **waste.** Relevant points which are not included in the later coming and more WEEE specific CID 2019 WEEE (see below) are [shortened and simplified]:

[1] *OJ L 197, 24.7.2012, p. 38 - DIRECTIVE 2012/19/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 4 July 2012 on **waste electrical and electronic equipment (WEEE)** (recast)*

[2] *OJ L 312, 22.11.2008, p. 3 - DIRECTIVE 2008/98/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 19 November 2008 **on waste** and repealing certain Directives, Article 3*

[3] *OJ L 150, 14.6.2018 p. 109 - DIRECTIVE (EU) 2018/851 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 30 May 2018 **amending** Directive 2008/98/EC **on waste***

[4] *OJ L 163, 20.6.2019 p 66 - 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*

- A **certain amount** of **impurities** of waste fractions do not have to be deducted from the amount of recycled waste[5]; there is no limit value set.

  - ✓ This exception may be applied for the **limit value** for **'pure' fractions** of **2 %** agreed for the WF-RepTool.

- For **energy recovery operations**[6][7] the **mineral fraction** of **incineration bottom ash** or **clinker** resulting from co-incineration shall **not be included** in the waste amount **recycled**[8] … *(continued)*

  - ✓ Interpreted as plastics / organic fractions / residue fractions incinerated in R1 MWI plants or e.g. tires, plastics fractions as input to cement kilns

  - ✓ **Target of use approach** of the WF-RepTool does only **count** the **energy recovery** from organic input material, not the material recovery of any mineral fraction

- with the **exception** of **metals separated** and **recycled** after incineration of municipal waste[9] provided that the recycled metals meet certain **quality criteria**[10]**.**

  - ✓ Separately collected WEEE will not be directly incinerated in MWI plants as separation of metals is one main target of treatment of WEEE

  - ! For WEEE **fractions** containing **metal residues** the metals are **not counted** up to now as small pieces of metals will be oxidised and/or incorporated into slag;

  - ✓ see remark on mineral fraction (slag/bottom ash) not to be counted in point before;

  - ➢ in case to be adapted in WF-RepTool but
    1) only the separable metal content of WEEE output fraction shall be counted (not total mass balance of the MWI plant), plus see quality criteria and
    2) separation of metals by MWI plant will have to be approved

The **WEEE Directive 2012** has been **amended** in **2018**[11] for setting **new time intervals** for **reporting** by Member States to the Commission and referring to an **implementation act** to establish the format for reporting.

This **Commission Implementing Decision**[12] (short as **CID 2019 WEEE**) was published in December 2019 and sets **rules** for the **calculation** and **reporting** of data and provides **data formats** on EEE placed on the market and WEEE generated and collected (Annex II, Table 1, not relevant for WF-RepTool) as well as (see Annex II, Table 2) amounts of **WEEE treated** in or outside the Member State and **amounts** of WEEE prepared for re-use, recycled and recovered and the corresponding preparing for re-use and recycling **rate** and recovery **rate**.

- ✓ **Amounts** and **rates** on **treatment are available from WF-RepTool reports**

Beside these tables, a format for the **quality check** is given (Annex III) in which the way of data generation has to be described and a **plausibility check** has to be done (point D.2.) e.g. asking for a plausibility check of the recycling rate and the recovery rate achieved (points 6, 7).

[5] *CID 2019 waste, objective, point 3*

[6] *Long version in CID 2019 waste, Article 3, point 7: Where municipal waste materials enter recovery operations whereby those materials are used principally as a fuel or other means to generate energy*

[7] *interpreted as: municipal waste incineration plants meeting R1 criteria and co-incineration plants*

[8] *CID 2019 waste, Article 3, point 7*

[9] *CID 2019 waste, Article 3, point 7 and Article 5, point 1*

[10] *CID 2019 waste, Article 11a, point 6*

[11] *OJ L 150, 14.6.2018 p 93, DIRECTIVE (EU) 2018/849 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 30 May 2018* ***amending*** *Directives 2000/53/EC on end-of-life vehicles, 2006/66/EC on batteries and accumulators and waste batteries and accumulators, and 2012/19/EU on* ***waste electrical and electronic equipment***

[12] *OJ L 330, 20.12.2019, p 72, COMMISSION IMPLEMENTING DECISION (EU) 2019/2193 of 17 December 2019 laying down* ***rules*** *for the* ***calculation****, verification and* ***reporting*** *of data and establishing data* ***formats*** *for the purposes of Directive 2012/19/EU of the European Parliament and of the Council on* ***waste electrical and electronic equipment (WEEE)***

Important issues of the **rules** for the **calculation** are [shortened and simplified]:

- The weight of WEEE reported as **prepared for re-use**[13] shall be the weight of **whole appliances** and of **components** of WEEE **after** a **preparing for re-use process** (e.g. checking, cleaning or repairing operations) that can be re-used without any further sorting or pre-processing

  ✓ **Fully covered by WF-RepTool options & remarks**

- The weight of '**recycling'**[14] shall be determined as the weight when '**entering the *recycling operation'*** *whereby waste materials are* ***reprocessed into products****, materials or substances that are* ***not waste****.*

  Points where waste materials are considered to **enter** the **recycling operation** are specified in **Annex I** (see page 6, Figure 2).

  ✓ **Weight entering** the **recycling operation** is **determined** (incl. target of use)

  ! **Options** of **technologies** are **stricter than** in the **WF-RepTool classification** – see discussed in point 'Recycling' by 'entry to recycling operation', page 6

  When waste materials **cease to be waste**, the amount of those material shall be included in the amount of WEEE reported as **recycled** (or recovered)[15].

  ! **No end-of-waste marking** in the WF-RepTool yet (discussed)

  ✓ Calculated to '**recycled'** or '**recovered'** by **target of use approach**

  The weight of WEEE reported as **recovered** shall **include** preparing for re-use, recycling and other recovery, including energy recovery

  ✓ **Applied by WF-RepTool**

  The weight of **WEEE** reported as **treated outside** the Member State (another Member State or outside the Union) shall only include the weight of **whole appliances exported**. This weight **shall not include** quantities of **exports of materials**/fractions derived from treatment of WEEE.

  ! **Take care:** WF-RepTool provides the option to enter the **point of delivery** for **fractions** from **treatment** of WEEE **within** the country to countries **outside** the Member State (e.g. mixed metal fractions delivered for handpicking to Far East)
  → **total of amounts of reports** to be considered as treated **inside the Member State**

[13] *Article 1, point 1*

[14] *Article 1, point 2*

[15] *see WFD 2018 obj. point (47) … to be counted to* ***recovery or recycling targets****; End-of-waste materials which are to be used as* ***fuels*** *or other means to* ***generate energy****, …, should* ***not*** *be counted towards the attainment of the* ***recycling targets****,*

II. From definitions to classifications in the WF-RepTool

For **terms** used under the **minimum targets** of the WEEE Directive 2012 'recovered', 'prepared for re-use' and 'recycled' we have to look to the **definitions** in the **WFD 2008** and to **WFD 2018** (see point I) in which some definitions are made more clear [text from Directives in Italic style].

Definitions from the WFD 2008 are taken over to the European Standard on Collection, logistics & Treatment requirements for WEEE (**EN 50625-1**). Additional definitions are given there.

First you have to distinguish **disposal** from **recovery** – see Figure 1. In following text, I included some remarks on wrong interpretations or terms used.

<table>
<tr><td colspan="5">treatment</td></tr>
<tr><td colspan="4">recovery</td><td rowspan="2">disposal</td></tr>
<tr><td colspan="3">material recovery</td><td rowspan="2">energy recovery</td></tr>
<tr><td>preparing for re-use</td><td>recycling</td><td>- backfilling
- other forms of material recovery</td></tr>
<tr><td>RU</td><td>R</td><td>OMR</td><td>ER</td><td>LD/TD</td></tr>
</table>

Figure 1: From definitions to WF-RepTool classifications

'treatment'[16] *means recovery or disposal operations, including preparation prior to recovery or disposal;*

In the EN 50625-1 document following additional definitions are given as:

3.35: treatment facility: location where WEEE undergoes treatment
3.36: treatment operator: operator responsible for the treatment of WEEE

Remark:
* quite often treatment operators are called 'recyclers'. This is wrong from perspective of definitions, if any material is 'recycled' will be decided at the end when entering dedicated recycling operation and/or when a product is achieved – see definitions. So only the last step treatment operator, e.g. producing a plastic granulate should be called 'recycler'

*'**disposal**'*[17] *means **any operation** which is **not recovery** even where the operation has as a secondary consequence the reclamation of substances or energy. **Annex I** sets out a non-exhaustive list of disposal operations;*

Annex I includes following WEEE relevant **disposal operations**:

D 1 Deposit into or on to land (e.g. landfill, etc.)
D 10 Incineration on land

Remark:
* a 'regular' municipal waste incineration plant or a hazardous waste incineration plant will be classified as D 10 – see exception as R1 only if efficiency criteria are met, see new exception for metals if separated.

*'**recovery**'*[18] *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** sets out a non-exhaustive list of recovery operations;*

Annex II includes following WEEE relevant **recovery operations**:

R 1 Use principally as a fuel or other means to generate energy (*)
(*) provides efficiency criteria to classify municipal solid waste incineration as R1
R 4 Recycling/reclamation of metals and metal compounds
R 5 Recycling/reclamation of other inorganic materials (***)
(***) This includes … recycling of inorganic construction materials.

Remark:
* quite often a classification as R+number operation is considered as 'recycling'. This is wrong as only **recovery** operations are listed. For a classification as 'recycling' see next point.

[16] *WFD 2008, Article 3, point 14*
[17] *WFD 2008, Article 3, point 19*
[18] *WFD 2008, Article 3, point 15*

*'**recycling**'[19] 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;*

There is no specific definition of **energy recovery** in the WFD 2008. The WFD 2018 introduces the term 'material recovery' (see next point) differentiating it from energy recovery with its *main purpose to generate energy*.

In the EN 50625-1 document following definition is given:

3.14: **energy recovery**: production of useful energy through direct and controlled combustion or other processing of waste.

***'material recovery'**[20] 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**;*

In the WFD 2018 now[21] the term 'backfilling is defined as:

*'**backfilling**'[22] 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;*

Ad 'inter alia' (in definition of 'material recovery): In the reasons for the WFD 2018 point (12) it is mentioned that the **term 'material recovery'** should be introduced to differentiate from 'energy recovery'. Besides preparing for re-use and recycling it shall include **backfilling** and **other forms of material recovery**.

As in quite some operations materials from WEEE are used for an useful purpose by replacing other materials (see recovery definition), but no products are achieved (see recycling definition) and the application is different than 'backfilling' (see definition above), this **other forms of material recovery** was **included** for the WF-RepTool classification – see Figure 1, page 4.

***'preparing for re-use'**[23] 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;*

Please see the rule from CID 2019 WEEE (see page 3) that only the **weight** of **appliances** and **components** after a **preparing for re-use** process shall be counted as **prepared for re-use**. An interim technology 'preparing for re-use' as well as final technologies of 're-use appliances' and 're-use components' are foreseen in the WF-RepTool. The classifications of 're-use of appliances (same purpose)' and 're-use of components (same purpose)' are summed up for the total of re-use (RU) – see Figure 1, page 4.

***'re-use'**[24] means any operation by which **products** or **components** that are not waste are **used again** for the **same purpose** for which they were conceived;*

Remark: sometimes the term 're-use' is used for a recycling operation, the reprocessing process or the application of reclaimed waste materials. The term re-use may only be applied for any operation resp. materials having ceased to be waste (or never got waste). Given by CID 2019 WEEE materials having ceased to be waste shall be counted to recycled (or recovered).

[19] *WFD 2008, Article 3, point 17*

[20] *WFD 2018, Article 1, (3) Article 3 is amended, (f) the following point is inserted, 15a*

[21] *was lacking quite some time or only covered under legislation for demolition waste*

[22] *WFD 2018, Article 1, (3) Article 3 is amended, (g) the following point is inserted, 17a*

[23] *WFD 2008, Article 3, point 16*

[24] *WFD 2008, Article 3, point 13*

III. Additional definitions & background information

a) Recycling

'Recycling' by 'entry to recycling operation'

The **Commission Implementing Decision 2019** on **WEEE**[25] sets the **rule** to **determine data** about the treatment of WEEE – see point I. The weight of material recycled shall be determined by weight that[26] *'**enter the recycling operation'** whereby waste materials are **reprocessed into products**, materials or substances that are **not waste**.*

Points where waste/WEEE **materials** are considered to **enter the recycling operation** are specified in Annex I – see below, Figure 2.

Two starting remarks:

- In daily practice the term '**fraction'** or 'WEEE output fraction' (WF-RepTool) is more often used than the term '**material'**. Following, the term 'material' is used when referring to entries in Figure 2, the term fraction is added for better understanding.
- It is **not** mentioned that this shall be a **non-exhaustive list** of materials or recycling operations[27]!

Material	Entry to the recycling operation
Glass	Sorted glass that does not undergo further processing before entering a glass furnace or the production of filtration media, abrasive materials, glass based insulation and construction materials.
Metals	Sorted metal that does not undergo further processing before entering a metal smelter or furnace.
Plastics	Plastic separated by polymers 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.
Wood	Sorted wood that does not undergo further treatment before utilisation in particleboard manufacture. Sorted wood entering a composting operation.
Textiles	Sorted textile that does not undergo further processing before its utilisation for the production of textile fibres, rags or granulates.
Components of WEEE composed of multiple materials	Metals, plastics, glass, wood, textiles and other materials resulting from the treatment of components of WEEE (e.g. materials from the treatment of printed circuit boards) that are subject to recycling.

Figure 2: Annex I of CID 2019 WEEE– classification as recycling by entry to recycling operation

Looking at Figure 2 shows that **materials**/fractions separated from WEEE are **missing** or **terms** are **not clear** (order of materials):

- Beside 'Glass' there is also a material/fraction '**Minerals'** possible (e.g. concrete pieces, sand separated from large household appliances), possible recycling operations are e.g. the production of construction materials.
  - in case the mineral fraction has to be considered as under 'Components of WEEE' – see there
- For '**Metals'** it is not clear if '**sorted** metal' means **one kind** of metal like iron, stainless steel, copper and copper alloys, aluminium and aluminium alloys, etc...
  - ✓ we interpret it as the **'target metals'** for a smelter or furnace applying the **second part** of the **rule** *'whereby waste materials are **reprocessed into products**, …'*

(for example: Cu, precious metals, Pb, Ni, Sb, Sn are recycled as pure metals, metal alloys or compounds or metals in solutions in a modern Cu smelter with refining steps)

[25] *see footmark 12*

[26] *CID 2019 on WEEE, Article 1, point 2*

[27] *like e.g. done for the definition of recovery or disposal operations in WFD 2008 Article 3, points 15 and 19*

- Materials/fractions - of in case of low volume but - being separated from WEEE in good quality to recycle products are **missing** like e.g.
  - **oil fraction** (e.g. separated from oil radiators or compressor oil from cooling & freezing appliances)
  - **(H)(C)FC fractions**, which may be split to products;

    ➢ in case these fractions have to be considered as under 'Components of WEEE' (i.e. 'from the treatment').

- For '**Components of WEEE** composed of multiple materials' (see Figure 2, last line) the recycling options and the procedure of calculation recycling is not clear. It is only mentioned that metals, plastics, glass, wood, textiles (see materials listed) and **other materials** resulting **from treatment** of components of WEEE (here example materials from treatment of printed circuit boards, but also hard discs, floppy drives, toner cartridges and concrete blocks etc. are possible) **'that are subject to recycling'**.

  ✓ **components 'subject to recycling'** is clear as components removed from WEEE that **failed** the **preparing for re-use process.**

  It is open if it means that listed materials/fractions (see open questions there) and **other materials**/fractions as **output fractions achieved** from treatment of components of WEEE (e.g. shredding and separation, i.e. also fractions of mixed materials like e.g. printed circuit board pieces, mineral fractions) 'may be counted' when entering '**their' recycling operations?**

  ✓ Here the **second part** of the **rule** *'whereby waste materials are **reprocessed into products**, … that are not waste'* **might be applied**, i.e. a product has been achieved – see point b) Product definition.

- Only the term **'sorted'** is used for most materials for recycling operations **not** defining **quality criteria**:

  ➢ we estimate that the **quality criteria** of the **recycling plant operators** shall be applied,

  ✓ covered in WF-RepTool with '**pure'** fractions[28] and the remark to the limit value that higher quality criteria of the acceptor of the fraction may apply

- **Mixtures** or **'not pure'** fractions are often a final fraction from preliminary treatment of WEEE which are the input to recycling operations (e.g. metals with organic/inorganic residues), they are **not mentioned**:

  ✓ we estimate that those fractions can be considered like mentioned under 'Components of WEEE' like **other materials/**fractions resulting **from treatment** 'that are **subject to recycling'**
  - see 'Components of WEEE'
  - see general 'recycling' definition and 'Recycling' explained by guidance document to WFD 2008

Looking at Figure 2 to the right column it shows that **options** for **recycling operations** are **limited.** Operations often used are **missing** like e.g. (order of Figure 2, page 6):

- '**Glass'**: beside operations mentioned, glass may be used <u>as</u> construction material (glass pieces) but also <u>in</u> construction materials (e.g. concrete production, ceramic industry - used for/in defined products), in other products of/with glass like e.g. glass tiles, glass bricks, glaze, glass particles for paints;
- '**Glass'** and **inorganic residues** in mixed/'not pure' fractions' may be used as **slag forming component** (e.g. smelters) and the **slag** may be used **as or in a defined product** like e.g. insulation material, for/in defined products for road construction, for/in defined construction products like plasterboard; [if no defined product, see point e), page 11];
- Non-target '**metals'** in smelters may be used as **reducing agent**, will be oxidized and go to the **slag**, the **slag** may be used **as or in a defined product** – see sub-point before;
- '**Metals'** may also be recycled by **other processes** than smelting like e.g. dissolving processes (e.g. rare earth metals);

[28] *limit value of 2 % impurity*

- ‘**Plastics’:** not only plastics separated to polymers are accepted for e.g. moulding operations, also **defined mixtures** of polymers are accepted; **not only plastic flakes** are used in final products (e.g. also fibres, PU foam particles), respectively it is not clear if **other products with plastics** like e.g. multilayer or mixed products like artificial wood, flooring etc. are covered; also the case as defined construction material as draining layer for the construction of landfill sites is known and accepted by the relevant authority as ‘recycling’;
- Optional recycling operations for **missing materials** (e.g. minerals, oil, (H)(C)FC fractions) are missing.

‘Recycling’ explained by guidance document to WFD 2008

The **guidance document** on the **WFD 2008**[29] provides explanations of the term ‘**recycling’** (see point 1.4.6, original wording in Italic style) as:

- *The common idea behind recycling is that a waste material is processed in order to alter its physico-chemical properties allowing it **to be used again** for the **same or other applications**.*
- *Recycling includes any physical, chemical or biological treatment **leading to a material** which is **no longer a waste**. … does not require any particular characterisation of the processing or reprocessing activity, as long as it serves the objective of **generating a material** which is used for the **original** or for **other purposes**, and thus of **closing the economic material circle**.*
- *It follows from the WFD recycling definition that only the **reprocessing** of waste **into products, materials or substances** can be **accepted as recycling**. Processing of waste which still results in a waste which subsequently undergoes other waste recovery steps would not be considered recycling, but pre-treatment prior to further recovery ...*

∑ Achieving a **product** is the pre-condition for the classification as ‘**recycling’**.

‘Recycling’ classification on base of meeting standards

In the reasons for the WFD 2018 point (12) it is mentioned that the term **‘material recovery’** should be introduced to differentiate from ‘energy recovery’. …it shall include … reprocessing of waste into secondary raw materials for engineering purposes in construction of roads or other infrastructure.

For these applications the **option** for the classification as ‘**recycling’** is given as:

*Depending on the specific factual circumstances, such reprocessing can fulfil the definition of **recycling** if the use of materials is based on **proper quality control** and **meets all relevant standards**, **norms**, **specifications** and **environmental and health protection requirements** for the **specific use**.*

Meeting technical standards and environmental requirements are key issues of our product definition as given in point b) Product definition.

You may see examples for the use of the **defined product** requirement in the WF-RepTool ‘List of available components use in final technology’ under ‘Use in final technology’ or in ’Examples technology’ which contain ‘defined product’.

[29] *Guidance on the interpretation of key provisions of Directive 2008/98/EC on waste, June 2012 - http://ec.europa.eu/environment/waste/framework/guidance.htm*

b) Product definition

In principle, a **product** processed by recycling should meet **product requirements** and **standards** as other products sold to the market (e.g. plastic granulates, metals). Especially if the product achieved is not sold to the market in a 'typical way' (like e.g. metals, plastic granulates – positive market value), but the substitution other products is given (e.g. sand or glass as/as additive in construction materials), finding a good definition for the **product attribute** is difficult.

Based on many discussions on the possible products achieved and considering the conditions for achieving the End-of-waste status given by the WFD 2008, we summed up the following requirements (see also 'Guidance doc - issues of harmonization' at the WF-RepTool website - www.wf-reptool.org - under Information / Guidance documents):

A **product** should:

- ✓ have any **product / brand name** (optional)
- ✓ have a **positive value** or at least the **price** to be paid for delivery should be (much) **less** than for delivering waste
- ✓ meet **product specification** like e.g. defined **technical requirements** and/or **requirements of standards** (e.g. like for certified recycling construction materials) like e.g. freezing stability, pressure stability, temperature stability, gas and water permeability or percolation factors
- ✓ meet **limit values** (e.g. organic shares, metal content, etc.)

In case that a product is used **'close to' waste streams** (e.g. defined construction material at/for landfill sites), additionally:

- ✓ **approval of application** by the acceptor (e.g. statement that material is solely and exclusively used for a defined application, kept separate from other materials)

If any material/output fraction separated shall be **used in / for the production of any product** (e.g. glass in concrete blocks, sand in asphalt), following requirements shall be met:

- ✓ information on the **product** achieved (incl. distinction to products from primary raw materials)
- ✓ **process description** - including information about in which **production step which** WEEE **fraction**(s) is(are) applied (optional)
- ✓ **product specification** – including
  - information on **which share (weight-%)** of the WEEE fraction **is included** in the **product**
  - information about **meeting** of **technical specifications/requirements** [take care with **the given share** of the **WEEE fraction]**
  - in case: description of positive influence by the WEEE output fraction to the product achieved
  - information about **meeting environmental requirements** (e.g. leaching tests)

IV. Findings on classifications

c) What to count as 'prepared for re-use'?

∑ The **weight** of **whole appliances** and of **components of WEEE** after a **preparing for re-use process** that are **returned to the market.**

Classification as **'prepared for re-use'** is **clear** from definitions and especially by CID 2019 WEEE rules:

- ✓ **appliances** (checked and/or repaired) returned to the market as Re-use Electrical and Electronic Equipment (REEE);
- ✓ **components** of WEEE (e.g. checked and/or repaired, re-filled) returned to the market for the same purpose for which they were conceived.

Open point: prepare for re-use companies may also run workshops (e.g. art departments) in which components of WEEE are used for e.g. design elements (e.g. table with a table leg of a washer drum, trinkets of/with pieces of circuit boards etc.). This is no preparing re-use for the same purpose but a product is achieved:

- ✓ **components** of WEEE returned to the market **in/as other products** we count as **'further use'** to **prepared for re-use.**

d) What to count as 'recycling'?

∑ The **weight** or **shares** (weight-%) of **WEEE output fractions**[30] from which **defined products** are achieved.

Classification as '**recycling'** is **clear** from definitions and by CID 2019 WEEE rules (see sorted material entering defined recycling operations):

- ✓ **metals** from which **metal products** are achieved (e.g. pure metals, alloys, metals in solutions);
- ✓ **plastics** from which **plastic products** are achieved;
- ✓ **glass** from which **glass products** are achieved, also production of **construction material** (see CID 2019 WEEE example, WF-RepTool: other products of/with glass);
- ✓ **material**(s) for **road construction** and other infrastructure (WF-RepTool: defined construction purposes) where defined product quality requirements are achieved[31].

Classification as '**recycling'** is not as clear by CID 2019 WEEE rules (see Figure 2, page 6, see open points discussed there) but classified **as recycling** within **WF-RepTool:**

- ✓ **metals** reclaimed (e.g. pure, as compound, in solution) by **other technologies** than smelter or furnace – e.g. dissolving processes;
- ✓ **metals** used as **reducing agents** in a smelter or furnace, metals go to the slag, the **slag** is a **by-product**[32] or used as/in a **defined product;**
- ✓ **plastics** from which **other products of/with plastics** are processed – e.g. multilayer or mixed products like artificial wood, flooring etc.; defined construction material as draining layer for construction of landfill sites (approval of technical specifications, application);
- ✓ **glass** from which **other products of/with glass** are processed than listed, e.g. glass in defined product (e.g. glaze);
- ✓ **glass** used in other technologies as **feedstock substitution** for **defined products** of cement industry, ceramic industry, concrete production;
- ✓ **minerals** from which **mineral products** (e.g. sand - meeting technical specifications, limit values) are achieved or which are used **in defined products** (e.g. asphalt production - meeting or improving technical specification, limit values);

[30] *called ‚materials' in Annex I of CID 2019 WEEE Figure 2, page 5*

[31] *see WFD option to classify as 'recycling' in point 'Recycling' classification on base of meeting standards, page 8*

[32] *ad **by-product**: see conditions in WFD 2018, Article 5; the Guidance document on the WFD 2008[32] provides the example that **blast furnace slag** from steel production may be considered a **by-product** and falls **outside the definition of waste**.*

- ✓ **inorganic residues** (e.g. in metal fraction) used as **slag** forming component > **slag** as **by-product** or as **defined product** for use.

If an application may **not** be classified as '**recycling'** (see no product achieved), you may check if the classification as 'other material recovery' or 'backfilling' may be achieved – see point e) following.

e) What not to count as 'recycling' but as 'other material recovery'?

∑ The **weight** of **WEEE output fractions** or **shares** of them, their **applications**[33] **meet** the **recovery definition** (see replacing other materials > particular function) but **not** the requirement from the **recycling definition** that a **defined product** is achieved.

Examples of not getting the classifying as recycling but as **other material recovery** are:

- ✓ **metals** used as **reducing agent** (or 'smelting detergent') in a smelter or furnace but the **slag** is **not** classified as **by-product** or used as **defined product;**
- ✓ **plastics** [or organic residues in fractions] used as **reducing agent** in e.g. steel mills, Cu smelters – the carbon of plastics/organics will be oxidized to $C0_2$, $C0_2$ will leave the process as $C0_2$ emissions.

  The authors of ESWI[34] proposed already in 2009 that with application of the WFD 2008 the use of plastics and/or organic shares of materials as reducing agents should not be considered as recycling. Within their project they already felt the strong opposition of operators of smelting technologies claiming that they use one of the best available technologies. The authors of the study stayed with their opinion.

  It is up to the operators of smelters or steel mills to call the application of plastics / organic fractions / organic shares of fractions (e.g. circuit boards) as reducing agent (with the argument to replace other reducing materials like coke) [classification OMR] or as fuel substitution [classification ER]. Both classifications count to recovery, the recovery rate but not as recycling.
- ✓ **material**(s) (e.g. glass) used for **feedstock substitution** as **slag forming component** but **no definite products of slag** are achieved e.g.:
  - Cu smelter - slag not classified as by-product slag or used as defined product for use
  - Pb smelter - slag as waste for landfill disposal
  - Hazardous waste incinerators[35] – e.g. slag to protect incineration drum, slag for landfill
- ✓ **material**(s) (e.g. glass, mineral fractions) used for '**backfilling'** – see excluded from 'recycling' by definition
- ✓ **material**(s) (e.g. glass, mineral fractions) use of **volume and/or physical properties**[36] in applications not listed under 'backfilling'[37] but for **other construction purposes** [other than road construction and defined construction purposes where defined product quality requirements are achieved - see 'recycling'] e.g.
  - unspecified construction material, not defined products
  - cover material at landfill sites
  - driveway construction at landfill sites

If an application may **not** be **classified** as **'recovery'** (see definition: replacing other materials > particular function), the application / use has to be classified as **'disposal'**.

[33] *or WF-RepTool: the target of use*

[34] *[ESWI, 2009] Consortium ESWI - Expert Team to Support Waste Implementation - Study on the calculation of recycling efficiencies and implementation of export article (Art. 15) of the Batteries Directive 2006/66/EC, study on behalf of the European Commission, Brussels, Final Report, May 2009 http://ec.europa.eu/environment/waste/batteries/pdf/batteries090528_fin.pdf*

[35] *in case additional argument to separate mercury from mercury containing glass*

[36] *the use similar to 'backfilling' but not listed there*

[37] *see definition at page 5: reclamation in excavated areas or for engineering purposes in landscaping*

f) What to count as 'energy recovery'?

∑ The **weight** or **shares** (weight-%) of **WEEE output fractions** from which useful **energy** is **produced** or with which other **fuel** is **definitely substituted**.

Based on the definition of energy recovery[38] we **count** as **'energy recovery':**

- ✓ **plastics, organic fractions, organic shares** of fractions used for **fuel substitution** in:
  - **Cu smelters, steel mills** and - in case[39] - **other smelters** and furnaces which provide an **energy concept** to approve the use of organics in their process (called **'special'** in WF-RepTool);
  - **co-incineration** with ER (fuel substituted and/or energy generated) like e.g. biomass incinerator, cement kiln, particle board production (oven), paper plant (oven);

  in case, and only if the **application** is **approved** (very seldom the case):
  - municipal waste incineration - special use (e.g. to heat up plant);
  - hazardous waste incineration - special use (e.g. to heat up plant);
- ✓ **plastics, organic fractions, organic shares** incinerated with **high energy efficiency** in:
  - **municipal waste incineration** classified as **R1**[40].

See next point for applications not meeting these requirements.

g) What not to count as 'energy recovery'? but as 'thermal disposal'

You may **not count** as **'energy recovery'**:

- ✓ **Plastics, organic fractions organic shares** incinerated in:
  - '**regular' municipal waste incinerators** not classified as **R1** (see D 10 Incineration on land, purpose of the plant[41])
  - **hazardous waste incinerators** in general (see D 10 Incineration on land, purpose of the plant, no R1 option foreseen)
  - **Cu smelters, steel mills** and other **smelters** which do not provide an **energy concept** to approve the definite use of organics in their process

These applications have to be counted as **thermal disposal**.

h) What to count as 'recovery in total'?

Under '**recovery'** you may **sum up** – see Figure 1, page 4 the weight of materials for which the use is classified as **'material recovery'** or as **'energy recovery'**.

The amount of **'material recovery'** will be **calculated** by summing up results for **'preparing for re-use', 'recycling'** and **'other material recovery'.**

[38] *see: production of useful energy through direct and controlled combustion or other processing of waste*

[39] *not foreseen yet in the WF-RepTool*

[40] *see page 3, pre-condition to classify as recovery operation*

[41] *see 'Guidance document – issues of harmonization' – https://www.wf-reptool.org/index.php/faq-front/guidance-documents*