

ReWeee

Development and Demonstration of Waste Electrical & Electronic Equipment (WEEE) Prevention and Reuse Paradigms

Action B.1 – Design and Development of Methodologies and Tools for Measuring Preparation for Re-Use

Deliverable B1.3 – Integrated Methodology for Measuring Re-Use & Preparation for Re-Use

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Abbreviations

CAS:	Civic Amenity Sites
D2DC:	Door-to-Door Collection
D2DD:	Door-to-Door Donation
D2I:	Delivery to Intermediates
DIYD:	Do-It-Yourself Delivery
DP:	Donation Points
DTR:	Dealers, Traders & Retailers
EEE:	Electrical and Electronic Equipment
EPR:	Extended Producer's Responsibility
EU:	European Union
IT:	Information Technology
MSW:	Municipal Solid Waste
PL:	Puntos Limpios
PRO:	Public Responsibility Organization
PRSE:	Private Sector Entities
PSP:	Preliminary Storage Point
PUSE:	Public Sector Entities
ReEEE:	Repaired Electrical and Electronic Equipment
ReWEEE:	Repaired Waste Electrical and Electronic Equipment
SA:	Societe Anonyme
WCP:	(W)EEE Collection Points
WEEE:	Waste Electrical and Electronic Equipment
(W)EEE:	Group of items containing potentially both EEE and WEEE

Abstract

The scope of the Deliverable titled 'Integrated Methodology for Measuring Re-Use & Preparation for Re-Use' (Deliverable B1.3), as part of the Action B.1: 'Design and Development of Methodologies and Tools for Measuring Preparation for Re-Use', aims at the formation of a methodology that will integrate the management of (Waste) Electrical and Electronic Equipment ((W)EEE) towards re-use and/or preparation for re-use. The integrated methodology will include a list of sequential procedures that will cover all stages of (W)EEE management from the collection of the respective waste stream up to the put-on-the-market of the re-used/prepared for re-use items (that we will call REWEEE). These procedures will be based on the results of the Deliverable B1.2 titled 'Comparative analysis report of existing measures used in the European Union' where the existing situation regarding the management of (W)EEE towards re-use and/or preparation for re-use was analysed and evaluated. Furthermore, the integrated methodology will provide quantitative guidelines for the measurement of re-use and preparation of re-use ratios in a way that can be applicable by all EU Member States and by the entities which are dealing with the re-usability of (W)EEE, namely, re-use centres either in a form of a network or as individual entities, waste agencies and Producer Responsibility Organizations (PROs).

In particular, the 1st Chapter will describe the process chain of (W)EEE management in relation with re-use and preparation for re-use. This description will incorporate all the potential pathways covering all stages of (W)EEE management from the collection phase up to the phase where REWEEE are considered as commercially available items. The respective pathways are reflecting the current situation regarding (W)EEE management towards re-use and preparation for re-use based on data that were collected during the Action B.1: 'Design and Development of Methodologies and Tools for Measuring Preparation for Re-Use' and also, they were presented as part of the content of Deliverable B1.2 titled 'Comparative analysis report of existing measures used in the European Union'.

In the 2nd Chapter, all the alternative routes where (W)EEE are managed as well as the involved entities at every stage of the (W)EEE management chain, will be modelled in order to set the baseline for the development of the electronic tool that will be tested by selected members of the Re-Use Network, as part of the Action B.1: 'Design and Development of Methodologies and Tools for Measuring Preparation for Re-Use'. The scope of this Chapter is the integration of all the currently applied methodologies that were reported, analysed and evaluated as part of the Deliverable B1.2 titled 'Comparative analysis report of existing measures used in the European Union' into one methodology that will integrate all the alternative routes in relation with (W)EEE management towards re-use and/or preparation for re-use. Furthermore, as part of the 2nd Chapter, we will describe through mathematical expressions the points where (W)EEE and REWEEE are calculated in relation with a step of the (W)EEE management chain. The respective ratios can be understood as performance indicators at the level of a re-use centre or at national level, taking into account (W)EEE collected and/or generated.

As part of the 3rd Chapter, the alternative routes of the sequential procedures which are forming the (W)EEE managerial chain will be visualized in the form of flow charts. These charts will be grouped depending on the type of the applied Delivery – Collection scheme. In addition, the visualization of (W)EEE management towards re-use and/or preparation for re-use will include the procedures which

are independent from Delivery – Collection schemes and are mainly related with (W)EEE Temporary Storage and Processing facilities, as well as with REWEEE Trading Stores. In this framework, the respective flow charts will be structured in a way that facilitates the development of the electronic tool since the steps of the procedures will be correlated with options for choices and/or options for data entry (in the case of calculations).

Besides the procedures that must be followed for the management of (W)EEE towards re-use and/or preparation for re-use, the proposed methodology will take under consideration the traceability of all (W)EEE items so as to be easily monitored not only in relation with their operational condition (potentially re-usable or non re-usable items) but also in relation with their effective management at the initial stages of the managerial process chain. To this end, additional flow charts simplifying some of the procedures related to Temporary Storage and/or Processing facilities will also be provided.

Finally, in the 4th Chapter, the integrated methodology defining the (W)EEE and REWEEE points of calculation will be introduced. It will cover certain stages of the whole managerial process chain and will aim at providing a unified calculation method for measuring re-use and preparation for re-use at national and EU level, taking into account the quantities of (W)EEE collected and generated.

1. Stages of Re-Use Related (W)EEE Management

In order to extract conclusions regarding the similarities and differences among the methodologies currently applied in EU Member States and based on the answers given by the respondents to the questionnaires, the stages of (W)EEE re-use and preparing for re-use will be analysed in accordance with the alternative pathways of the procedures that they consist of. In particular, the following stages of (W)EEE re-use and preparing for re-use will be assessed:

- “Delivery – Collection”, by means of identifying the type of collection schemes in place, the categories of discarders that deliver (W)EEE for re-use and the types of structures in which (W)EEE is collected.
- Management facilities where the collected (W)EEE or REWEEE is either stored ((W)EEE Temporary Storage), re-used or prepared for re-use ((W)EEE Processing) or showcased for their trading (REWEEE Trading Stores):
 - (W)EEE Temporary Storage : Pre-treatment of (W)EEE, which implies the infrastructures where (W)EEE is collected and stored prior to its treatment.
 - (W)EEE Processing: Refers to the facilities where (W)EEE are prepared for re-use or re-used. Preparation for re-use stands as a list of procedures where a WEEE item is checked, cleaned or repaired in order to be operational and available to be used again as an EEE item. Re-use stands for the management of a non-waste second-hand EEE made to facilitate its way back on the market.
 - REWEEE Trading Stores where RE(W)EEE is showcased for sell or donation.

For the purpose of this study, those 3 different facilities will be considered separately. However, it has to be mentioned that those facilities can be merged in 2 or even 1 facility if deemed relevant by the operators for logistic considerations.

For each stage of the (W)EEE managerial chain, an extended list of possible alternative pathways regarding the certain procedures that can be applied at each stage of the re-use and preparing for re-use process will be presented.

In order to extract differences and similarities that will set the baseline of their comparative evaluation, and based on the results of the collected questionnaires, all the existing (W)EEE re-use and preparing for re-use methodologies will be studied.

1.1 Delivery – Collection

This section will focus on the transfer of (W)EEE from a discarder who intends to get rid, sell or donate a used EEE to a (W)EEE re-use or preparing for re-use operator.

Firstly, we will assess what type of collection scheme is put in place to create the link between the discarder and the (preparing for) re-use operator. For the purpose of this study, the different applied schemes that have been presented by the respondents to the ReWEEE questionnaires have been

aggregated when similar in order to propose a harmonised classification. Four different applied “Delivery – Collection” schemes have therefore been identified: Civic Amenity Sites, (W)EEE Door to Door Collection, (W)EEE Collection Points and Do-It-Yourself Delivery.

Secondly, the (W)EEE discarders will be classified in three different categories, plus one merging all the three different categories together when the source of (W)EEE is not clearly identified: Private Sector Entities, Public Sector Entities, Households and “Mixed Origination” (including all the previous mentioned (W)EEE discarders).

The drafting of this section is mainly based on the answers given by the respondents to the question related to the origination of (W)EEE (in question 5 for Annex 1 and in question 6 for Annex 2). The answers collected needed to be clarified and then aggregated given that some respondents understood the origination as being determined by the (W)EEE discarder while some others understood it as being the way (W)EEE has been collected. To aggregate the results, certain Applied Delivery – Collection schemes will result in the determination of the (W)EEE discarder, and vice versa.

1.1.1 Applied Delivery - Collection Scheme

1.1.1.1 Civic Amenity Sites

Civic Amenity Sites (CAS) are facilities where (W)EEE and other types of waste are collected to be incinerated, recycled, prepared for re-use or re-used. This Applied Delivery – Collection scheme includes different (W)EEE sources identified by the respondents:

- Municipal collection points
- Municipal household waste collection
- Local household waste recycling centres
- Waste collection points or centres
- Other waste managers
- Scrap yards

Those different (W)EEE sources have been aggregated after having made sure that they correspond to the same following criteria:

- Even though they might include a space dedicated to the collection of (W)EEE, their main activity is to collect large amounts of all types of household waste
- It is very unlikely to find a separation between the different (W)EEE types at a CAS.
- The collection of waste is their only or main activity, being sometimes coupled with incineration, basic sorting (residual waste, recyclables, bulky waste, etc.) or recycling activities
- They provide large amounts of low quality (W)EEE

- Except in one particular situation in Cyprus where the identification of a product as being waste or non-waste do not depend on the source of the product, this source provides only WEEE
- They are in general located in remote areas and are not easily accessible without a motorised transport
- The transportation to the CAS is made by the (W)EEE discarder itself
- In general, a fee needs to be paid by the (W)EEE discarder

This Delivery – Collection scheme is similar in nature to the later described “(W)EEE Collection Points” (see 1.1.1.3 section). The main difference between the two schemes is the fact that the (W)EEE Collection Points are dedicated to the collection of (W)EEE or of recyclable waste which results in a collection which safeguards better the re-usability of (W)EEE. It is also much more probable to find EEE products (non-waste) in “(W)EEE Collection Points” than in CASs.

Those facilities are mainly used to collect household waste, but it has been assumed to be also the source of Private and Public Sector Entities since their large scale collection does not make possible a proper traceability of the (W)EEE discarder. The (W)EEE discarder related to this Applied Delivery – Collection scheme will then be referred as “Mixed Origination”.

They will be considered as (W)EEE Temporary Storage facilities (see section 1.3.1). The transportation from the CAS to the (W)EEE Processing facility (see section 1.3.2) is, in general, made by a staff member of the (W)EEE Processing facility who will also conduct a first visual inspection of what is potentially re-useable. However, the transportation can also be made by a staff member of the CAS, or by an independant professional transporter.

1.1.1.2 (W)EEE Door to Door Collection

(W)EEE Door to Door Collection (D2DC) is identified when a (W)EEE transportation entity, being dependant to or commissioned by a (W)EEE Management facility, is charged to transport (W)EEE directly from the (W)EEE discarder to the first (W)EEE Management facility of the re-use or preparing for re-use chain.

For some cases, the respondents clearly mentioned that they were operating a D2DC at households. However, most of the time, the respondents only informed us about which discarder they collected their (W)EEE from. The D2DC has been deducted from the (W)EEE discarder and then confirmed by the respondents when asked again thanks to a second round of interview.

Every type of (W)EEE discarder identified (households and private or public sector entities) can be part of a D2DC. The following discarders have been identified by the respondents as being the source of a D2DC:

- Private companies, enterprises, manufacturers, brokers, shops, businesses, corporate, retailers, industries, stores, malls
- Public institutions, administration

- Non-governmental organisations
- Take back system
- Households

The collection made with those discarders respect the same following criteria:

- The transporter can be from the public sector, the private sector, be related to a (W)EEE Management facility or directly to a re-use or preparing for re-use operator.
- Both WEEE and EEE can be collected from this source, depending mainly on the reason why the product is discarded.
- In general, the (W)EEE transportation entity collects (W)EEE upon the discarder's request.
- When the (W)EEE Discarder still considers his/her used EEE as valuable and decides to donate or sell it, the product will be considered as an EEE.
- For this type of scheme, it is assumed that the quality of the (W)EEE collected will mainly depend on the (W)EEE transportation entity collecting it. The more this entity will be related to the re-use or preparing for re-use activities, the more it will be expected to safeguard the re-usability of (W)EEE during its transportation.
- The cost of the transportation service can be free or at the charge of the (W)EEE discarder or the EPR scheme.

In the cases where the Private or Public entities are collecting (W)EEE from Households as part of an Extended Producer Responsibility scheme, or as a mean to facilitate the transfer of (W)EEE between discarders and (W)EEE re-use and preparing for re-use operators, the Applied Delivery – Collection scheme will be considered as being a (W)EEE Collection Point (see following section 1.1.1.3). However, when the 1 for 1 system is applied, which means when an EEE retailer is required to take back an old appliance when delivering a new one to its customer as part of an Extended Producer Responsibility scheme, the source will be classified as a D2DC because the two schemes are very similar in nature.

After the collection at the discarder is done, the (W)EEE can be delivered at a (W)EEE Temporary Storage facility (see section 1.3.1) or at a (W)EEE Processing facility (see section 1.3.2) merged with the earlier.

1.1.1.3 (W)EEE Collection Points

(W)EEE Collection Points (CPs) are identified when an entity or a facility is collecting household (W)EEE for recycling, re-use or preparing for re-use at a small scale. Those (W)EEE CPs have been identified by the respondents as being:

1. Distributors, retailers, EPR schemes, enterprises, big stores, malls
2. Pontos Limpios (Clean Points), municipalities green collection points

3. Charities
4. Open days, campaigns, movable units

They can be related to:

1. An Extended Producer Responsibility (EPR) scheme as part of the obligation from the EEE retailers to also collect (W)EEE from their customers. They can also be placed out of the EEE retailer facilities, but still be run at the expense of the Producer Responsibility Organisations (for example, Recupel points in Belgium).
2. A Municipal Waste Collection system set up to maximise the collection of recyclable waste (“Puntos Limpios” in Spain for example).
3. An entity willing to facilitate the transfer between (W)EEE Discarders and (W)EEE Management facilities as part of their environmental goals (like a charity collecting household (W)EEE to then give it to a re-use or preparing for re-use operator from the social economy).
4. A temporary (W)EEE collection event related to an awareness raising campaign

All those collection systems respond to the same following criteria:

- They are completely or partly dedicated to the collection of (W)EEE and are, when compared to CASs, set up to safeguard the quality and the potential recyclability or/and reusability of the material collected.
- It is more likely, especially in (W)EEE CPs completely dedicated to the collection of (W)EEE, to find a separation between the different (W)EEE categories (see section 1.2.1.3).
- No other waste management activities (sorting, re-use, preparing for re-use, recycling or incineration) will be conducted in those facilities.
- They tend to be quite accessible in the urban areas and do not necessarily require a motorised transportation for the (W)EEE Discarder to bring its material.
- They tend to be free of charge because of the value that the material collected still contains.
- They tend to be part of waste reduction programmes involving the citizen in a more responsible way to discard waste.
- They are used to collect (W)EEE only from households.
- They can provide a separation between recyclable and reuseable (W)EEE, but not necessarily.

The temporary (W)EEE collection events could have also been integrated in the Do-It-Yourself Delivery scheme (see section 1.1.1.4) because of the fact that the (W)EEE discarder has to transport its (W)EEE itself to the event and that this event is, in general, organised by the (W)EEE re-use or preparing for re-use operator itself. However, it has been decided to integrate this model in the (W)EEE Collection Points scheme because of the similarity of the models involving a transportation organised by both the (W)EEE Discarder and the (W)EEE re-use or preparing for re-use operator.

Concerning Municipal Waste Collection systems set up to maximise the collection of recyclable waste, in general, they are not set up to collect only (W)EEE and could therefore be compared to Civic Amenity Sites. However, the fact that they operate on small scales and that they are, in general, much more adapted to protect the value of the material collected (Puntos Limpios in Spain, for example, are set up to be weatherproof, which is not the case of the majority of CASs) tends to make them appear similar to (W)EEE collection points set up in the framework of an EPR scheme .

The (W)EEE CP will be considered as being a (W)EEE Temporary Storage facility (see section 1.3.1). As for CASs, the transportation from the (W)EEE CPs to the (W)EEE Processing facilities (see section 1.3.2) is, in general, made by a staff member of the (W)EEE Processing facility who will also conduct a first visual inspection of what is potentially re-useable. However, the transportation can also be made by a staff member of the (W)EEE CP, or by an independant professional transporter.

1.1.1.4 Do-It-Yourself Delivery

This Delivery – Collection scheme is mainly characterised by one criteria: the (W)EEE discarder is taking care of all the transportation directly from its spot to the re-use or preparing for re-use centre facilities.

Only households have been identified as (W)EEE discarders for this scheme which is in general described by the respondents as being made through donations (direct donation, collection in shops, etc.).

Donations are in general considered as being non-waste, but for the particular situation of EEE re-use, donations are in general managed by operators dealing also with WEEE who tends to mix all the sources together and consider everything as being WEEE (like it is the case in Belgium and Spain for example). Do-It-Yourself Delivery schemes can therefore be a source of both WEEE and EEE.

Given that the (W)EEE discarder already selects what is potentially reusable when this scheme is applied, the quality of the material collected through this scheme is quite high. Also, the re-use or preparing for re-use operator collecting material thanks to this scheme is also able to refuse the items that it considers as being not re-useable, which makes the re-use ratio between what is collected and what is re-used quite high.

As it is the case for the (W)EEE Door-to-Door Collection scheme, the respondents sometimes only informed us about which discarder they collected their (W)EEE from. The D2DC has been therefore deducted from the (W)EEE discarder and then confirmed by the respondents when asked again thanks to a second round of interview. This collection system was therefore referred to by the respondents as originating from households or end users.

In general, the delivery is done by the (W)EEE Discarder to a (W)EEE Temporary Storage facility which is necessarily merged with one or several of the others (W)EEE Management facilities. If it was delivered to a separate (W)EEE Temporary Storage facility, it would be considered as a Civic Amenity Site or a (W)EEE Collection Point scheme.

1.1.2 (W)EEE Discarders

The term “discarder” has been selected here to avoid the confusion with WEEE producers which are in general considered as being the entities who manufactured or sold the EEE which then becomes a second-hand EEE or a WEEE. However, the term “discarder” is quite related to the idea of waste so we need to precise here that we will also include the entities selling or donating EEE in its definition.

For the purpose of the study, the (W)EEE Discarder will therefore be considered as any entity getting rid of, selling or donating (W)EEE through one of the above described Delivery – Collection schemes. They will also be considered as the original and/or end users of the (W)EEE.

1.1.2.1 Private Sector Entities

Private Sector Entities (PRSE) are any entity that is not related to the public administration, including but not limited to private companies, enterprises, distributors, retailers, manufacturers, shops, businesses, private organisations, corporate, industry, stores/malls, NGOs etc.

This category has been made up to gather all the actors who use EEE through their professional activities and who will deliver or make available those products as waste or non-waste after their use life. However, this term will be used with caution to avoid the confusion between what has been directly produced by a private entity, and what has been simply collected by them (see section 1.1.1.3). In the second case, the actual discarders are more likely to be households and the private entities are only respecting their national rules in terms of collection of (W)EEE by providing (W)EEE collection points to their customers (which is very often the case at EEE retailers).

The Private Sector Entities can discard (W)EEE for two reasons:

- They will discard (W)EEE (mainly WEEE in this situation) because their activity implies the use of EEE and their periodic renewal for a more advanced technology or for replacing non-functional items. They can as well be getting rid of, donate or sell their (W)EEE, mainly depending on the quality of the material that they are discarding.
- They will sell second-hand EEE as part of their main or principal activity. This is particularly the case for brokers.

They tend to provide quality material and re-use or preparing for re-use operators are mentioning this source as being one to promote in order to have access to more re-useable (W)EEE.

They can discard (W)EEE at CASSs, CPs or thanks to D2DC. However, they do not practice DIYD since this scheme is considered reserved to Households.

1.1.2.2 Public Sector Entities

Public Sector Entities (PUSE) are authorities at national, decentralized, regional and/or municipal level, public utility organizations etc. which are also using EEE for their own operational activities. This category has been made up to gather all the actors from the public institutions who use EEE

through their professional activities and who will deliver or make available those products as waste or non-waste after their use life.

This category is not that different from the PRSEs. The way Private and Public Sector Entities will discard their (W)EEE will depend on more or less the same criteria which is the quality and the quantity of the (W)EEE, their location and the nature of their activity. The main difference will be that the handling of the (W)EEE produced by public entities might be subject to public procurements.

They also will be considered as (W)EEE discarders only in the case where the (W)EEE that they discard is resulting from their own activities, and not if they act as a (W)EEE Collection Point for Households (see section 1.1.1.3).

Another difference is that they cannot, in any case, sell EEE as their main professional activity as it can be the case for some PRSEs (brokers mainly).

They can discard (W)EEE at CASs, CPs or thanks to D2DC. However, they do not practice DIYD since this scheme is considered reserved to Households.

1.1.2.3 Households

Households of the residential complex (HAB) which are using EEE for their own needs. This category covers all the households using EEE for domestic use and which will deliver or make available those products as waste or non-waste after their use life. They can be involved in all the Delivery – Collection schemes identified in the section 1.1.1.

The quality of the (W)EEE that they discard will mainly depend on the Delivery – Collection scheme chosen by the households.

1.2 (W)EEE Management Facilities

The (W)EEE Management facilities will be the base on which we will extract conclusions regarding the similarities and differences among the assessment methodologies applied in EU Member States. Indeed, the identification of those facilities will be useful to understand where the points of calculation are and therefore assess the quality of a methodology. Those (W)EEE Management facilities are the following:

- (W)EEE Temporary Storage: Pre-treatment of (W)EEE, which implies the infrastructures where (W)EEE is collected and stored prior to its treatment.
- REWEEE Processing: Refers to the facilities where (W)EEE are prepared for re-use or re-used. Preparation for re-use stands as a list of procedures where a WEEE item is checked, cleaned or repaired in order to be operational and available to be used again as an EEE item. Re-use stands for the management of non-waste second-hand EEE to facilitate its way back on the market.
- REWEEE Trading Stores: Refers to where RE(W)EEE is showcased for sell or donation.

For the purpose of this study, those 3 different facilities will be considered separately. However, it has to be mentioned that those facilities can be merged in 2 or even 1 facility if deemed relevant by the operators for logistic reasons.

1.2.1 (W)EEE Temporary Storage

A (W)EEE Temporary Storage facility is used to store (W)EEE prior to its transportation (if need be) to the (W)EEE Processing facility where re-use or preparation for re-use will take place.

For the purpose of this study, even if merged with any of the other (W)EEE Management facilities, the (W)EEE Temporary Storage facility will always be considered as the first point of calculation of the input of (W)EEE. It will therefore always be considered as existent, even if not physically separated from the other (W)EEE Management facilities. For example, in the case where all the facilities are merged, the (W)EEE Temporary Storage facility will be the space allocated to store (W)EEE before its processing.

(W)EEE Temporary Storage facilities will always be considered as separate facilities for the following Delivery – Collection scheme:

- Civic Amenity Sites: For this scheme, the (W)EEE Temporary Storage facility will be considered as being the Civic Amenity Site (CAS) itself. What will be calculated here is not the input to the CAS, but the potentially re-useable output being transported to the (W)EEE Processing facility for re-use or preparing for re-use.
- (W)EEE Collection Points: For this scheme, the (W)EEE Temporary Storage facility will be considered as being the (W)EEE Collection Point itself. In the case of re-use centres and networks, what will be calculated here is not the input to the (W)EEE CP, but the potentially re-useable output being transported to the (W)EEE Processing facility for re-use or preparing for re-use. In the case of PROs, what will be reported is the input to the (W)EEE CP.

In the case of a (W)EEE Door-to-Door Collection (D2DC) scheme, the (W)EEE Temporary Storage facility will be the first facility where (W)EEE is delivered after its collection at a discarder. It can potentially be:

- A separate (W)EEE Temporary Storage facility in the case of a 1 for 1 take back scheme organised in the framework of an Extended Producer Responsibility scheme. (W)EEE will be stocked in a separate place before being transferred to the (W)EEE Processing facility. What will be calculated here is the output of the (W)EEE Temporary Storage facility transferred to the (W)EEE Processing facility.
- Merged to one or all of the other (W)EEE Management facilities. What will be calculated here is the input to the first facility receiving the collected (W)EEE, facility which will be then considered as the (W)EEE Temporary Storage facility.

In the case of a Do-It-Yourself Delivery (DIYD) scheme, the (W)EEE Temporary Storage facility will be necessarily merged to one or all of the other (W)EEE Management facilities. What will be calculated

here is the input to the first facility receiving the collected (W)EEE, facility which will be then considered as the (W)EEE Temporary Storage facility.

The different assessment actions conducted during the handling of (W)EEE coming through a (W)EEE Temporary Storage facility are the following:

- Categorisation of (W)EEEE
- Traceability of (W)EEE
- Qualitative Assessment of (W)EEE
- Numerical Assessment of (W)EEE
- Quantitative Assessment of (W)EEE

Each of those assessment actions will be studied in order to facilitate the evaluation procedure as well as the preference level scoring.

1.2.1.1 Categorisation of (W)EEE

It will be assessed if the (W)EEE Temporary Storage facility receives:

- WEEE only
- EEE only
- EEE and WEEE

1.2.1.2 Traceability of (W)EEE

We will assess if the Delivery – Collection schemes and the (W)EEE discarders are identified (recording of (W)EEE discarding sources) or not (absence of recording of (W)EEE discarding sources) by the (W)EEE Temporary Storage facility.

1.2.1.3 Qualitative assessment of (W)EEE

It will be assessed if (W)EEE is recorded taking into account the different (W)EEE types. Considering the respondents questionnaires, the alternative pathways regarding the qualitative assessment of (W)EEE types include:

- **Sorting and identification of (W)EEE** according to their classification, where, according to questionnaires' respondents, the respective quantities are divided in categories, namely:
 - **Small Electronic Appliances.** Based on the WEEE Directive (Directive 2012/19/EU), these items (indicatively listed in Annex II) fall within the 3rd category titled 'IT and Telecommunication Equipment', according to Annex I (valid until August 2018). According to Annex III (valid from August 2018) these items fall within the 6th

category titled ‘Small IT and Telecommunication Equipment (no external dimensions more than 50cm)’ (indicatively listed in Annex IV of the WEEE Directive).

- **Screens.** Based on the WEEE Directive (Directive 2012/19/EU), these items (indicatively listed in Annex II) fall within the 3rd category titled ‘IT and Telecommunication Equipment’ and 4th category titled ‘Consumer Equipment and Photovoltaic Panels’, according to Annex I (valid until August 2018). According to Annex III (valid from August 2018) these items fall within the 2nd category titled ‘Screens, monitors, and equipment containing screens having a surface greater than 100cm²’ and 5th category titled ‘Small Equipment (no external dimension more than 50cm)’ (indicatively listed in Annex IV of the WEEE Directive).
- **Large Household Appliances.** Based on the WEEE Directive (Directive 2012/19/EU), these items (indicatively listed in Annex II) fall within the 1st category titled ‘Large Household Appliances’, according to Annex I (valid until August 2018). According to Annex III (valid from August 2018) these items fall within the 4th category titled ‘Large Equipment (any external dimension more than 50cm’ and 1st category titled ‘Temperature Exchange Equipment’ (indicatively listed in Annex IV of the WEEE Directive).
- **Temperature Exchange Equipment.** Based on the WEEE Directive (Directive 2012/19/EU), these items (indicatively listed in Annex II) fall within the 1st category titled ‘Large Household Appliances’, according to Annex I (valid until August 2018). According to Annex III (valid from August 2018) these items fall within the 1st category titled ‘Temperature Exchange Equipment’ (indicatively listed in Annex IV of the WEEE Directive).
- **Toys.** Based on the WEEE Directive (Directive 2012/19/EU), these items (indicatively listed in Annex II) fall within the 7th category titled ‘Toys, Leisure and Sports Equipment’, according to Annex I (valid until August 2018). According to Annex III (valid from August 2018) these items fall within the 4th category titled ‘Large Equipment (any external dimension more than 50cm’ and 5th category titled ‘Small Equipment (no external dimension more than 50cm)’ (indicatively listed in Annex IV of the WEEE Directive).
- **Lamps and Leds.** Based on the WEEE Directive (Directive 2012/19/EU), these items (indicatively listed in Annex II) fall within the 5th category titled ‘Lighting Equipment’, according to Annex I (valid until August 2018). According to Annex III (valid from August 2018) these items fall within the 3rd category titled ‘Lamps’ (indicatively listed in Annex IV of the WEEE Directive).
- **Information Technology (IT) and Telecommunication Equipment.** Based on the WEEE Directive (Directive 2012/19/EU), these items (indicatively listed in Annex II) fall within the 3rd category titled ‘IT and Telecommunication Equipment’, according to Annex I (valid until August 2018). According to Annex III (valid from August 2018) these items fall within the 2nd category titled ‘Screens, monitors, and equipment containing screens having a surface greater than 100cm²’ and 6th category titled

'Small IT and Telecommunication Equipment (no external dimensions more than 50cm)' (indicatively listed in Annex IV of the WEEE Directive).

- **Consumer Equipment.** Based on the WEEE Directive (Directive 2012/19/EU), these items (indicatively listed in Annex II) fall within the 2nd category titled 'Small Household Appliances' and 4th category titled 'Consumer Equipment and Photovoltaic Panels', according to Annex I (valid until August 2018). According to Annex III (valid from August 2018) these items fall within the 4th category titled 'Large Equipment (any external dimension more than 50cm' and 5th category titled 'Small Equipment (no external dimension more than 50cm' (indicatively listed in Annex IV of the WEEE Directive).
- **Non-Identified (W)EEE.** For the cases where (W)EEE were not classified it is assumed that the respective quantities were handled accumulatively regardless of their type. To this end, 'Non-Identified (W)EEE' are considered as items that fall within all 10 WEEE categories according to Annex I (valid until August 2018) and within all 6 categories According to Annex III (valid from August 2018) of the WEEE Directive.

The above mentioned list partially follows the WEEE classification according to Annexes I and III of the Directive¹ due to the fact that the respondents used one or the other Annexe to classify the material treated.

- **Non-identification of (W)EEE**, where the different (W)EEE types are not calculated separately but accumulatively.

1.2.1.4 Numerical assessment of (W)EEE

We will monitor if the quantities of (W)EEE collected are counted as individual items. Considering the respondents' questionnaires, the alternative pathways regarding the numerical assessment of (W)EEE include:

- Counting of (W)EEE separately for each appliances' types (requires the sorting and the identification of the (W)EEE collected).
- Counting of (W)EEE accumulatively regardless of the appliances' types.
- Absence of (W)EEE counting.

1.2.1.5 Quantitative assessment of (W)EEE

The applied technique regarding the weighting of (W)EEE will be assessed. Based on the respondents questionnaires, the alternative pathways regarding the quantitative assessment of (W)EEE include:

¹ Seyring N., Kling M., Weißenbacher J. (BiPRO), Hestin M., Lecerf L. (BIO by DELOITTE), Magalini F., Khetriwal D.S., Kuehr R. (United Nations University), (2015), 'Study on WEEE Recovery Targets, Preparation for Re-Use Targets and on the Method for Calculation of the Recovery Targets', Final Report, European Commission

- Weighting of (W)EEE tonnage separately for each appliances' types by using physical scales (requires the sorting and the identification of the (W)EEE collected).
- Weighting of (W)EEE tonnage separately for each appliances' types by using proxy weight data (requires the sorting and the identification of the (W)EEE collected, as well as the knowledge of the proxy weights for each (W)EEE type).
- Weighting of (W)EEE tonnage accumulatively by using physical scales.
- Weighting of (W)EEE tonnage accumulatively by using proxy weight data (requires to estimate the average weight of a (W)EEE item regardless the type it belongs to)².
- Combination of the above.

1.2.2 REWEEE Processing

REWEEE Processing facilities are the facilities where the (W)EEE quantities collected undergo a re-use or preparation for re-use process. They are what is generally considered as being preparing for re-use or/and re-use centres. Based on the respondents' answers to the questionnaires, the operators of re-use centres are public and/or private sector entities, but mainly private sector entities. In some countries, REWEEE Processing facilities have formed networks to represent them at the national level. Those networks act like platforms for exchanging best practices, as well as representatives of the REWEEE Processing facilities in the policy debates related to their activities.

The REWEEE Processing facilities necessarily belong to the re-use / preparing for re-use path and are likely to be merged with one or several other (W)EEE Management facilities involved in the re-use or the preparing for re-use of (W)EEE. The activities conducted are the checking, cleaning, data-erasing and/or repairing recovery operations which can be conducted in the context of both re-use and preparing for re-use activities³. They can also conduct some transportation activities.

The visual inspection of the potentially re-useable part of the (W)EEE collected is deemed to be done upstream, but it is possible that another one occurs at this stage.

Since the assessment of the quantities of (W)EEE collected (input) is done at the level of the (W)EEE Temporary Storage facility and that the assessment of what becomes REWEEE is done at the level of the REWEEE Trading Store facility, no measurement process will be monitored at the stage of the REWEEE Processing facility.

² In the cases where a respondent would fit with this type of quantitative assessment, which seems quite unpracticable if you collect different types of (W)EEE, it is very likely to be due to the fact that they work with mainly one type of (W)EEE and do not feel the need to sort the (W)EEE collected per type (as it is the case of Ateliere Fara Frontiere in Romania which collects mainly Information Technology (IT) and Telecommunication Equipment, plus a residual quantity of non-identified (W)EEE).

³ Seyring N., Kling M., Weißenbacher J. (BiPRO), Hestin M., Lecerf L. (BIO by DELOITTE), Magalini F., Khetriwal D.S., Kuehr R. (United Nations University), (2015), 'Study on WEEE Recovery Targets, Preparation for Re-Use Targets and on the Method for Calculation of the Recovery Targets', Final Report, European Commission

However, the activities conducted at the REWEEE Processing facilities will be assessed in term of jobs creation. It will therefore be assessed:

- How many jobs are created through the preparing for re-use activities.
- How many jobs are created through the re-use activities.
- How many jobs are created for all the re-use and preparing for re-use activities (when impossible for the re-use operator to distinguish both activities).

1.2.3 REWEEE Trading Store

REWEEE Trading Stores are the facilities where the (W)EEE which has been through a (W)EEE Processing facility ends up when considered has having a potential for being sold or donated. It is where the refurbished (W)EEE is showcased before its trading. It must be underlined that the term 'trading' does not only imply the commercialisation of the repaired and/or donated EEE but also refers to the portion which is donated.

The output of these facilities (what is sold or donated) will be considered as the most precise point of calculation for monitoring what is re-used / prepared for re-use.

However, the input might also be considered as the point of calculation when the re-use operators are considering what enters in the REWEEE Trading Store as being already prepared for re-use. This assessment method is less precise because a part of what is counted might not find a second life and is likely to be recycled and not actually re-used. Calculating the input (which, technically, is also the output of the (W)EEE Processing facility) instead of the output also allows to declare the end of waste earlier and avoid having the REWEEE Trading Stores considered as waste management facilities and obliged to comply with additional rules related to the waste legislation.

The input is necessarily coming from (W)EEE Processing facilities. The output can be delivered to the final user, or directly picked up by the final user.

Information has been collected on four aspects related to the REWEEE Trading Store:

- Numerical assessment of REWEEE
- Quantitative assessment of REWEEE
- The point of calculation
- The type of trading

1.2.3.1 Numerical assessment of REWEEE

We will assess if the quantities of REWEEE collected are counted as individual items or not. Considering the respondents' questionnaires, the alternative pathways regarding the numerical assessment of REWEEE include:

- Counting of REWEEE separately for each appliances' types (requires the sorting and the identification of the (W)EEE collected).
- Counting of REWEEE accumulatively regardless of the appliances' types.
- Absence of (W)EEE counting.

1.2.3.2 Quantitative assessment of REWEEE

The applied technique regarding the weighting of REWEEE will be assessed. Based on the respondents questionnaires, the alternative pathways regarding the quantitative assessment of REWEEE include:

- Weighting of REWEEE tonnage separately for each appliances' types by using physical scales (requires the sorting and the identification of REWEEE).
- Weighting of REWEEE tonnage separately for each appliances' types by using proxy weight data (requires the sorting and the identification of REWEEE, as well as the knowledge of the proxy weights for each (W)EEE type).
- Weighting of REWEEE tonnage accumulatively by using physical scales.
- Weighting of REWEEE tonnage accumulatively by using proxy weight data (requires to estimate the average weight of a REWEEE item regardless the type it belongs to)⁴.
- Combination of the above.

1.2.3.3 Point of calculation

It will be assessed at which point the material is considered as being prepared for re-use or re-used. Two alternative pathways are possible:

- Consideration of REWEEE as being prepared for re-use or re-used when it is available in the REWEEE Trading Store ready to be sold or donated.
- Consideration of REWEEE as being prepared for re-use or re-used when sold or donated.

1.2.3.4 Trading of REWEEE

As for the trading of REWEEE three alternative pathways will be possible:

⁴ In the cases where a respondent would fit with this type of quantitative assessment, which seems quite unpracticable if you collect different types of (W)EEE, it is very likely to be due to the fact that they work with mainly one type of (W)EEE and do not feel the need to sort REWEEE per type (as it is the case of Ateliere Fara Frontiere in Romania which collects and prepare for re-use mainly Information Technology (IT) and Telecommunication equipment, plus a residual quantity of non-identified (W)EEE).

- Trading of REWEEE for gaining profit
- Donation of REWEEE
- Combination of the above

2. Integrated Methodology Modelling

In this Chapter, the sequential procedures which are forming the process chain of (W)EEE management towards re-use and preparation for re-use will be modelled so as to facilitate the development of the electronic tool which, at a later phase, will be tested by selected members of the RREUSE Network in order to simulate and assess each methodology and to measure (W)EEE re-use ratios. Each procedure will be described through tables including all entities which are involved in order to model an integrated approach which will unify all the methodologies that are currently applied in EU Member States as they were reported by the questionnaire respondents and as they were analysed and evaluated in the Deliverable B1.2 titled 'Comparative analysis report of existing measures used in the European Union'. Given that the electronic tool will be tested by selected members of the RREUSE Network, the integrated methodology and the modelling of the subsequent procedures at each stage of re-use related (W)EEE management will take under consideration the existing models which are applied by re-use centres networks, individual re-use centres, producer's responsibility organizations and waste agencies.

2.1 Modelling of Delivery – Collection

At the upper (1st) layer of the procedure where (W)EEE are discarded and/or donated (delivered) by a discarder, or alternatively, (W)EEE are received (collected) by a site and/or a facility, four (4) different schemes have been identified and classified as:

- Delivery of discarded and/or donated (W)EEE at Civic Amenity Sites (CAS), or alternatively, collection of (W)EEE through CAS.
- Delivery – Collection of discarded and/or donated (W)EEE through the implementation of a Door-to-Door Collection scheme (D2DC).
- Delivery of discarded and/or donated (W)EEE at (W)EEE Collection Points (WCP), or alternatively, collection of (W)EEE through WCP.
- Delivery – Collection of discarded and/or donated (W)EEE by implementing a Do-It-Yourself Delivery (DIYD).

Given that, in several methodologies, the Delivery – Collection procedure was not identified in accordance with the applied scheme but in relation to the type of entity that discarded the respective (W)EEE quantities, in the framework of developing an integrated methodology, it is essential to establish this distinction. To this end, as part of the discarders' identification, (W)EEE are collected by four (4) types of entities which are:

- Private Sector Entities (PRSE).
- Public Sector Entities (PUSE).
- Households (HAB).

- Mixed Origination (MIX) which means that (W)EEE quantities are delivered – collected by all or some of the above mentioned entities (PRSE, PUSE and HAB).

Based on the above, the matrix that correlates the applied Delivery – Collection scheme with the discarders by type can be expressed through the following Table.

Table 1: Initial Correlation Matrix of Delivery – Collection Scheme with (W)EEE Discarder Types

Delivery – Collection Scheme / Type of (W)EEE Discarders	Private Sector Entities	Public Sector Entities	Households	Mixed Origination
Civic Amenity Sites				
Door-to-Door Collection				
(W)EEE Collection Points				
Do-It-Yourself Delivery				

The above Table will be further analyzed through 2nd level correlation matrices, according to alternatives which are related to a basic Delivery – Collection scheme or to sub-types of (W)EEE discarders. It is noted that 2nd level correlation matrices can be applied only when relevant information is available at the level of an EU Member State and/or at the level of an entity which is practicing (W)EEE re-use and/or preparation for re-use (re-use centres networks, individual re-use centres, producer’s responsibility organizations and waste agencies).

Concerning the entities which are transporting the (W)EEE quantities from the sites where (W)EEE are discarded onto the (W)EEE Processing facilities, the matrix that correlates the applied Delivery – Collection schemes with the transporters by type can be expressed through the following Table.

Table 2: Initial Correlation Matrix of Delivery – Collection Scheme with (W)EEE Transporter Types

Delivery – Collection Scheme / Type of (W)EEE Transporters	WEEE Processing Facility Staff Member	Staff Member of the Applied Collection Scheme	Independent Professional Transporter	WEEE Discarder
Civic Amenity Sites				
Door-to-Door Collection				
(W)EEE Collection Points				
Do-It-Yourself Delivery				

Based on the methodologies that are currently applied in the EU Member States and are related to the re-use and preparation for re-use of (W)EEE, the correlation among applied Delivery – Collection schemes and the types of (W)EEE discarders, as well as among applied Delivery – Collection schemes and the types of (W)EEE transporters will be further analyzed in order to identify certain routes that will structure the process chain of the integrated methodology.

2.1.1 Civic Amenity Sites

The 2nd layer correlation matrix which analyzes the CAS applied Delivery – Collection scheme in accordance with the different types of discarders is valid only when all of the following prerequisites are fulfilled:

- Several types of pre-sorted household waste streams are collected at the CAS, including (W)EEE.
- There is no separation of the different (W)EEE types collected (e.g. electric or electronic appliance or even more, based on the categorization listed in Annex III (valid from August 2018) of the (W)EEE Directive (Directive 2012/19/EU)), or alternatively, (W)EEE are subjected to bulk collection.
- The basic activity of the CAS is the collection and preliminary or Temporary Storage of pre-sorted household waste streams, including (W)EEE.
- The collected material is considered as a waste stream.
- CAS is located in a remote – decentralized area.
- CAS is receiving (W)EEE quantities only by discarders and not by intermediate entities (e.g. transporters etc.).

- The quality level of a discarded (W)EEE item towards its re-use and/or preparation for re-use cannot be ensured.

CASs can collect (W)EEE quantities from all four (4) types of (W)EEE discarders but, since a proper traceability of the (W)EEE discarder per type (PRSE, PUSE and/or HAB) cannot be ensured it is assumed that CASs are receiving (W)EEE from all types of (W)EEE discarders (mixed origination). In this framework, the 2nd layer correlation matrix can be related only with different versions of CAS and is described by the following Table.

The black cells of the correlation matrix are indicating that the correlation between what is collected at CASs and the (W)EEE discarder types cannot be made.

Table 3: 2nd Layer Correlation Matrix of Delivery – Collection Scheme with (W)EEE Discarder Types / Civic Amenity Sites

Civic Amenity Site Types / Type of (W)EEE Discarders	Private Sector Entities	Public Sector Entities	Households	Mixed Origination
Municipal Collection Points				
Municipal Household Waste Collection Points				
Local Household Waste Recycling Centres				
Waste Collection Points or Centres				
Scrap Yards				

In addition, according to the transportation of (W)EEE quantities from the CAS to the (W)EEE Processing facility, the correlation matrix of CASs and the type of transportation entity involved is expressed as follows. It is noted that a ‘transportation entity’ is a person who transports the bulky collected (W)EEE quantities from the CAS to the (W)EEE Processing facility.

The black cells of the correlation matrix are indicating that the correlation between a CAS and a DIYD cannot be made.

Table 4: 2nd Layer Correlation Matrix of Delivery – Collection Scheme with Types of Transportation Entities / Civic Amenity Sites

Civic Amenity Site Types / Type of Transportation Entities	WEEE Processing Facility Staff Member	Staff Member of the Applied Collection Scheme	Independent Professional Transporter	WEEE Discarder
Municipal Collection Points				
Municipal Household Waste Collection Points				
Local Household Waste Recycling Centres				
Waste Collection Points or Centres				
Scrap Yards				

2.1.2 Door-To-Door Collection Scheme

To relate a D2DC scheme to a certain type of discarder is valid only when all of the following prerequisites are fulfilled:

- The transportation entity collects (W)EEE upon discarder’s request.
- The transportation entity collects (W)EEE from the discarder’s site.
- Even if it is not monitored, the type of (W)EEE discarder can theoretically be traced.
- The material collected can also be considered as a non-waste stream.

In the framework of a D2DC scheme, any type of (W)EEE discarder can be identified (Private Sector Entities, Public Sector Entities and/or Households). In addition, (W)EEE transporters can also be of any type (WEEE Processing facility Staff Member, Staff Member of the Applied Collection scheme and/or Independent Professional Transporter).

As a result, the only possible distinction between the different D2DC schemes is if they depend or not on an Extended Producer Responsibility schemes (EPR). In this framework, the 2nd layer correlation between D2DC schemes and (W)EEE discarders types as well as between D2DC schemes and types of transportation entities can be expressed by the following Tables.

The black cells of the correlation matrices are indicating that in the framework of a D2DC scheme, the tracing of the (W)EEE discarder type is possible even if it is not reported by the questionnaires’ respondents. To this end, a (W)EEE item can be identified as for its discarder type.

Table 5: 2nd Layer Correlation Matrix of Delivery – Collection Scheme with (W)EEE Discarder Types / Door-To-Door Collection

Door-To-Door Collection Types / Type of (W)EEE Discarders	Private Sector Entities	Public Sector Entities	Households	Mixed Origination
Door-To-Door Collection as Part of an EPR Scheme				
Non EPR Dependent Door-To-Door Collection				

Table 6: 2nd Layer Correlation Matrix of Delivery – Collection Scheme with Types of Transportation Entities / Door-To-Door Collection

Door-To-Door Collection Types / Type of Transportation Entities	WEEE Processing Facility Staff Member	Staff Member of the Applied Collection Scheme	Independent Professional Transporter	WEEE Discarder
Door-To-Door Collection as Part of an EPR Scheme				

2.1.3 (W)EEE Collection Points

The following 2nd layer correlation matrix analyzes the WCP applied Delivery – Collection scheme in accordance with the different types of discarders. It is valid only when all of the following prerequisites are fulfilled:

- WCPs are completely or at least partly dedicated to the collection of (W)EEE items with a quality level that can ensure, if not their re-usability, at least their recyclability.
- At WCPs, the separation of (W)EEE according to their type (e.g. electric or electronic appliance or even more, based on the categorization listed in Annex III (valid from August 2018) of the WEEE Directive (Directive 2012/19/EU)), is highly possible to happen.
- (W)EEE quantities can be separated according to their re-usability or recyclability potential.
- WCPs are oftenly located in urbanised areas.
- WCPs are correlated with waste reduction programmes and/or environmental awareness raising campaigns.
- WCPs are receiving (W)EEE quantities that are generated by households.
- WCPs are generally operating at a smaller scale when compared to CASs.
- As it is the case for D2DC schemes, WCP can be part of an EPR scheme.

- The basic activity of a WCP is the collection and preliminary or Temporary Storage of the collected (W)EEE.
- The material collected can also be considered as a non-waste stream.

In this framework, the 2nd layer correlation matrix can be related only with different versions of WCP and is described by the following Table.

The black cells of the correlation matrix are indicating that the correlation between a WCP and a (W)EEE discarder type cannot be addressed.

Table 7: 2nd Layer Correlation Matrix of Delivery – Collection Scheme with (W)EEE Discarder Types / (W)EEE Collection Points

WEEE Collection Points Types / Type of (W)EEE Discarders	Private Sector Entities	Public Sector Entities	Households	Mixed Origination
Distributors, Retailers, Enterprises, Big Stores, Malls				
Puntos Limpios (Clean Points), Municipalities Green Collection Points				
Charities				
Open Days, Campaigns, Movable Units				
WEEE Collection Points as Part of an EPR Scheme				
WEEE Collection Points as Part of a PRO Scheme				

In addition, concerning the transportation of the material from the WCPs to the (W)EEE Processing facility, the correlation matrix of WCPs and the type of the transportation entity is expressed as follows. It is noted that a ‘transportation entity’ is considered as a person who transports the pre-sorted collected (W)EEE quantities from WCP to the (W)EEE Processing facility. Generally, the transportation of the material from the WCPs to the (W)EEE Processing facilities is made by the staff members of the processing facility. However, other possibilities regarding the transportation entity involved can also be considered.

The black cells of the correlation matrix are indicating that the correlation between a WCP and a certain transportation entity type cannot be made (in this case, the (W)EEE discarder).

Table 8: 2nd Layer Correlation Matrix of Delivery – Collection Scheme with Types of Transportation Entities / (W)EEE Collection Points

(W)EEE Collection Points Types / Type of Transportation Entities	(W)EEE Processing Facility Staff Member	Staff Member of the Applied Collection Scheme	Independent Professional Transporter	(W)EEE Discarder
Distributors, Retailers, Enterprises, Big Stores, Malls				
Puntos Limpios (Clean Points), Municipalities Green Collection Points				
Charities				
Open Days, Campaigns, Movable Units				
(W)EEE Collection Points as Part of an EPR Scheme				
(W)EEE Collection Points as Part of a PRO Scheme				

2.1.4 Do-It-Yourself Delivery Scheme

The 2nd layer correlation matrix which analyzes the DIYD scheme in accordance with the different types of discarders is valid only when all of the following prerequisites are fulfilled:

- The (W)EEE discarder and the transportation entity are the same entity.
- WEEE discarders are reported to be households.
- The items collected can be considered as waste or non-waste.
- DIYD schemes are completely dedicated to the Delivery – Collection of (W)EEE items with a relatively high quality level that can ensure the re-usability of the items collected.
- The discarder delivers the material to the nearest (W)EEE Processing facility. For the cases where the discarder delivers (W)EEE quantities at a WCP (or at a CAS), then the Delivery – Collection scheme cannot be considered as a DIYD.

In this framework, the 2nd layer correlation matrix only is referring to one variation of the respective scheme and is described by the following Table.

The black cells of the correlation matrix are indicating that the respective correlation between a DIYD scheme and (W)EEE discarder type cannot be made (in this case, every type of discarder except from households).

Table 9: 2nd Layer Correlation Matrix of Delivery – Collection Scheme with (W)EEE Discarder Types / Do-It-Yourself Delivery

Do-It-Yourself Delivery Types / Type of (W)EEE Discarders	Private Sector Entities	Public Sector Entities	Households	Mixed Origination
Do-It-Yourself Delivery				

In addition, concerning the transportation of the discarded items from the discarder to a (W)EEE Processing facility, the correlation matrix of the DIYD scheme and the type of the transportation entity is expressed as follows.

The black cells of the correlation matrix are indicating that the correlation between a DIYD scheme and a certain transportation entity type cannot be made.

Table 10: 2nd Layer Correlation Matrix of Delivery – Collection Scheme with Types of Transportation Entities / Do-It-Yourself Delivery

Do-It-Yourself Delivery Types / Type of Transportation Entities	WEEE Processing Facility Staff Member	Staff Member of the Applied Collection Scheme	Independent Professional Transporter	WEEE Discarder
Do-It-Yourself Delivery				

Overall, taking into consideration the above mentioned facts regarding the correlation between the applied Delivery – Collection schemes and the types of (W)EEE discarders, as well as between the applied Delivery – Collection schemes and the types of (W)EEE transporters, the 1st level correlation matrices are described in the following tables.

The black cells of the correlation matrices are indicating that the correlation between a certain Delivery – Collection scheme and a certain Type of (W)EEE Discarder, as well as between a certain Delivery – Collection scheme and a certain Type of (W)EEE Transporter cannot be made.

Table 11: 1st Layer Correlation Matrix of Delivery – Collection Scheme with (W)EEE Discarder Types

Delivery – Collection Scheme / Type of (W)EEE Discarders	Private Sector Entities	Public Sector Entities	Households	Mixed Origination
Civic Amenity Sites				
Door-to-Door Collection				
(W)EEE Collection Points				
Do-It-Yourself Delivery				

Table 12: 1st Layer Correlation Matrix of Delivery – Collection Scheme with (W)EEE Transporter Types

Delivery – Collection Scheme / Type of (W)EEE Transporters	(W)EEE Processing Facility Staff Member	Staff Member of the Applied Collection Scheme	Independent Professional Transporter	(W)EEE Discarder
Civic Amenity Sites				
Door-to-Door Collection				
(W)EEE Collection Points				
Do-It-Yourself Delivery				

2.1.5 Procedures Related to (W)EEE Re-use & Preparation for Re-use

Despite the fact that most of the material collected and monitored in this study is considered as being waste, certain Delivery – Collection schemes sometimes result in a re-use activity related to non-waste products. The concept of ‘delivering – collecting’ potentially re-usable items, underlines additional procedures which are related with:

- Reception or Rejection of a (W)EEE item according to its re-usability potential.
- Separation of (W)EEE according to their categorization listed in Annex III (valid from August 2018) of the (W)EEE Directive (Directive 2012/19/EU).
- Visual Inspection of (W)EEE in order to assess their re-usability potential prior their transportation.
- Implementation of the PAYT (‘pay-as-you-throw’) principle upon the (W)EEE discarder.
- Implementation of the PAYT (‘pay-as-you-throw’) principle upon the EEE producer in the framework of an EPR scheme.

These procedures often determine the quality of the collected items and may affect the performance of not only the applied Delivery – Collection scheme, but also of the entire process chain in terms of effectiveness towards (W)EEE re-use and preparation for re-use.

In this framework, a 1st layer correlation matrix can be formed to express the existence of the above mentioned additional procedures in the different Delivery - Collection scheme . This correlation is described in the following Table where the black cells are indicating that the correlation between a certain Delivery – Collection scheme and a certain procedure cannot, in general, be made.

It is noted that these procedures are not applied by the (W)EEE discarders, but by the staff members of each Delivery – Collection scheme whether if they are receptors or transporters. In addition, the PAYT principle is expressing the possibility of charging the discarder with a fee in order to allow him to dispose / discard a (W)EEE item.

Table 13: 1st Layer Correlation Matrix of Delivery – Collection Scheme with Procedures Occured

Delivery – Collection Scheme / Certain Procedures	Reception or Rejection of (W)EEE	Separation of (W)EEE by Category	Visual Inspection of (W)EEE	Implementation of PAYT on Discarder	Implementation of PAYT on Producer
Civic Amenity Sites					
Door-to-Door Collection					
(W)EEE Collection Points					
Do-It-Yourself Delivery					

2.2 Modelling of (W)EEE Management Facilities

After the disposal, preliminary storage, collection and transportation, the next step in the (W)EEE managerial chain is the delivery to a (W)EEE Management facility in order to be re-used, prepared for re-use and/or recycled. In this framework, according to the sequential stages of the (W)EEE managerial chain, these facilities are grouped based on their main procedure / activity which will be:

- Temporary Storage of (W)EEE where, after transportation, (W)EEE are stored prior to their treatment.

- Processing of (W)EEE where the temporary stored items are checked, cleaned and repaired prior to their insertion on the market as REWEEE.
- Trading of REWEEE where the repaired items are donated or sold to third parties / customers.

The above mentioned procedures are distinguishing (W)EEE management towards re-use and preparation for re-use from waste management in general.

2.2.1 (W)EEE Temporary Storage

According to the currently applied methodologies regarding (W)EEE re-use and preparation for re-use, (W)EEE Temporary Storage facilities are found either as separate – stand alone – facilities either are merged with (W)EEE Processing facilities, either are part of the applied Delivery – Collection scheme . This distinction is essential due to the fact that a (W)EEE Temporary Storage facility is the first place where the quantity of (W)EEE is monitored.

In this framework, a 1st layer correlation between a certain Delivery – Collection scheme and a (W)EEE Temporary Storage facility is described in the following Table. The black cells are indicating that the correlation between a certain Delivery – Collection scheme and a (W)EEE Temporary Storage facility cannot be made.

Table 14: 1st Layer Correlation Matrix of Delivery – Collection Scheme with (W)EEE Temporary Storage Facility

Delivery – Collection Scheme / (W)EEE Temporary Storage	Stand Alone Facility	Merged with a (W)EEE Processing Facility	Merged with a REWEEE Trading Store
Civic Amenity Sites			
Door-to-Door Collection			
(W)EEE Collection Points			
Do-It-Yourself Delivery			

The procedures which might occur at a (W)EEE Temporary Storage facility are the following:

- Categorisation of (W)EEE items according to their types,
- Traceability of (W)EEE,
- Qualitative Assessment of (W)EEE,
- Numerical Assessment of (W)EEE and

- Quantitative Assessment of (W)EEE.

From the above mentioned procedures, the categorization of (W)EEE as well as the traceability of (W)EEE are affected by the type of the applied Delivery – Collection scheme.

The 2nd layer matrices which are correlating a certain (W)EEE Temporary Storage procedure with a certain Delivery – Collection scheme are described in the following Tables. It is noted that, for the cases of CASs and WCPs, these procedures are part of the (W)EEE Processing facility.

Table 15: 2nd Layer Correlation Matrix of Delivery – Collection Scheme with Categorisation of (W)EEE

Delivery – Collection Scheme / Categorisation of (W)EEE	WEEE Only	EEE Only	WEEE and EEE
Civic Amenity Sites			
Door-to-Door Collection			
(W)EEE Collection Points			
Do-It-Yourself Delivery			

Table 16: 2nd Layer Correlation Matrix of Delivery – Collection Scheme with Traceability of (W)EEE

Delivery – Collection Scheme / Traceability of (W)EEE	Discarders Can Be Traced	Discarders Cannot Be Traced
Civic Amenity Sites		
Door-to-Door Collection		
(W)EEE Collection Points		
Do-It-Yourself Delivery		

The three other procedures which are related to the Qualitative, Numerical or Quantitative Assessment of (W)EEE can only be related to a (W)EEE Temporary Storage and/or Processing facility and not with a Delivery – Collection scheme.

The black cells indicate that the respective correlation cannot be made.

Table 17: 3rd Layer Correlation Matrix of Qualitative Assessment and Numerical Assessment of WEEE

Numerical Assessment of (W)EEE / Qualitative Assessment of (W)EEE	Sorting and identification of (W)EEE	Non-identification of (W)EEE
Counting of (W)EEE Separately per Appliance Type		
Counting of (W)EEE Accumulatively		
Absence of (W)EEE Counting		

Table 18: 3rd Layer Layer Correlation Matrix of Qualitative Assessment and Quantitative Assessment of (W)EEE

Quantitative Assessment of (W)EEE / Qualitative Assessment of (W)EEE	Sorting and identification of (W)EEE	Non-identification of (W)EEE
Weighting of (W)EEE Separately per Appliance Type through Physical Scale		
Weighting of (W)EEE Separately per Appliance Type through Proxy Data		
Weighting of (W)EEE Accumulatively through Physical Scale		
Weighting of (W)EEE Accumulatively through Proxy Data		
Combination of the Above		

For the cases where (W)EEE Temporary Storage facilities are a separate part of the Delivery – Collection scheme (cases of CASs and WCPs, see Table 14), the above mentioned procedures are taking place at the (W)EEE Processing facility. In these cases, the point of calculation for (W)EEE is taking place at the (W)EEE Processing facility and refers to the fraction of the collected (W)EEE which is considered as being potentially re-usable. This fraction can be expressed as follows:

$$f_{reusability,C} = \frac{[(W)EEE]_{potential_R}}{[(W)EEE]_{collected}}, \text{ in \% where}$$

$f_{reusability}$ - Fraction of the collected (W)EEE which is considered to be potentially re-usable. For the cases of CASs and/or WCPs, this fraction refers to the (W)EEE quantities which

were selected from CASs and/or WCPs in order to be transported to the (W)EEE Processing facilities.

$[(W)EEE]_{potentially_R}$ - Amount of (W)EEE which, after a visual inspection, is considered as being potentially re-usable. This quantity is considered as the output of the CASs and/or WCPs, or alternatively, as the input of the (W)EEE Processing facility. This data is monitored by the Re-Use Centres or their networks if they exist.

$[(W)EEE]_{collected}$ - Total amount of collected (W)EEE. This data is monitored by Producer Responsibility Organisations or by Local Authorities and is considered as being the input of the (W)EEE Temporary Storage facility.

If the visual inspection is made when the (W)EEE items are collected at the (W)EEE Temporary Storage facility, and if this visual inspection results in the rejection of all the non-reusable items before the calculation of the collected quantities (which will be given back to the discarder or sent for recycling), there will not be any difference between $[(W)EEE]_{potentially_R}$ and $[(W)EEE]_{collected}$ and $f_{reusability}$ will be equal to one (1). If it is not the case, the ratio $f_{reusability}$ can be considered as a ratio that measures the effectiveness of a Delivery – Collection scheme.

In the framework of developing an integrated methodology, or alternatively, in the case where all Delivery – Collection schemes are applied, the re-usability ratio on the basis of (W)EEE collected is expressed by the following equation:

$$f_{reusability,C} = \left\langle \frac{[WEEE]_{potentially_R}}{[WEEE]_{collected}} \right\rangle_{CAS} + \left\langle \frac{[(W)EEE]_{potentially_R}}{[(W)EEE]_{collected}} \right\rangle_{D2DC} + \left\langle \frac{[(W)EEE]_{potentially_R}}{[(W)EEE]_{collected}} \right\rangle_{WCP} + \left\langle \frac{[(W)EEE]_{potentially_R}}{[(W)EEE]_{collected}} \right\rangle_{DND}$$

where,

$\left\langle \frac{[WEEE]_{potentially_R}}{[WEEE]_{collected}} \right\rangle_{CAS}$ - Fraction of (W)EEE collected through CASs which is considered as potentially re-usable, in %.

$\left\langle \frac{[(W)EEE]_{potentially_R}}{[(W)EEE]_{collected}} \right\rangle_{D2DC}$ - Fraction of (W)EEE collected through a D2DC scheme which is considered as potentially re-usable, in %.

$\left\langle \frac{[(W)EEE]_{potentially_R}}{[(W)EEE]_{collected}} \right\rangle_{WCP}$ - Fraction of (W)EEE collected through WCPs which are considered as potentially re-usable, in %.

$\left\langle \frac{[(W)EEE]_{potentially_R}}{[(W)EEE]_{collected}} \right\rangle_{DIYD}$ - Fraction of (W)EEE collected through a DIYD scheme which are considered as potentially re-usable, in %.

Given the fact that the total amounts of (W)EEE collected at national level are subjected to quantified targets and that these targets are expressed on the basis of (W)EEE generated at national level, the reusability ratio on the basis of (W)EEE generated can be given by the following equation:

$$f_{reusability,GEN} = f_{reusability,C} \cdot f_{collectability}, \text{ in \% where}$$

$f_{reusability,C}$ - Re-usability ratio on the basis of (W)EEE separately collected.

$f_{collectability}$ - Ratio that expresses the amounts of separately collected (W)EEE ($[(W)EEE]_{CAS,D2DC,WCP,DIYD}$) on the basis of total (W)EEE generated at national level ($[(W)EEE]_{GEN}$) where:

$$f_{collectability} = \frac{[(W)EEE]_{CAS,D2DC,WCP,DIYD}}{[(W)EEE]_{GEN}}.$$

The formula for the calculation of the total WEEE quantities generated in a Member State is described in detail in the Annex II of the Commission Implementing Regulation 2017/699/EU.

The fraction of WEEE which is not collectable is usually the fraction which is deemed to be non-functional or not used anymore, but still stored at the discarders.

The fraction of WEEE that is not reusable is being recycled in material recovery facilities.

2.2.2 (W)EEE Processing

When REWEEE Processing facilities are merged with (W)EEE Temporary Storage facilities, the procedures prior to the treatment of (W)EEE items as well as the correlation matrices were described and modelled in the previous section (see section 2.2.1). In the (W)EEE Processing facilities, activities such as checking, cleaning, data erasing (for IT equipment) and repairing of (W)EEE are conducted in order to produce re-usable and operational items.

In addition, for the cases where (W)EEE Processing facilities are not merged with (W)EEE Temporary Storage facilities (as it is the case for CASs and WCPs), transportation of the potentially re-usable items to the Processing facility is needed.

The REWEEE items which are considered as having a potential to be sold and/or donated are transferred from the (W)EEE Processing facilities to the REWEEE Trading Stores. To this end and given the fact that the input of the (W)EEE Processing facilities (made directly through D2DC and DIYD schemes and indirectly through (W)EEE Temporary Storage facilities such as CASs and WCPs schemes) is related to the (W)EEE quantities which are potentially re-usable, the internal capacity factor for a (W)EEE Processing facility can be given thanks to the following equation:

$$f_{repairability} = \frac{[(W)EEE]_{repaired}}{[(W)EEE]_{potentially_R}}, \text{ in \% where}$$

$f_{repairability}$ - Fraction of the potentially re-usable (W)EEE which is finally repaired.

$[(W)EEE]_{repaired}$ - Amount of (W)EEE that was repaired and is readily available to be delivered at REWEEE Trading Stores. These quantities are considered as the output of the (W)EEE Processing facility.

$[(W)EEE]_{potentially_R}$ - Amount of (W)EEE which, after visual inspection, is considered to be potentially re-usable. These quantities are considered as the input of the (W)EEE Processing facility.

Inside the (W)EEE Processing facility, the procedures that can take place and which are related to the monitoring of REWEEE are the following:

- Qualitative Assessment of REWEEE,
- Numerical Assessment of REWEEE and
- Quantitative Assessment of REWEEE.

In this framework, the correlation matrices between the above mentioned procedures are displayed in the following tables. These procedures can also take place at a REWEEE Trading Store.

It is noted that the black cells are indicating that the correlations cannot be made.

Table 19: 3rd Layer Correlation Matrix of Qualitative Assessment and Numerical Assessment of REWEEE

Numerical Assessment of REWEEE / Qualitative Assessment of REWEEE	Sorting and identification of REWEEE	Non-identification of REWEEE
Counting of REWEEE Separately per Appliance Type		
Counting of REWEEE Accumulatively		
Absence of REWEEE Counting		

Table 20: 3rd Layer Layer Correlation Matrix of Qualitative Assessment and Quantitative Assessment of REWEEE

Quantitative Assessment of REWEEE / Qualitative Assessment of REWEEE	Sorting and identification of REWEEE	Non-identification of REWEEE
Weighting of REWEEE Separately per Appliance Type through Physical Scale		
Weighting of REWEEE Separately per Appliance Type through Proxy Data		
Weighting of REWEEE Accumulatively through Physical Scale		
Weighting of REWEEE Accumulatively through Proxy Data		
Combination of the Above		

The ratio $f_{repairability}$ can be considered as a ratio that measures the efficiency of a (W)EEE Processing facility and can be related to criteria such as the specialisation of the staff in repairing certain appliance’s types or its ability to deal with all the different types of (W)EEE collected.

Taking inot account the amount of (W)EEE collected, the repairability ratio can be expressed as follows:

$$f_{repairability,C} = f_{repairability} \cdot f_{reusability,C}$$

Taking into account the amount of (W)EEE generated, the repairability ratio can be expressed as follows:

$$f_{\text{repairability,GEN}} = f_{\text{repairability,C}} \cdot f_{\text{collectability}}$$

The fraction of (W)EEE that is not repairable although being considered as re-usable can be either used for spare parts and/or be sent for recycling in material recovery facilities.

2.2.3 REWEEE Trading

Concerning the situation when the point of calculation of REWEEE is done when the items are sold or donated, it must be stated that a fraction of repairable REWEEE might never be sold. As a result, only a fraction of repairable REWEEE re-enters the economic life-cycle as second-hand products can be considered as marketable. The mathematical expression of this fraction is given by the following equation:

$$f_{\text{marketability}} = \frac{[(W)EEE]_{\text{marketable}}}{[(W)EEE]_{\text{repaired}}}, \text{ in \% where}$$

$f_{\text{marketability}}$ - Fraction of the marketable REWEEE which has already been sold and/or donated to customers / third parties as second-hand products.

$[(W)EEE]_{\text{marketable}}$ - Amount of REWEEE which has been sold and/or donated to third parties / customers. This amount is considered as being the output of the REWEEE Trading Stores.

$[(W)EEE]_{\text{repaired}}$ - Amount of (W)EEE that was repaired and is readily available to be delivered at REWEEE Trading Stores. These quantities are considered as being the output of the (W)EEE Processing facility.

The ratio $f_{\text{marketability}}$ can be considered as a ratio that measures the capacity of the market to encourage the buying of second hand EEE, as well as the capacity of a social economy business to create social added-value by donating REWEEE to disadvantaged groups.

Taking into account the amount of (W)EEE collected, the marketability ratio can be expressed as follows:

$$f_{\text{marketability,C}} = f_{\text{marketability}} \cdot f_{\text{repairability,C}} \cdot f_{\text{reusability,C}}$$

Taking into account the amount of (W)EEE generated, the marketability ratio can be expressed as follows:

$$f_{marketability,GEN} = f_{marketability,C} \cdot f_{collectability}$$

The fraction of REWEEE which is not marketable, even though it has been repaired, can be temporary stored or traded in developing countries.

3. Integrated Methodology Visualization

In this Chapter, the modelling of the integrated methodology concerning the alternative routes which are followed for the management of (W)EEE towards re-use and preparation for re-use will be displayed in flow charts. They will be divided in two groups reflecting:

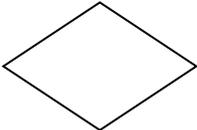
- the part of the methodology affected by the applied Delivery – Collection scheme
- the part of the methodology affected by the internal procedures occurring at the (W)EEE Temporary Storage facilities, the (W)EEE Processing facilities and the REWEEE Trading Stores.

Given the fact that there are several points of calculation regarding the quantitative assessment of both (W)EEE and REWEEE, the structure of each flow chart will be accompanied by certain indicators for the calculation of ratios that were mathematically expressed in the 2nd Chapter.

The Table below illustrates the symbols that are used for structuring each flow chart.

Table 21: Interpretation of Flow Chart Symbols

Flow Chart Symbol	Interpretation
	Input / Output
	Logical 'AND'
	Multiple Choice Decision
	Logical 'OR'
	Transaction
	Process

Flow Chart Symbol	Interpretation
	Data Entry (point of calculation)
	Dual Choice Decision

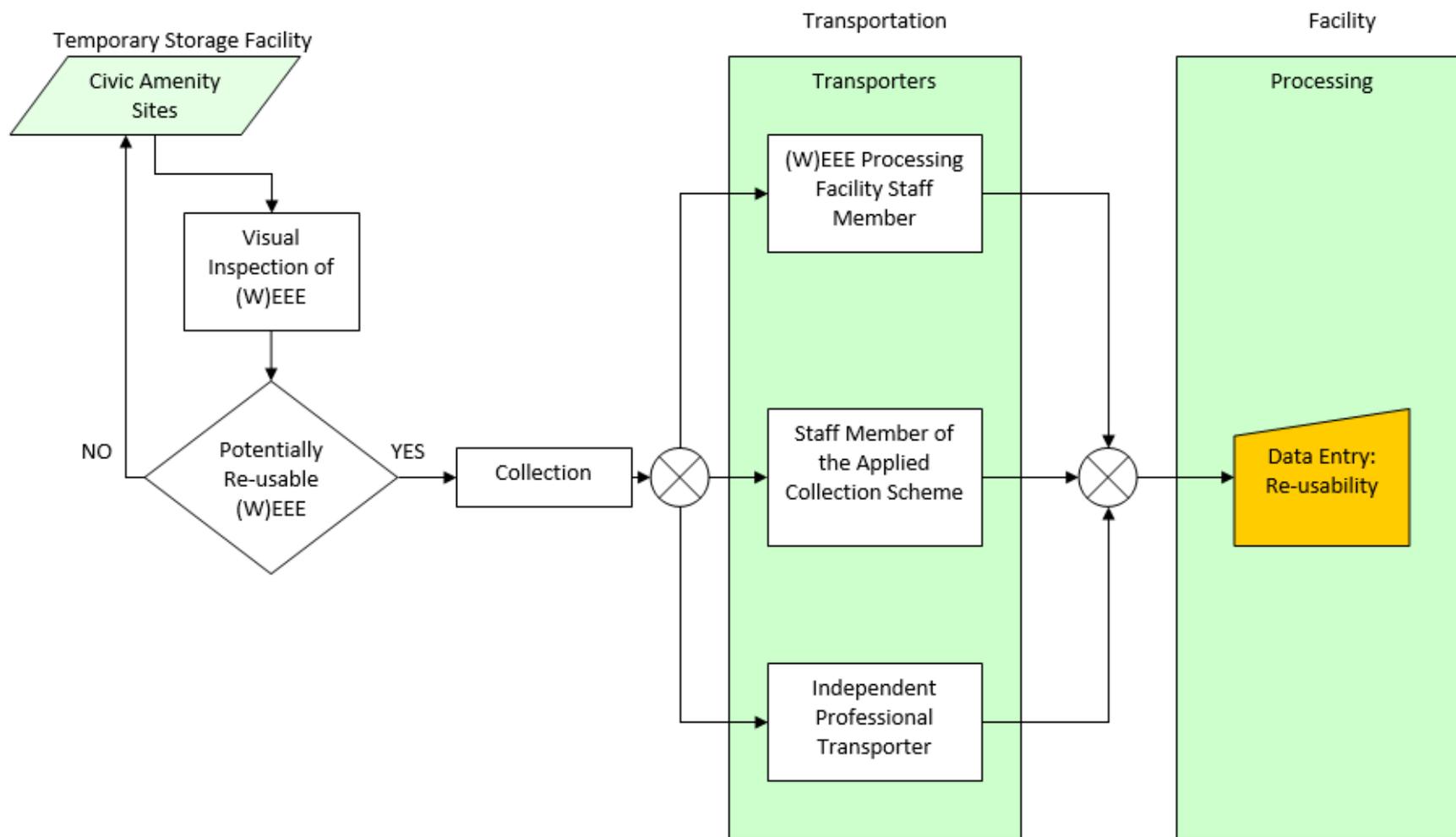
3.1 Delivery – Collection

The integrated methodology identifies the four alternative Delivery – Collection schemes and their respective potential discarders at the first point of (W)EEE calculation, meaning at the step where the respective quantities are entering a (W)EEE Management facility.

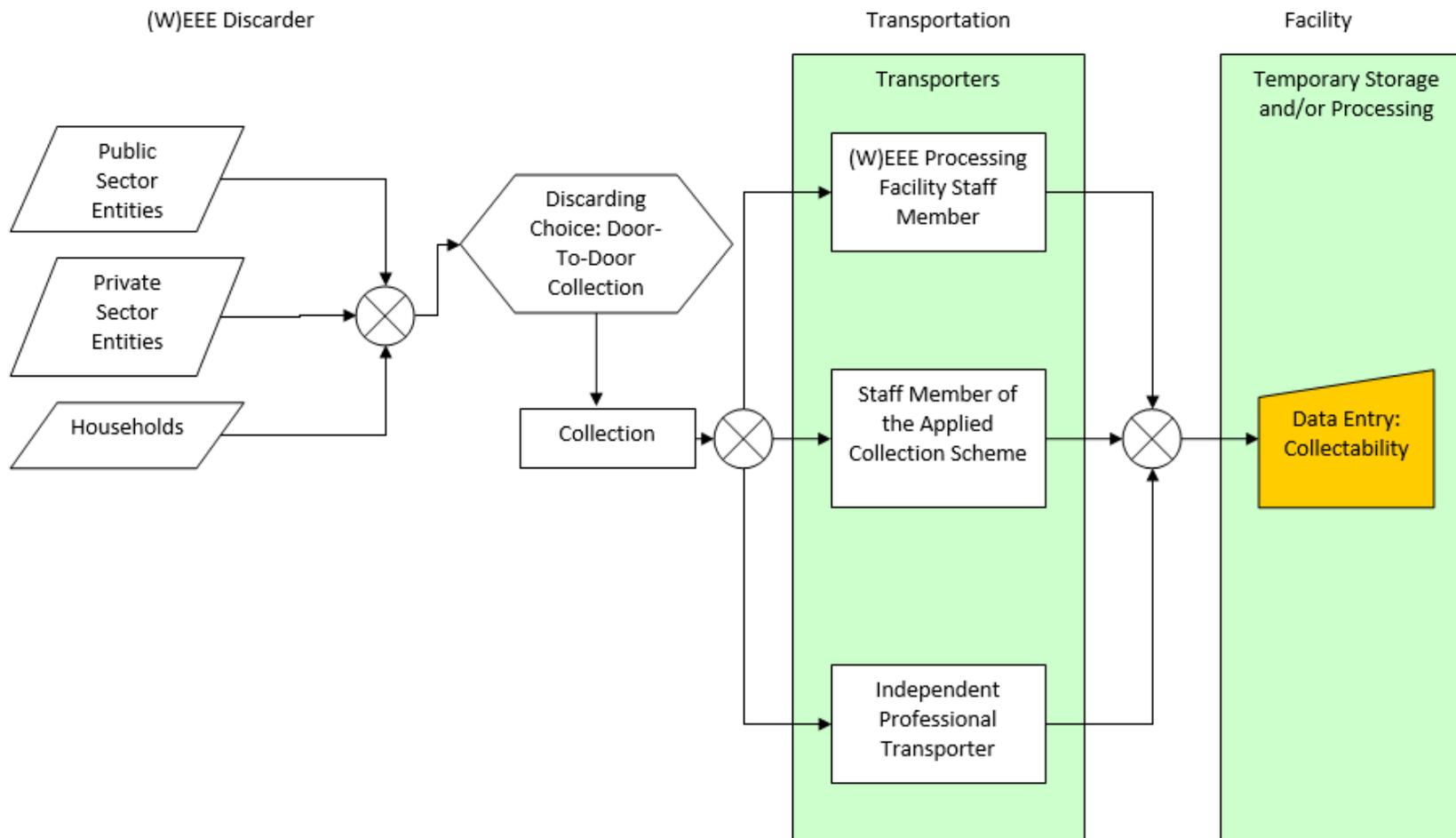
The flow charts below are illustrating the routes that can be followed during the implementation of a Delivery – Collection scheme that is based on CASs, D2DC, WCPs and/or DIYD scheme. In particular:

- Concerning a CAS scheme, the flow charts are illustrating the routes:
 - From the discarder to the Temporary Storage facility and
 - From the Temporary Storage facility to the Processing facility.
- Concerning a D2DC scheme, the flow chart is illustrating the route from the discarder to the Temporary Storage and/or Processing facility.
- Concerning a WCP scheme, the flow charts are illustrating the routes:
 - From the discarder to the Temporary Storage facility and
 - From the Temporary Storage facility to the Processing facility.
- Concerning a DIYD scheme, the flow chart is illustrating the route from the discarder to the Temporary Storage and/or Processing facility.

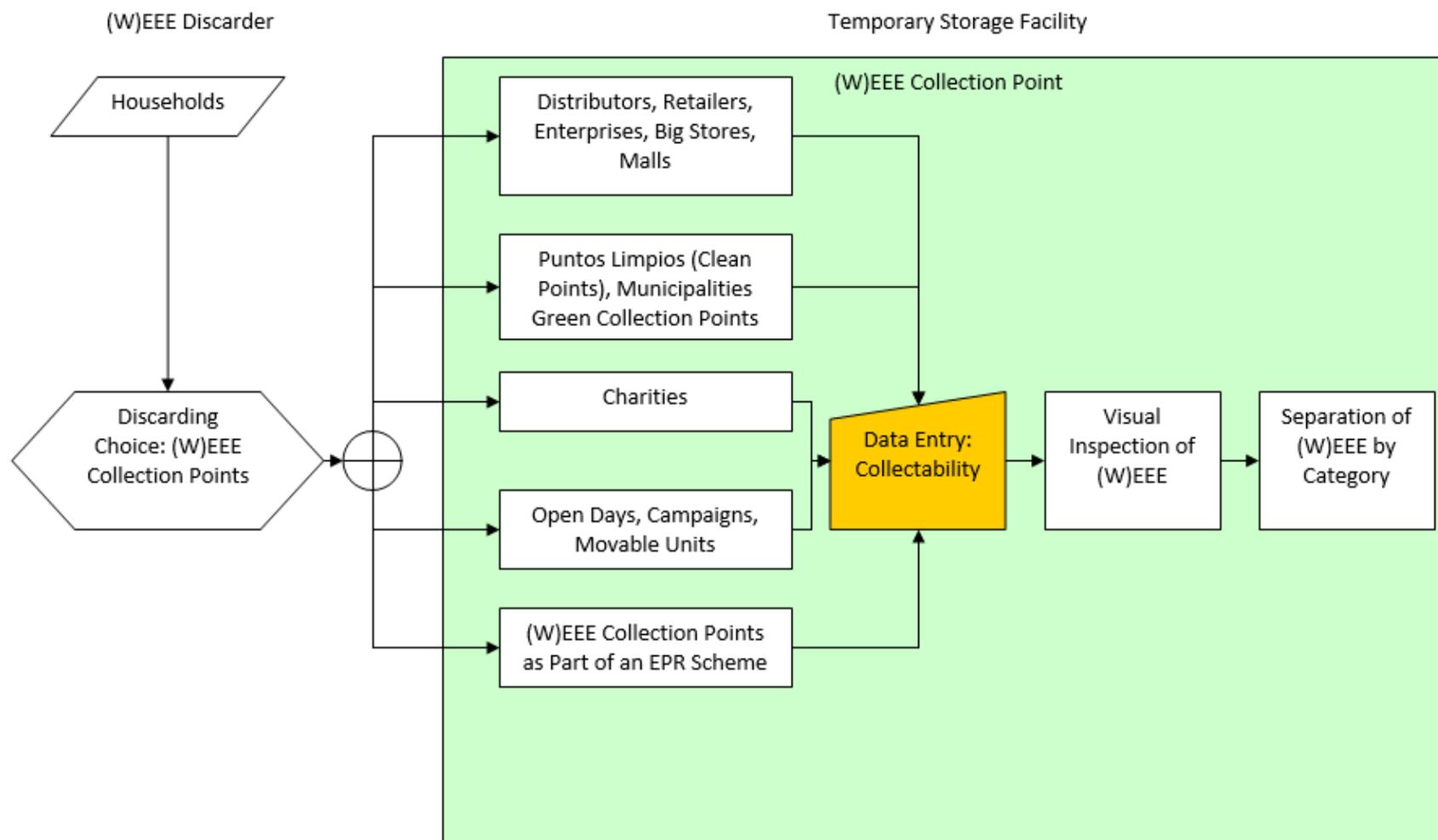
Flow Chart 2: Delivery – Collection Through the Application of Civic Amenity Sites – From Temporary Storage to Processing



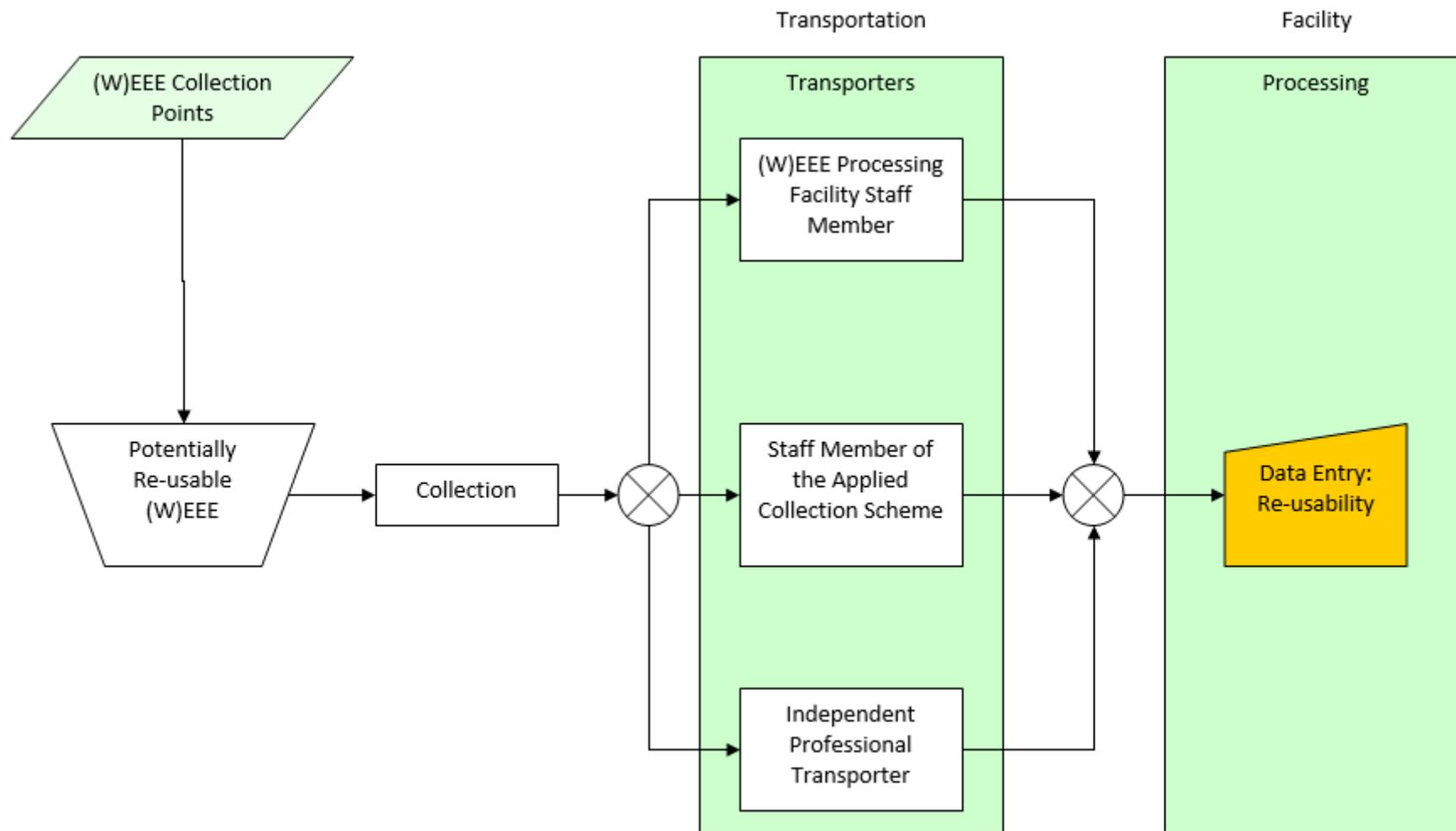
Flow Chart 3: Delivery – Collection Through the Application of Door-To-Door Collection Scheme – From Discarder to Temporary Storage and/or Processing Facility



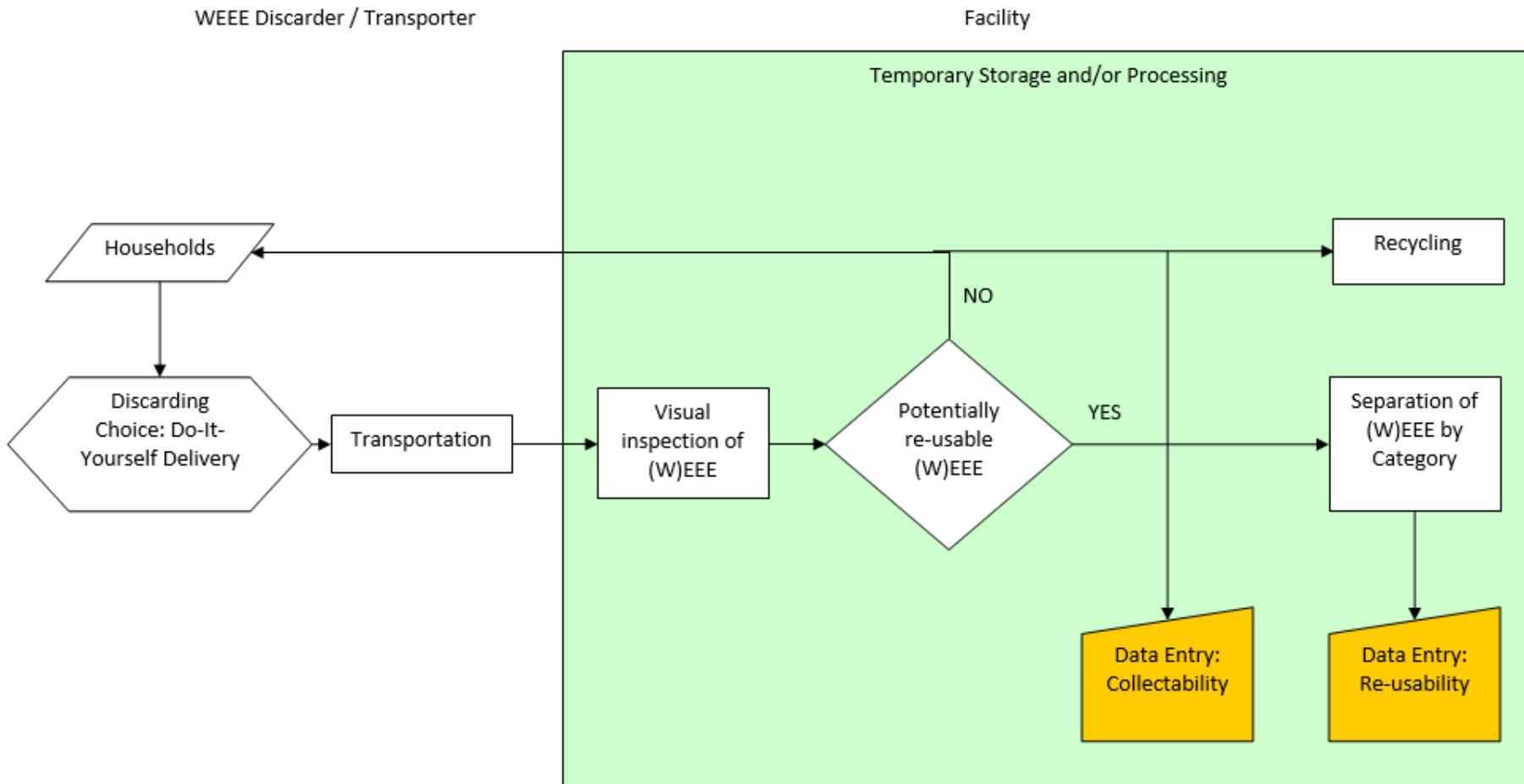
Flow Chart 4: Delivery – Collection Through the Application of (W)EEE Collection Points – From Discarder to Temporary Storage



Flow Chart 5: Delivery – Collection Through the Application of (W)EEE Collection Points – From Temporary Storage to Processing



Flow Chart 6: Delivery – Collection Through the Application of Do-It-Yourself Delivery Schemes – From Discarder to Temporary Storage and/or Processing Facility



3.2 Temporary Storage & Processing

In this section, we will visualise the procedures which are related to the internal activities of a (W)EEE Temporary Storage & Processing facility, for the cases where the (W)EEE Temporary Storage facilities are not separated from the Processing facilities as it is automatically the case for CASs and WCPs. It must be noted that for the cases where a (W)EEE Temporary Storage facility is not merged with a (W)EEE Processing facility, a transportation of the temporary stored (W)EEE is required between the storage and the processing site.

Firstly, the internal procedures will be illustrated taking into account their alternative routes, based on the questionnaires responses, in order to form an integrated approach for the Temporary Storage & Processing of (W)EEE prior to their trading as readily available second-hand products. For this case, the Temporary Storage facilities and the (W)EEE Processing facilities will be considered as merged. It is reminded that the procedures which are taking place at a (W)EEE Temporary Storage facility include:

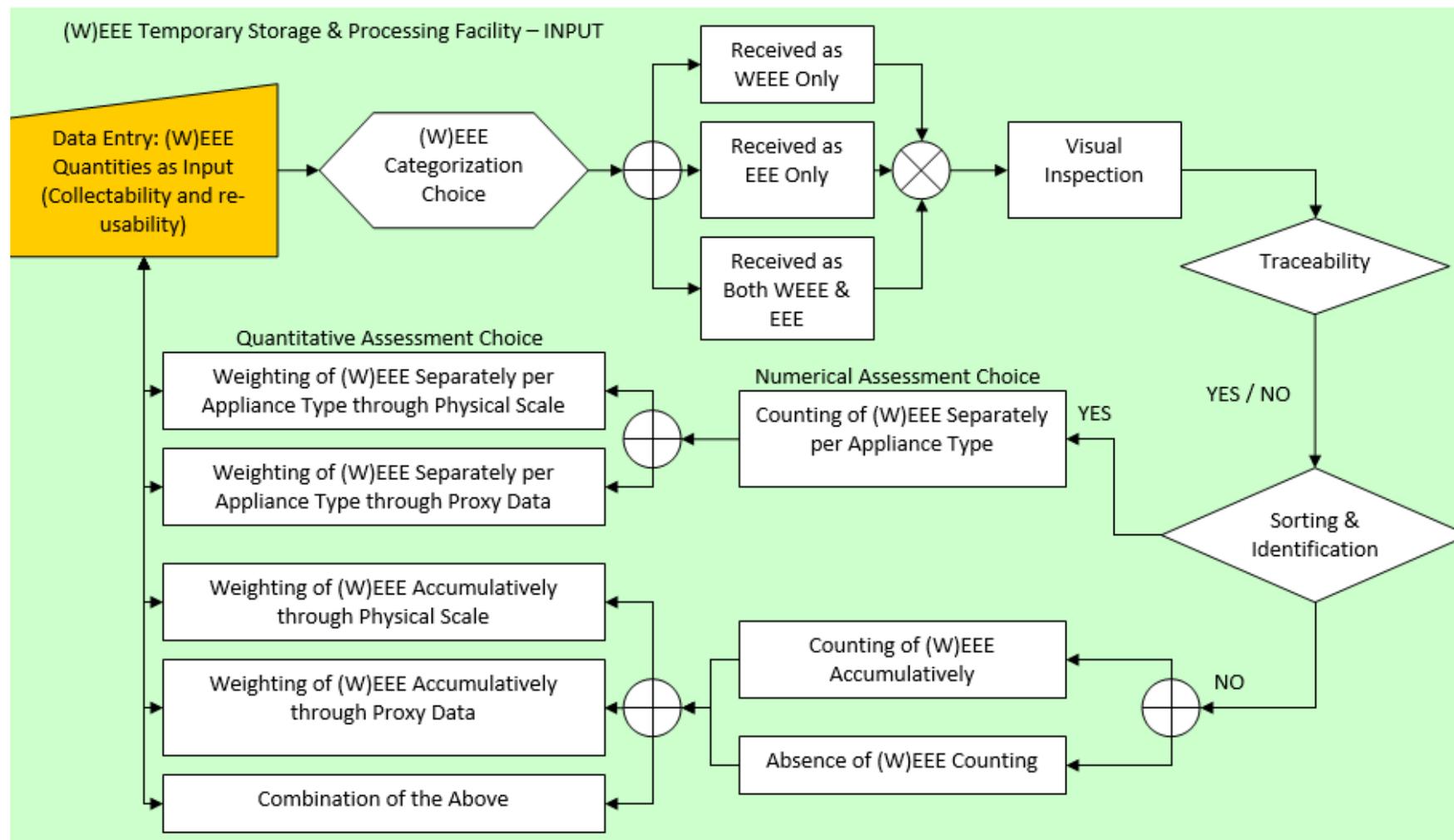
- Categorisation of (W)EEE ,
- Traceability of (W)EEE ,
- Qualitative Assessment of (W)EEE ,
- Numerical Assessment of (W)EEE and
- Quantitative Assessment of (W)EEE .

In addition, the procedures which are taking place at a (W)EEE Processing facility include:

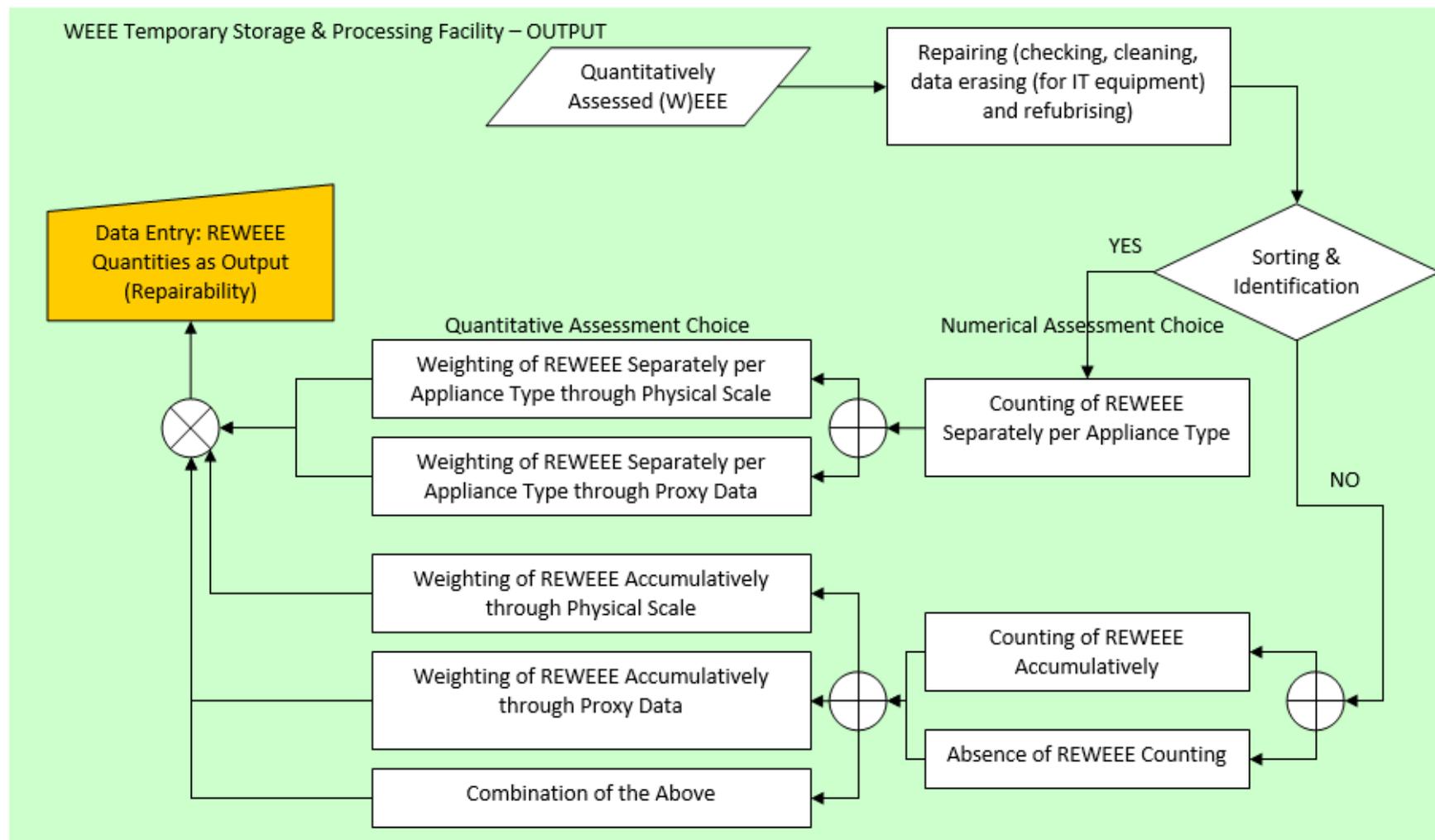
- Repairing (checking, cleaning, data erasing (for IT equipment) and refurbishing) of (W)EEE ,
- Qualitative Assessment of REWEEE,
- Numerical Assessment of REWEEE and
- Quantitative Assessment of REWEEE.

These procedures can also take place at a REWEEE Trading Stores , but in order to provide a more integrated approach, we consider that they are taking place right after the refurbishment of the (W)EEE items inside the Processing facility.

Flow Chart 7: Temporary Storage & Processing of (W)EEE – From Input to Weighting



Flow Chart 8: Temporary Storage & Processing of (W)EEE – From Repair to Output



3.3 Trading of REWEEE

The term 'Trading of REWEEE' refers to all the procedures which are related to REWEEE management from the stage where the (W)EEE items have been refurbished up to the stage where these items are temporary stored, sold and/or donated to customers / third parties. These procedures include:

- Qualitative Assessment of REWEEE,
- Numerical Assessment of REWEEE and
- Quantitative Assessment of REWEEE.

These procedures can also take place at a REWEEE Trading Store when this facility is merged with the (W)EEE Processing facility. For the other cases, the delivery of the REWEEE to the REWEEE Trading Stores is done through transportation. Before that, each REWEEE Trading Stores is ordering a batch of REWEEE items which are having certain qualitative and quantitative characteristics that are related to the:

- Storage space of each REWEEE Trading Store and
- The types of appliances which are considered as being marketable. For example, according to Annex III (valid from August 2018) televisions fall within the 2nd category titled 'Screens, monitors, and equipment containing screens having a surface greater than 100cm²'. Even though repairable, a screen might not be marketable because obsolete (for e.g. only flat screens can be considered as marketable on the EU market now).

In this framework, there must be a distinction between marketable and non- marketable (obsolete) REWEEE where, the marketable items are easily accepted by REWEEE Trading Stores in order to be marketed, while the non- marketable ones are cannibalised (dismantled to collect still usable spare parts) or temporary stored in the Processing facility in order to be potentially exported to developing countries.

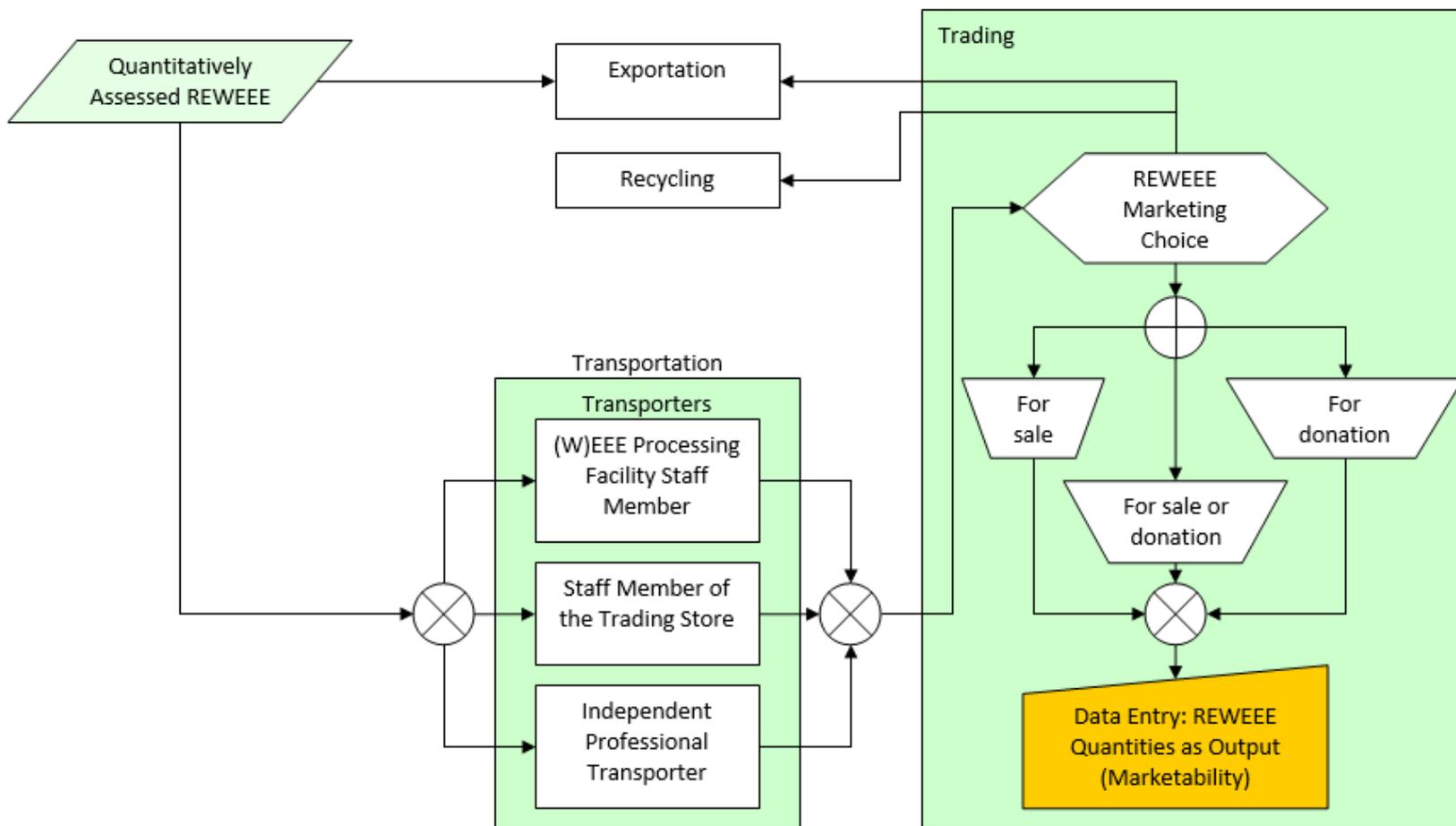
The items which are considered as marketable are temporary stored in the Processing facility in order to be sold and/or donated to customers / third parties.

All the procedures which are related to the trading of REWEEE are represented in the flow chart below.

Flow Chart 9: Trading of REWEEE

Temporary Storage & Processing Facility

REWEEE Trading Store



3.4 Integrated Methodology According to Delivery – Collection Scheme

Concerning the internal procedures of the Temporary Storage and/or Processing facility, as well as those conducted in a REWEEE Trading Store, the integrated methodology reflects all the alternative pathways where (W)EEE items are managed towards their sale/donation as second-hand products. However, some of the above mentioned procedures can be differentiated according to the applied Delivery – Collection scheme due to characteristics that are affecting some of the facilities' internal procedures. For example, it is to be expected that the (W)EEE items collected in a WCP will be already sorted according to their types, in particular because the separation between the different EEE types can be potentially suggested to the discarder. Furthermore, when we talk about the quantities of (W)EEE items collected from CASs, we actually talk about the fraction which is considered as being potentially re-usable and ending up as the input of the (W)EEE Processing facilities. To this end and concerning the internal procedures which are related to the Temporary Storage and/or Processing facility from the input to the weighting, the respective flow charts are slightly different according to the applied Delivery – Collection scheme. In particular, for the cases of CASs and WCPs which are considered as 'Temporary Storage facilities', the modified internal procedures are part of the Processing facility.

It is noted that these modifications were not reported by the questionnaire's respondents. They are still listed here as they can be considered as logical assumptions that can be implemented in order to rationalize the temporary storage and/or Processing facilities operations by mean of limiting some of the alternative pathways which are related to the traceability, the categorization and the weighting of (W)EEE prior to their processing. Concerning the internal procedures which are not affected by the applied Delivery – Collection scheme, the alternative pathways are related to criteria such as jobs (e.g. person needed for the counting of (W)EEE/REWEEE) and/or equipment (e.g. use of physical scale or of proxy data for weighting (W)EEE/REWEEE).

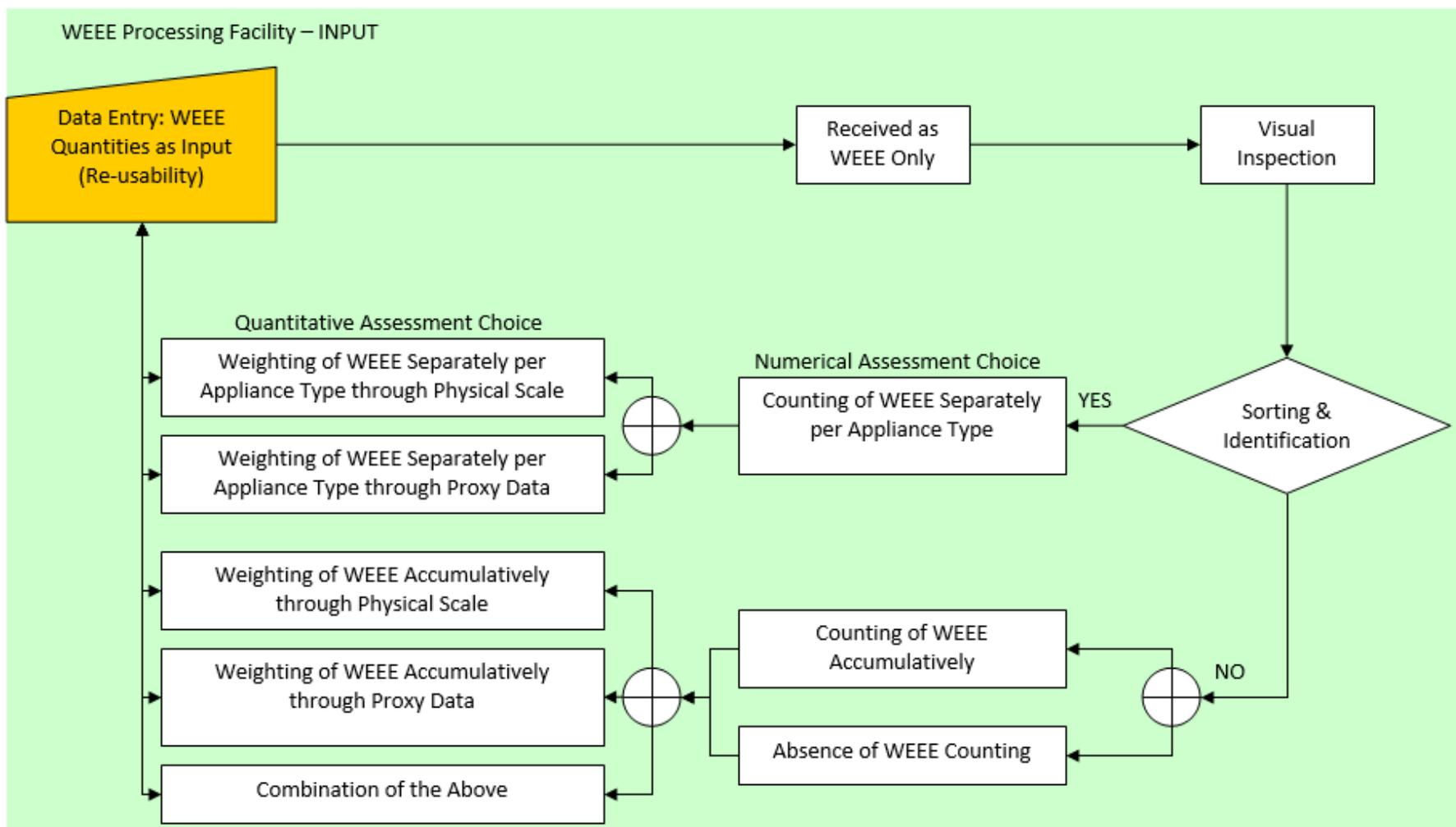
In particular, the major differences between the internal facilities' procedures in relation to the applied Delivery – Collection schemes are including:

- For CASs:
 - The fraction of (W)EEE which is delivered at the Processing facility is only a part of the totally collected (W)EEE at a CAS.
 - The delivered – potentially re-usable – (W)EEE quantities can only be considered as waste.
 - The delivered – potentially re-usable – (W)EEE quantities cannot be traced as for their origination.
- For D2DC schemes:
 - The fraction of (W)EEE which is delivered at the Processing facility can be considered as the whole collected fraction.

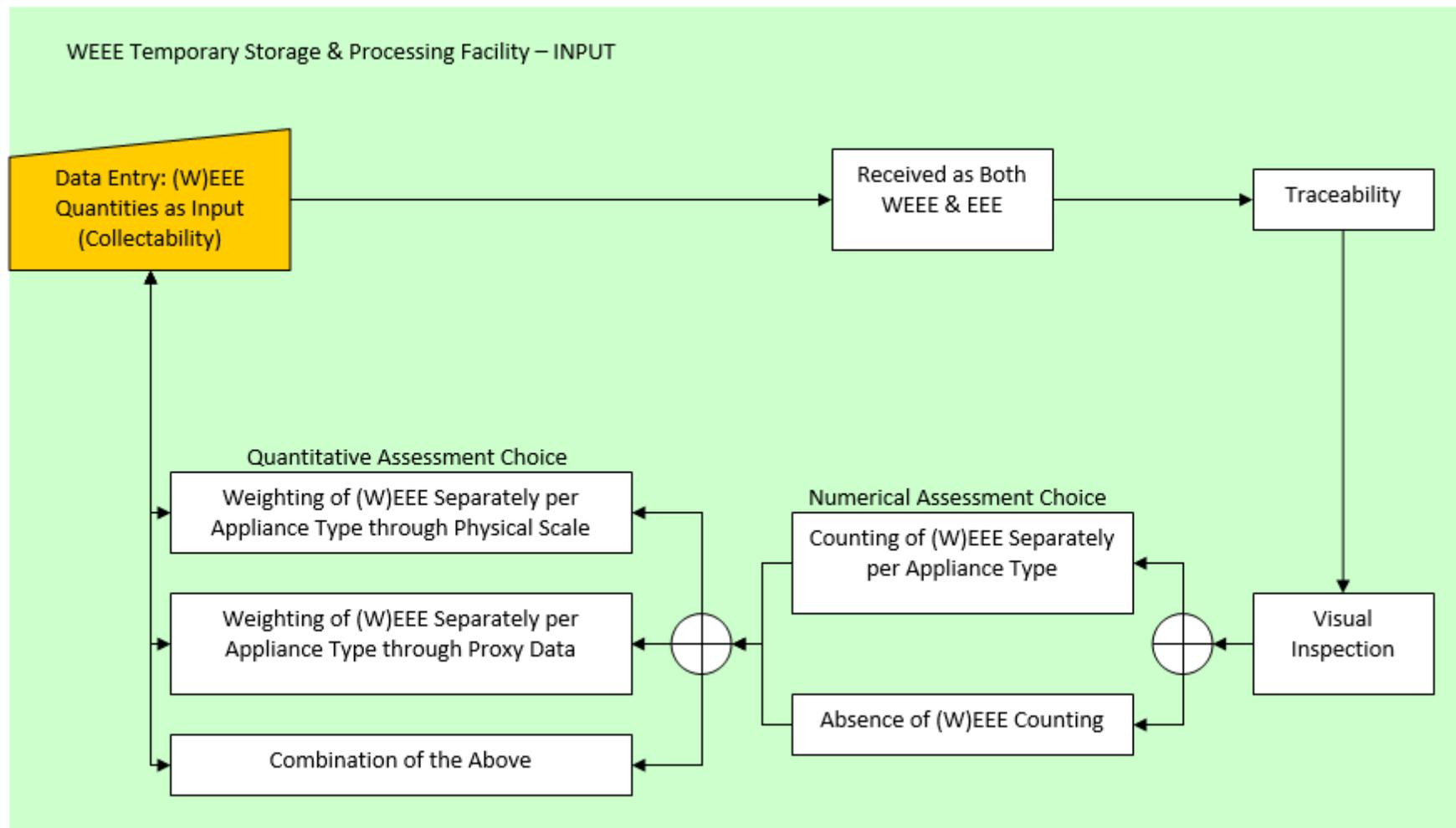
- The delivered – potentially re-usable – (W)EEE quantities can be also considered as a non-waste stream (therefore, the input quantities can be considered as EEE).
- The delivered – potentially re-usable – (W)EEE quantities can be traced as for their origination.
- The delivered – potentially re-usable – (W)EEE quantities are delivered in a pre-sorted form as for their classification according to Annex III (valid from August 2018) of the (W)EEE Directive.
- For WCPs:
 - The fraction of (W)EEE which is delivered at the Processing facility is only a part of the totally collected (W)EEE at a WCP. However, at a WCP, the totally collected quantities can be recorded.
 - The delivered – potentially re-usable – (W)EEE quantities can also be considered as non-waste (therefore, the input quantities can be considered as EEE).
 - The delivered – potentially re-usable – (W)EEE quantities can be traced as for their origination.
 - The delivered – potentially re-usable – (W)EEE quantities can be delivered in a pre-sorted form as for their classification according to Annex III (valid from August 2018) of the WEEE Directive.
- For DIYD schemes:
 - The fraction of (W)EEE which is delivered at the Processing facility can be considered as the whole collected fraction. However, non-acceptable (W)EEE quantities can also be recorded at the location of the Processing facility.
 - The delivered – potentially re-usable – (W)EEE quantities can be also considered as non-waste (therefore, the input quantities can be considered as EEE).
 - The delivered – potentially re-usable – (W)EEE quantities can be traced as for their origination.
 - The delivered – potentially re-usable – (W)EEE quantities are delivered in a pre-sorted form as for their classification according to Annex III (valid from August 2018) of the WEEE Directive.

The flow charts below will describe these procedures.

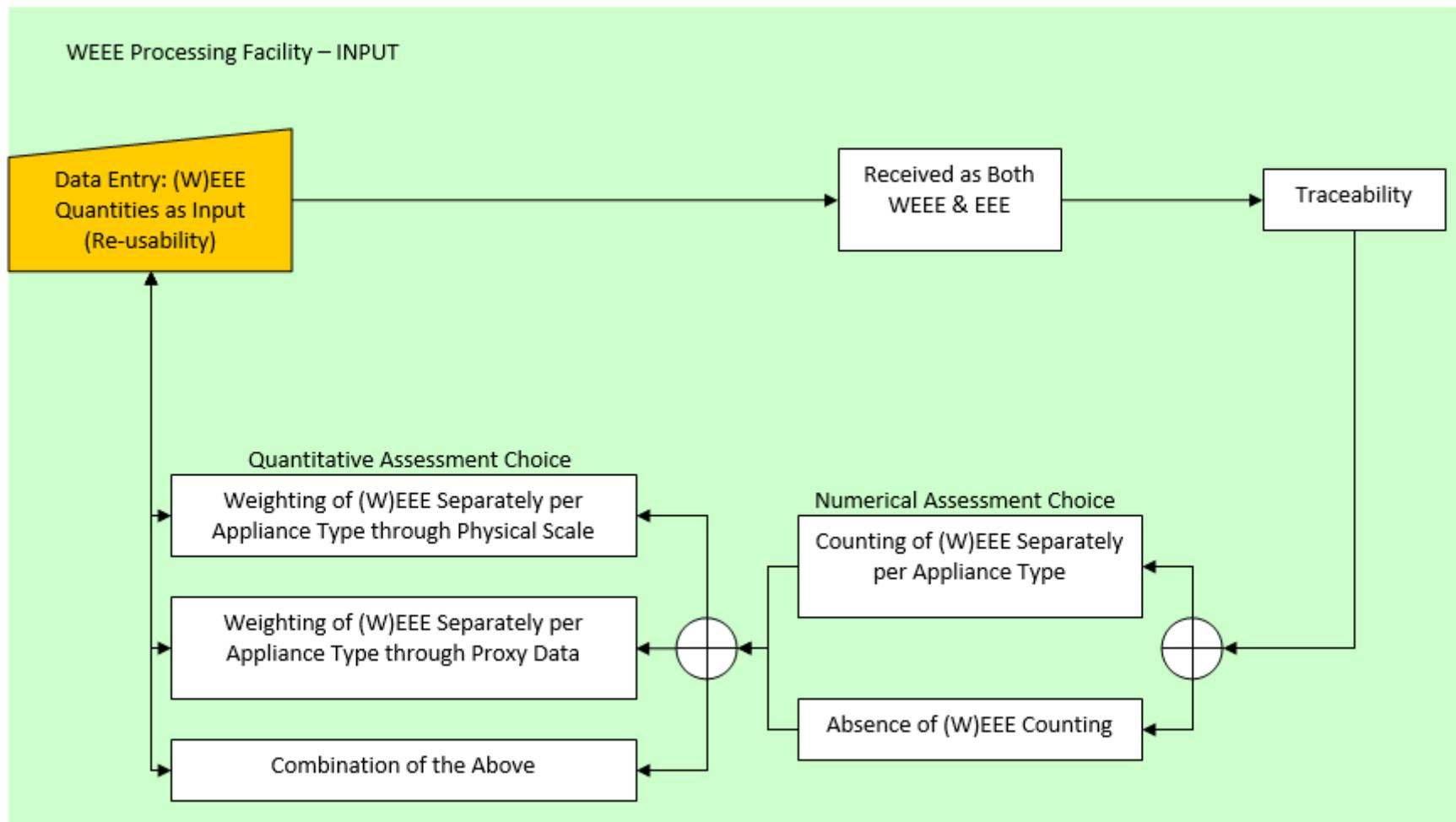
Flow Chart 10: Processing Facilities' Internal Procedures for Quantities Received by Civic Amenity Sites – From Input to Weighting



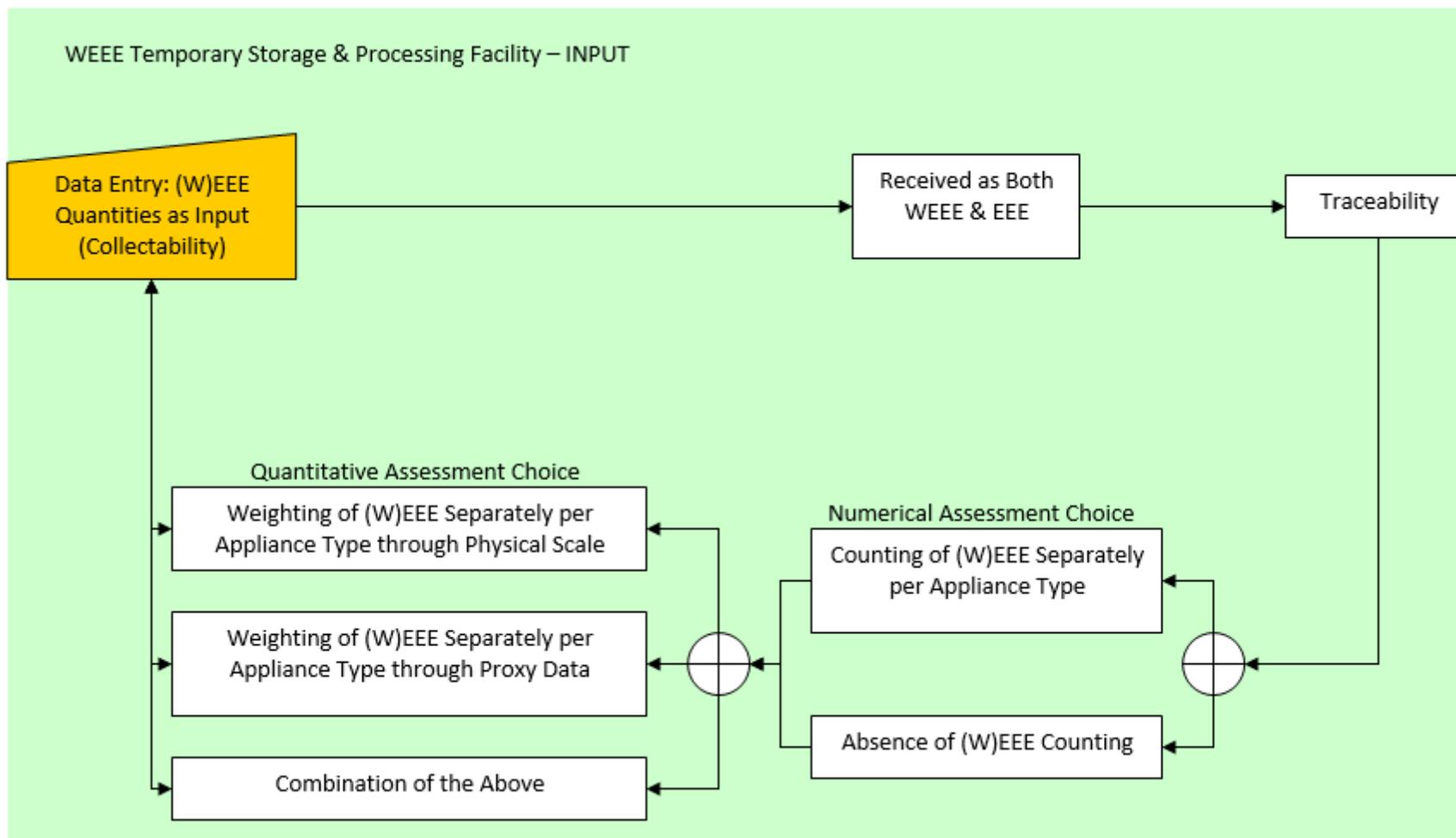
Flow Chart 11: Processing Facilities' Internal Procedures for Quantities Received through Door-To-Door Collection Schemes – From Input to Weighting



Flow Chart 12: Processing Facilities' Internal Procedures for Quantities Received by (W)EEE Collection Points – From Input to Weighting



Flow Chart 13: Processing Facilities' Internal Procedures for Quantities Received through Do-It-Yourself-Delivery Schemes – From Input to Weighting



4. Conclusions

The formation of an integrated methodology has been made taking into account the characteristics existing in different (W)EEE management methodologies used in the EU. These characteristics depend on the applied Delivery – Collection schemes, as well as on the internal procedures which are associated to each step of the (W)EEE managerial chain, from the collection of the discarded (W)EEE items until their placement on the second-hand market as end products. The integration of this methodology consists in the formation of a single methodology that could be implemented by the entities that are involved in the management of (W)EEE towards re-use, namely, re-use centres (as individual re-use centres as well as networks), waste agencies and producer responsibility organisations (PROs). The implementation of the integrated methodology will be incorporated in an electronic tool that will assist the above mentioned entities in selecting one or several of the available managerial routes.

While the development of an integrated methodology implies the formation of a unified approach in managing (W)EEE towards re-use and/or preparation for re-use, this study has come up with the following general conclusions as for the (W)EEE managerial chain:

- It is preferable for the (W)EEE items which are subjected to repair to be traced as for their origination sources. To this end, along with the implementation of D2DC and DIYD collection schemes, WCPs should be favoured since they are able to provide an adequate traceability, as well as an initial separation of the (W)EEE items collected by type. Applied Delivery – Collection schemes which are based on the existence of CASs can provide access to large quantities of (W)EEE but should rely on a strong cooperative relationship between the re-use networks, the local authorities and the national PROs.
- The sorting and identification of (W)EEE prior to their processing may provide a better organisation of the managerial chain in terms of extracting accurate data that could help achieve the targets on recycling and preparation for re-use which are imposed by the European legislation. Furthermore, this procedure will also facilitate the accuracy of proxy weight data helping the estimation of the re-used or prepared for re-use items.
- Concerning the weighting of both (W)EEE and REWEEE, the use of proxy weight data should be favoured as long as the counting system is accurate enough. This will imply that (W)EEE items should be weighted and counted in order to extract records of accurate data.
- The measurement of re-used and prepared for re-use items at national or regional level should be done taking into account the REWEEE items which are re-inserted on the market as second-hand items.

In addition, the integrated methodology inserts measurable units at different stages of the (W)EEE managerial chain for the calculation of rated that can be used to monitor the performance of an already implemented Delivery – Collection scheme as well as the efficiency of a (W)EEE Processing facility. In particular, these points of calculation are capable of measuring rates related to:

- The amount of potentially re-usable (W)EEE as a fraction of the total of (W)EEE collected or, alternatively, as a fraction of the (W)EEE that have been separately collected ($f_{reusability}$).

This rate can be applied at the initial stages of the (W)EEE managerial chain, meaning during the collection and transportation of the (W)EEE items and, in any case, before the processing of (W)EEE towards re-use and/or preparing for re-use.

In the case of a WCP scheme, the amount of potentially re-usable (W)EEE is not the total collected, but the part which is transported from the WCP to the Processing facilities because identified as having a potential to be re-used (the remaining fraction usually goes to recycling).

In the case of a CAS scheme, the potentially re-usable fraction is measured by the re-use operators, but not the non-re-usable part which is generally monitored by the staff of the CAS but not reported to the re-use operators. It makes the validity of this rate depend on the sharing of collection rates data between the entities managing the CASs (in general, the waste agencies and the local authorities) and the re-use centres/re-use networks.

In the case of a D2DC scheme, the potentially re-usable fraction can be identified, but only if the collector does not make any pre-selection of the re-usable items when collecting the (W)EEE items at the discarder's location. If this happens, the identification of the denominator will not be possible. This fraction can be measured by the re-use operator when the (W)EEE items are received in the (W)EEE Processing facility. It is the part which will be identified as having a potential to be re-used, as opposed to the remaining part which will be sent for recycling. The calculation of the rate can be done by the re-use operator itself.

In the case of a DIYD scheme, the potentially re-usable fraction can be identified, but only if the re-use operator does not make any pre-selection of the re-usable items when receiving the (W)EEE items in its (W)EEE Processing facility. If this happens, the discarder has to collect back the non-reusable fraction which remains uncounted, leaving no possibility to know what the denominator could be. This fraction can be measured by the re-use operator when the (W)EEE items are received in the (W)EEE Processing facility. It is the part which will be identified as having a potential to be re-used, as opposed to the remaining part which will be sent for recycling. The calculation of the rate can be done by the re-use operator itself.

The purpose of the re-usability rate is to identify the efficiency of an applied Delivery – Collection scheme in terms of safeguarding the re-usability of the collected items. It also identifies the capacity of an applied Delivery – Collection scheme to attract a higher rate of re-usable items, indicating what system should be prioritized by small structures searching for quality and not quantity.

- The amount of repaired (W)EEE as a fraction of the total of the (W)EEE items which have been identified as being potentially re-usable ($f_{repairability}$).

This rate can be monitored by an individual re-use centre or by the re-use and preparation for re-use facilities of a re-use network. It represents the correlation between the input and the output of the refurbishment procedure. The difference with the re-usability ratio is that, although an item can be identified (and therefore collected) as being potentially re-usable, it might not end up being repairable. The reasons for this are varied and include:

- Lack of spare parts due to the obsolescence of the item.

- Lack of skilled personnel specialised in the reparation of certain types of items.
- Design which prevents the possibility to repair an item.
- Neglect of repair based on the experience that a certain item has no value on the second-hand market.

Taking into account the above mentioned reasons, as well as a future widespread of the (W)EEE re-use concept, this ratio can measure the effectiveness of an individual facility in repairing (W)EEE items, as well as the capacity of the collectors to accurately identify re-usable items. From another point of view, this ratio can monitor the capacity of the collector (and its supplementary entities – WCPs, transporters, etc.) to share data with the (W)EEE Processing facility (when they are not the same entity).

- The amount of marketable REWEEE as a fraction of the total amount of repairable WEEE items ($f_{marketability}$).

This rate reflects the connection between the Processing facilities and the REWEEE Trading Stores as it is related to the output of the Processing facility and the input of the REWEEE Trading Stores. It represents the correlation between (W)EEE items that are potentially repairable by the (W)EEE Processing facilities and those which are considered as marketable by the REWEEE Trading Stores. The reasons why an item although that is repairable, it cannot be considered as marketable, are varied and include:

- Rapid obsolescence of the item due to rapid technological evolution of the respective EEE type and/or classification.
- Lack of second-hand trading stores attracting clients for the types of items repaired and/or impossibility for the REWEEE Trading Stores to absorb products (not enough space for storage).
- Lack of demand from the market for these types of items.

The measurement of this rate can be useful to monitor the capacity of REWEEE Trading Stores to market and store second-hand products. From another point of view, this ratio can monitor the capacity of the collector refurbisher to share data with the REWEEE Trading stores (when they are not the same entity).

Furthermore, this rate is related to the internal operation of the REWEEE Trading Store and represents the difference between what has been repaired and what can actually be sold or donated. The marketability rate can also be considered as the fraction of the amount REWEEE that Trading Stores receive from (W)EEE Processing facilities.

This rate is useful to monitor the eagerness of a market to absorb REWEEE items. In addition, the low value of this ratio can provide new market perspectives to re-use networks as for their orientation towards new markets indevelopping countries as well as the expansion of social solidarity bonds in the form of REWEEE donations to groups at risk of socioeconomic exclusion.

All of the above mentioned ratios can be measured at multiple levels, from a single re-use centre to a network or at national level on the base of (W)EEE collected or of (W)EEE generated.

Considering the measurement of re-use and preparation for re-use at national and EU level, the integrated methodology can be expressed on the base of both (W)EEE collected and generated. It also has to be considered that prepared for re-use WEEE (ReWEEE) and re-used EEE (ReEEE) have to be kept separated if it is manageable by the reporting entities. If ReWEEE and ReEEE are mixed, then everything should be considered as being ReWEEE.

To this end, the mathematical expression for the measurement of (W)EEE re-use and preparation for re-use rates at national level and on the basis of (W)EEE generated is expressed as follows:

$$RPR_{gen} = \frac{[ReWEEE + ReEEE]}{WEEE_{gen}} \cdot 100\%, \text{ where}$$

$Re(W)EEE$ - Annually produced quantities of repaired (W)EEE coming from (W)EEE Processing facilities, that had been placed on the market as second-hand items by ReWEEE Trading Stores, measured in $\frac{tn}{y}$. A 'WEEE Processing facility' is any re-use centre having at least a part of the processed coming from the waste stream. A 'ReWEEE Trading Store' is the physical place of transaction where a ReWEEE item is re-inserted in the economic life-cycle through its placement on the market.

$Re EEE$ - Annually produced quantities of repaired EEE from EEE Processing facilities, that had been placed on the market as second-hand items by ReWEEE Trading Stores, measured in $\frac{tn}{y}$. The repaired fraction is considered to have originated exclusively from EEE (non-waste stream). An 'EEE Processing facility' is a recognised re-use operator dealing exclusively with non-waste. A 'ReWEEE Trading Store' is the physical place of transaction where a ReEEE item is re-inserted in the economic life-cycle through its placement on the market.

$WEEE_{gen}$ - Annually produced (W)EEE quantities at national level, measured in $\frac{tn}{y}$. The formula for the calculation of the total (W)EEE quantities generated in a Member State is described in detail in the Annex II of the Commission Implementing Regulation 2017/699/EU.

Based on the Article 7 of the Directive 2012/19/EU and from 2019, the minimum and combined (re-use, preparation for re-use and recycling) collection rate to be achieved annually on the territory of a Member State can be expressed as follows:

$$(RPR_{gen} + REC_{gen}) \cdot 100\% = 85\%, \text{ where}$$

RPR_{gen} - (W)EEE re-use and preparation for re-use rate, on the basis of (W)EEE generated at national level and

REC_{gen} - (W)EEE recycling rate, on the basis of (W)EEE generated at national level.

In addition, given the fact that in Annex V of the Directive 2012/19/EU the preparation for re-use and recycling targets are combined, a mathematical expression for the measurement of (W)EEE re-use and preparation for re-use rate at national level and on the basis of (W)EEE collected should also be mentioned. To this end, a separate target for the re-use and preparation for re-use of (W)EEE is expressed as follows:

$$RPR_{sepc} = \frac{[Re(W)EEE + Re EEE]}{WEEE_{sepc}} \cdot 100\%, \text{ where}$$

$WEEE_{sepc}$ - Annually separately collected (W)EEE quantities, at national level, measured in $\frac{tn}{y}$ which are considered either as a waste stream (prior to collection), either as a non-waste stream that have been separately collected by any recognised operator of EEE (non-waste stream) having a traceability and reporting system in place.

Based on the Annexes III and V of the Directive 2012/19/EU and from the 15th August 2018, the minimum and combined targets for preparation for re-use and recycling rate to be achieved annually on the territory of a Member State and on the basis of (W)EEE collected, can be expressed as follows:

$$(RPR_{sepc} + REC_{sepc}) \cdot 100\% = 80\%$$

for (W)EEE falling within category 1 (temperature exchange equipment) and 4 (large equipment with any external dimension more than 50cm),

$$(RPR_{sepc} + REC_{sepc}) \cdot 100\% = 70\%$$

for (W)EEE falling within category 2 (screens, monitors and equipment containing screens having a surface greater than 100cm²)

$$(RPR_{sepc} + REC_{sepc}) \cdot 100\% = 55\%$$

for (W)EEE falling within category 5 (Small equipment with no external dimension more than 50 cm) and 6 (Small IT and telecommunication equipment with no external dimension more than 50 cm) and

$$(RPR_{sepc} + REC_{sepc}) \cdot 100\% = 80\%$$

for (W)EEE falling within category 3 (lamps).

where

RPR_{sepc} - (W)EEE re-use and preparation for re-use ratio, on the basis of (W)EEE separately collected at national level and

REC_{sepc} - (W)EEE recycling ratio, on the basis of (W)EEE separately collected at national level.