Deliverable 1.3

Selection of 12 validated case studies

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Credits

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1. Introduction

The aim of the Collectors project is to identify and highlight existing good practices on the collection and sorting of packaging and paper waste (PPW), waste electrical and electronic equipment (WEEE) and construction and demolition waste (CDW). As part of the project, an inventory of 242 waste collection systems operating in different regions in Europe was conducted. The outcome from the inventory is a database that includes information from systems currently in place for collecting PPW, WEEE and CDW from mainly private households and similar sources. Based on the information included in in the database, the project will highlight 12 case studies that act as examples of good practices in different local conditions.

For selecting the case studies, methods of group decision-making were applied. Altogether three multicriteria decision-making (MCDM) exercises were conducted as part of the Regional Working Group (RWG) meeting that took place in Malta, in September 2018. During the RWG meetings, MCDM was applied for collecting feedback and opinions from the members of the RWG and other invited local and European experts in a structured way. RWG members were experts working within public waste management companies and other public organisations across Europe.

The aim of this report is to describe the approach and methods used for identifying a group of potential cases that could be studied during the project. A final case selection will be done by the project group, considering the feedback received from the RWG meetings, availability of data for the case study and interest of the targeted regions to participate in the study. Additionally, selected cases should be located in different countries across Europe, and represent different regional characteristics. Importance and relevance of different regional aspects was one of the topics discussed during the meetings.

2. Methodology for the case study selection

2.1 Multicriteria decision-making

Methods of multicriteria decision-making (MCDM) can be used for breaking down complex problems into manageable components. With the help of MCDM, different dimensions that are important for the decision-making context may be considered and evaluated one at a time. With the help of group decision-making methods, opinions from several decision-makers (possibly having different values and preferences) can be collected and included in the decision.

In general, the MCDM process consists of several steps that include:

- Definition of the overall objective ("Goal") for the decision-making
- Dividing the goal to several lower level objectives that describe different dimensions relevant for reaching the goal
- Defining the criteria that describe the performance of the alternatives in each selected dimension
- Defining the decision alternatives and collecting data on their performance and characteristics
- Creating a matrix that describes the performance of the alternatives on each selected criteria
- The actual decision-making, consisting of criteria weightings by the participating decision-makers and ranking of the decision alternatives.

In this study, the goal of the MCDM was to rank the alternative waste collection systems that were included in the inventory of the waste collection systems (database), and to select 12 good practice case studies based on their performance on selected criteria. Within the project, it is considered that good practices should be identified and evaluated based on their performance on several dimensions that include:

- quality of the collected waste;
- economics;
- environment and
- societal acceptance.

Criteria for describing the characteristics and performance of the waste collection systems on these dimensions were defined at the beginning of the project together with external experts and members of the RWG. All criteria for the three waste streams are described in detail in Collectors deliverable 1.1 Key parameters for waste collection systems defined and validated.[1]

Defined criteria were then used for conducting the inventory and creating a database of the waste collection systems currently operating around Europe. Project partners conducted the data collection for the inventory during summer 2018.

By the time of the Regional Group meeting at Malta, altogether 242 systems were included in the database. For WEEE, the database included 73 systems from 18 different countries. For PPW, 135 systems from 25 countries were included and for CDW, the database comprised of 34 systems from 17 different countries. For the case study phase, five systems for WEEE, five systems for PPW and two systems for CDW need to be selected for further studies. The database is presented in Collectors deliverable 1.2 (Completed inventory database) that will be made accessible via a webportal on the Collectors' website (www.collectors2020.com). A complete list of regions included in the inventory database in September 2018 is provided in Appendix 1 of this report. Please note that updates and changes to the contents of the database during later stages of the project are possible.

It is noteworthy that availability of data and local contacts within the project consortium affected data collection and inclusion of systems from different countries. In addition, there was variation in completeness of the data, as not all systems had information available on all the criteria. In addition, reporting of the data may vary between countries and between regions. Thus, in addition to importance of the criteria, the completeness and comparability of the data had to be considered in the process, acknowledging that there is a need to operate with incomplete datasets and missing data.

Preceding the decision-making workshops, available data in the waste collection system inventory was assessed for coverage and comparability between the entries. Basic statistical analysis for each of the criteria included in the inventory database was conducted prior to the MCDM exercise. These included analysing the maximum and minimum values for each of the criteria, together with the average and median values, standard deviation and 25% and 75% percentiles. Additionally, data coverage (describing the relative number of responses available for each criteria), was considered. This information was used for pre-selecting criteria that would be included in the MCDM exercise. As anticipated, due to data gaps in some of the key performance criteria, the group of criteria had to be narrowed down when compared to the original list of criteria that was included in D1.1. Additionally, methodological approaches had to be selected to address missing performance data also in the final set of criteria.

During the meeting at Malta, one MCDM session for each of the three waste streams was held in order to collect feedback from the RWG members and other participating experts. During the

[1] Weiβenbacher J, Ursanic S, Dollhofer M. (2018) Deliverable 1.1 Specification - and validation - of key parameters for collection systems. Available at: https://www.collectors2020.eu/wp-content/uploads/2018/06/COLLECTORS-WP1-D1.1-Specification-and-validation-of-key-parameters-for-collection-systems.pdf

session, the criteria weights were elicited in expert group discussions using the SWING method. The weights described the importance given for a waste collection system's performance in a certain criterion, such as capture rate.

In the SWING weighting method, the most important criterion is given a value of 100 points. The next most important criterion is given an importance of equal or smaller than 100 points, the third most important criterion an importance equal or smaller than the second criterion etc. This is continued until arriving to the least important criterion that has an importance of equal or higher than zero. To make use of the valuable expertise of the stakeholders gathered at the decision-making workshop, weights were elicited also for relevant criteria unavailable for the actual case selection due to data limitations.

In order to manage with the data gaps in selected performance criteria, an approach was devised where two different but redundant aggregation methods, which translate the criterion performances and weights into a ranking of the alternatives, were simultaneously used. Applied methods were the value based Multi-Attribute Value Theory (MAVT) and the outranking method PROMETHEE. The use of these two aggregation methods was chosen based on their fundamentally different manners to deal with missing data. In the outranking method PROMETHEE, the degree to which one alternative dominates another is defined by assessing how much the performances differ in each criterion. If one of the two alternatives is missing a performance data, the method judges the alternatives equal in respect to that specific criterion. On the contrary, in MAVT the missing performance data must be replaced by either average or minimum values. In the method applied for the case selection by MAVT, all missing criteria performances were replaced by average values from the data available in the inventory. The final ranks of the waste collection alternatives were calculated as an average between the MAVT and PROMETHEE approaches. This way, the impact of missing data could be partly neutralised, as missing data was considered to present neither better nor worse performance compared to other systems with data available.

Finally, the stakeholders' views were incorporated into the definition of the necessary constraints to make sure the proposed cases not only were performing well but also represented a sufficient geographical spread and conditions where waste collection might be especially challenging or interesting. The decision-makers were asked to vote for two of the most important non-performance-related parameters that best define the conditions where the collection system is applied and what challenges it faces. The assumption was to select the five highest-ranking PPW and WEEE cases that include all permutations of these two constraining parameters, measured whether the case is higher or lower than median.

2.2 Results from the expert workshops

Altogether three MCDM sessions, one for each waste stream, were held together with the external stakeholders and project group members to elicit the criteria weights necessary to arrive at a ranking of the waste collection system inventory. The experts who participated in the group decision making were asked to give their preferred weights for a range of performance-oriented criteria, including some that were in previous workshops recognised as important but were lacking sufficient and comparable data for the purpose of the case selection.

Prior to the weighing, all criteria and available data for each of the criterions were presented to the participating decision-makers. Challenges related to possible misinterpretations due to differing or lacking data were discussed during the workshops, and it was considered that some important information and differences between the performances might be ignored due to data constraints. Besides, some variation might be caused by differing interpretation of the criterion by the persons collecting and reporting the data from different countries, similarly to different interpretations made by the participating decision-makers. In addition, there are differences in how data is collected and reported between the different member states, which causes its own challenges for comparison.

During the WEEE and PPW sessions, the discussions were held in two parallel groups and the results from the two groups were merged at the end of the session and shared with the participants. 27 decision-makers participated in the WEEE session, 26 in the PPW session and 20 in the CDW session. The session for CDW was held in one group, due to smaller number of participants.

Results from the WEEE session

For WEEE, a total of nine performance criteria were selected for discussion and weighting during the MCDM session. Selection of the criteria was conducted based on data coverage (percentage of systems in the database including a value for the criteria) and considering the different dimensions that should ideally be included when defining well performing systems (quality of the collected waste, economics, environment and societal acceptance). The performance criteria discussed during the WEEE workshop are presented in Table 1.

Table 1. List of performance criteria with data coverage for the WEEE collection systems.

Performance criteria	Unit	Coverage
1. Total WEEE collected per inhabitant	kg/cap/year	99 %
2. WEEE collection rate (calculated)	%	93 %
3. Share of WEEE in mixed residual waste	%	42 %
4. Number of WEEE categories collected in CAS	No.	84 %
5. Share of WEEE collected in CAS in relation to total WEEE collected	%	58 %

6. Number of inhabitants per 1 non-retail bring point	No.	77 %
7. Number of inhabitants per 1 retail bring point	No.	37 %
8. Number of direct jobs	No.	47 %
9. Existence of customer feedback gathering systems (Yes/no)		34 %

While the importance of all nine criteria listed in table nine was discussed and criteria weighs were elicited, finally only the two most robust parameters, *Total WEEE collected per inhabitant* and *Share of WEEE in mixed residual waste*, were applied for the ranking purposes. The number of criteria included in the final ranking was reduced due to challenges with comparability of the data and possible differences in how to interpret the data. For example, while creation of jobs was in general considered as an important aspect for the regions, it was considered that if the overall goal should be economic efficiency, it could be considered that the number of jobs in the collection phase should be minimised. Consequently, both minimising and maximising the value could be considered as beneficial. Because of this, the criterion was excluded from the weighting phase.

Final results from the exercise (criteria weights for eight of the criteria) are presented in Figure 1. In addition to importance of a criterion, the availability of data for a criterion commonly affected the weight given to a criterion.

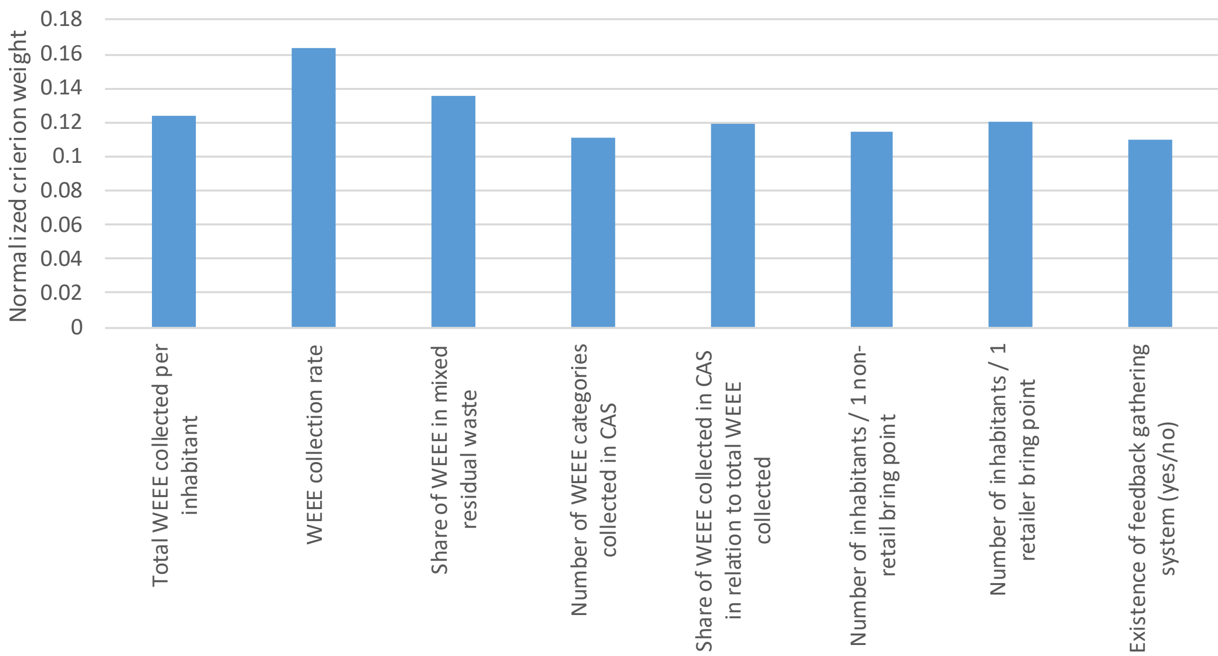

Figure 1: Performance criteria weights for the WEEE collection system selection.

In addition to the performance-related criteria weights, the decision-makers were asked to give their votes for the two most important non-performance-related general parameters that indicate whether a case would be interesting for further studies. The general criteria for the WEEE stream, together with some background information on the criteria, are presented in Table 2. Additionally, the decision-makers were allowed to add their own suggestions for a parameter if preferred.

Table 2. Background information and general criteria for the WEEE collection systems

General criteria	Unit	Min	Max	Coverage
1. Area size	km^2	39	15 400	100 %
2. Area characterization	remote / not remote			
3. Population	No. of inhabitants	31 163	2 876 614	100 %
4. Population density	No. of inhabitants/ km^2	19	7 287	100 %
5. Type of housing - Share of detached and semi-detached houses	%	11.7	92.6	49 %
6. Housing – Total number of households	No.	4 526	1 368 269	95 %
7. Housing – Average number of persons per household	No.	1.85	3.0	96 %
8. GDP per inhabitant	€	2 015	92 800	85 %
9.Estimated WEEE generation per capita	kg/capita/year	0.5	21.9	99 %
10. Estimated WEEE generation	t	43	50 916	100 %

For WEEE collection, the two most interesting general criteria characterising potential regional differences were population density and GDP per inhabitant. (See Figure 2). Consequently, selected cases should include regions with both high and low population density and high and low GDP per inhabitant.

The distribution of the values for the two most interesting criteria (population density and GDP per inhabitant) for the WEEE collection systems available in the inventory is presented in Figure 3. It should be noted that the median value for the GDP per inhabitant in the inventory (26307 eur/capita/year) was somewhat below the EU average.

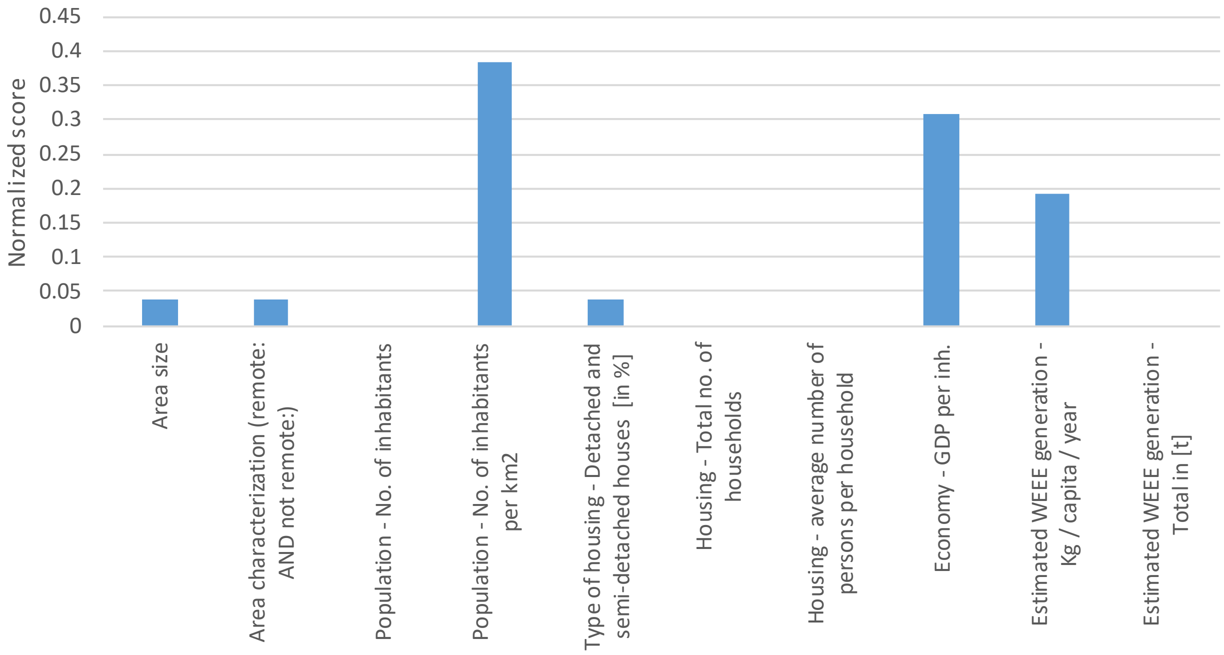

Figure 2: General parameter importance for WEEE collection systems.

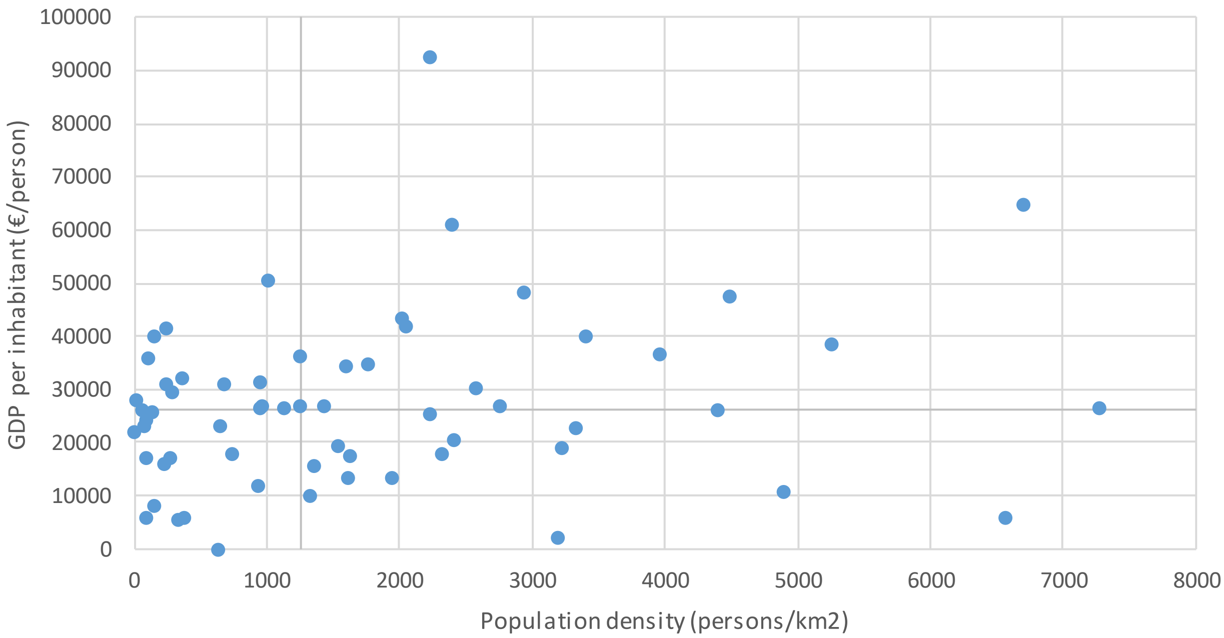

Figure 3: Distribution in the two most defining general parameters for WEEE collection systems. Axes cross at median values. Median value for the GDP per inhabitant in the database was 26307 eur. Median value for the population density was 1252 persons/km^2.

Results from the PPW session

For the PPW session, 11 performance criteria were chosen from the database. Similarly to the WEEE stream, the criteria were selected based on availability of data (data coverage) and with the overall aim of including criteria that would describe the four dimensions (quality of the collected raw materials, economy, environmental and societal acceptance). However, comparable data for all the dimensions was not available. All criteria discussed during the PPW session are presented in Table 3.

From Table 3, it should be noted that the capture rate is calculated from generation and losses to the mixed residual waste, which makes criteria 1-8 partly redundant.

Table 3. List of performance criteria with data coverage for PPW collection systems.

Performance criteria	Unit	Coverage
1. Share of glass in mixed residual waste	%	84 %
2. Share of paper & cardboard in mixed residual waste	%	84 %
3. Share of metal in mixed residual waste	%	77 %
4. Share of plastic in mixed residual waste	%	76 %
5. Capture rate of glass	%	81 %
6. Capture rate of packaging & non-packaging (paper)	%	75 %
7. Capture rate of plastic	%	47 %
8. Capture rate of metal	%	44 %
9. Annual waste fee per capita	€	65 %
10. Number of direct jobs	No.	56 %
11. Existence of feedback gathering system (yes/no)		69 %

Data coverage for the performance criteria varied considerably between different criteria. Lack of data (low coverage in the database) commonly affected the weighting results and importance of the criteria.

The elicitated performance criteria weights for the PPW collection systems are presented in Figure 4. Capture rate of plastic was seen as the most important criterion. In addition, the share of plastic in the mixed residual waste was considered more important than the similar shares for other packaging waste fractions. This was due to, for example, difficulties related to sorting of plastics ending up in mixed residual waste, and emissions occurring from plastics ending up in incineration together with mixed residual waste.

The *Existence of feedback gathering systems* and the least valued *Annual waste fee per capita* were eventually ignored in the ranking due to issues perceived in the data comparability. However, this was not necessarily due to low importance of the criteria, but due to challenges in interpreting and comparing available data, together with the low coverage of responses on those criteria. For example, criterion related to existence of feedback gathering mechanisms and its importance provoked many comments, as those who were used in conducting regular customer feedback surveys considered it extremely important. However, the availability of small number of responses on this criterion, together with most likely differing interpretations of what is meant with feedback gathering, clearly affected the importance of this criterion in this context.

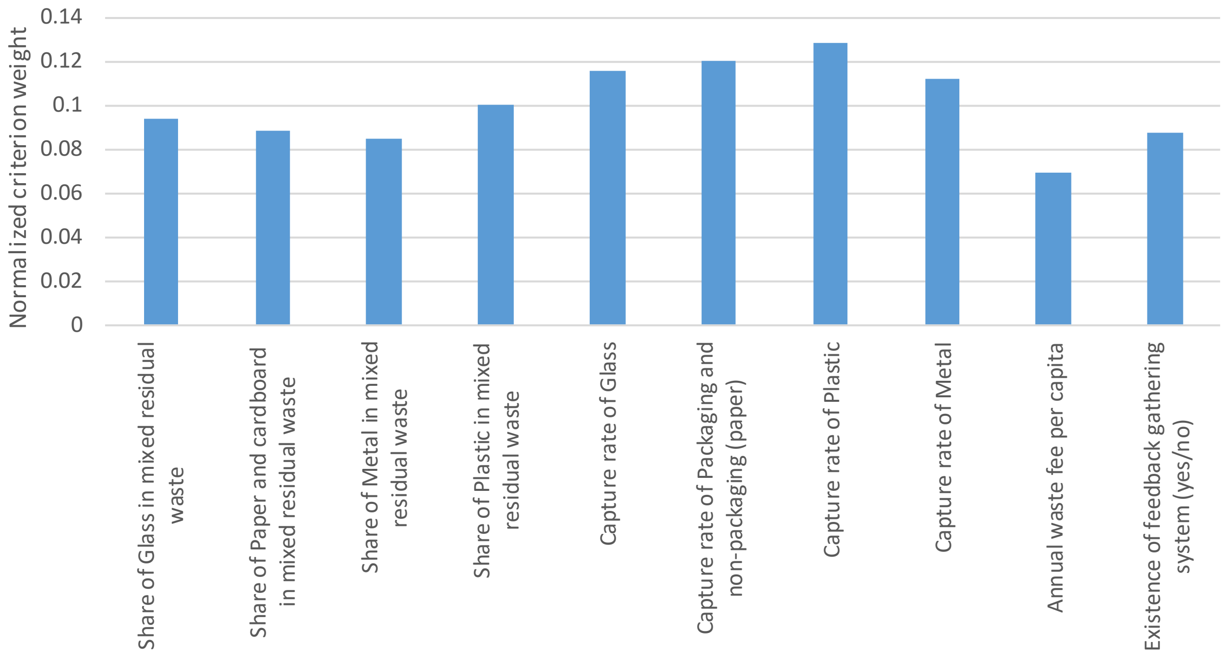

Figure 4: Performance criteria weights for PPW collection system selection.

The non-performance related general criteria discussed for the PPW collection are presented in Table 4. Altogether 10 criteria with rather high data coverage could be included in the discussion.

Table 4. Background information on general criteria for PPW collection systems

General criteria	Unit	Min	Max	Coverage
1. Area size	km^2	9.8	17 000	99 %

2. Area characterization	remote / not remote			
3. Population	No. of inhabitants	926	3 537 100	100 %
4. Population density	No. of inhabitants / km^2	5.04	21 287	99 %
5. Type of housing - Share of detached and semi-detached houses	%	0.87	100	76 %
6. Housing – Total number of households	No.	499	1 964 399	96 %
7. Housing – Average number of persons per household	No.	1.64	3.3	92 %
8. GDP per inhabitant	€	2 015	92 800	96 %
9. Tourism - Overnight stays per inhabitant per year	No./capita/year	0.16	753.8	89 %
10. Total MSW generated	kg/capita/year	194	1 810	99 %

The most important non-performance-related general parameters that should be considered when selecting the case studies for the PPW stream were *Tourism and commuters* (as overnight stays per capita) and *Total MSW generation per capita* (Figure 5). Both higher and lower than median values should be included in the eventual group of five selected cases for PPW collection. However, it was noted that both criteria should be interpreted with care, since independently they do not necessarily describe the aspects very thoroughly. For example, regarding tourism, its impacts for waste creation and waste management may differ depending of the region, and amount of overnight stays describes only one aspect of tourism. Moreover, from waste management point of view, most important might be how the collected waste is utilised. Unfortunately, this data is much more difficult to find.

Regarding Total MSW generation per capita, those figures might be large due to inclusion of CDW as part of MSW, as the statistics may vary between the cases, and thus looking only at one criteria might lead to misleading conclusions. In addition, large amount of tourist visits or secondary houses (such as summer cottages) may affect the figures. Therefore, some futher studies on the available inventory data are necessary before the the final case selection, in order to avoid misinterpretations.

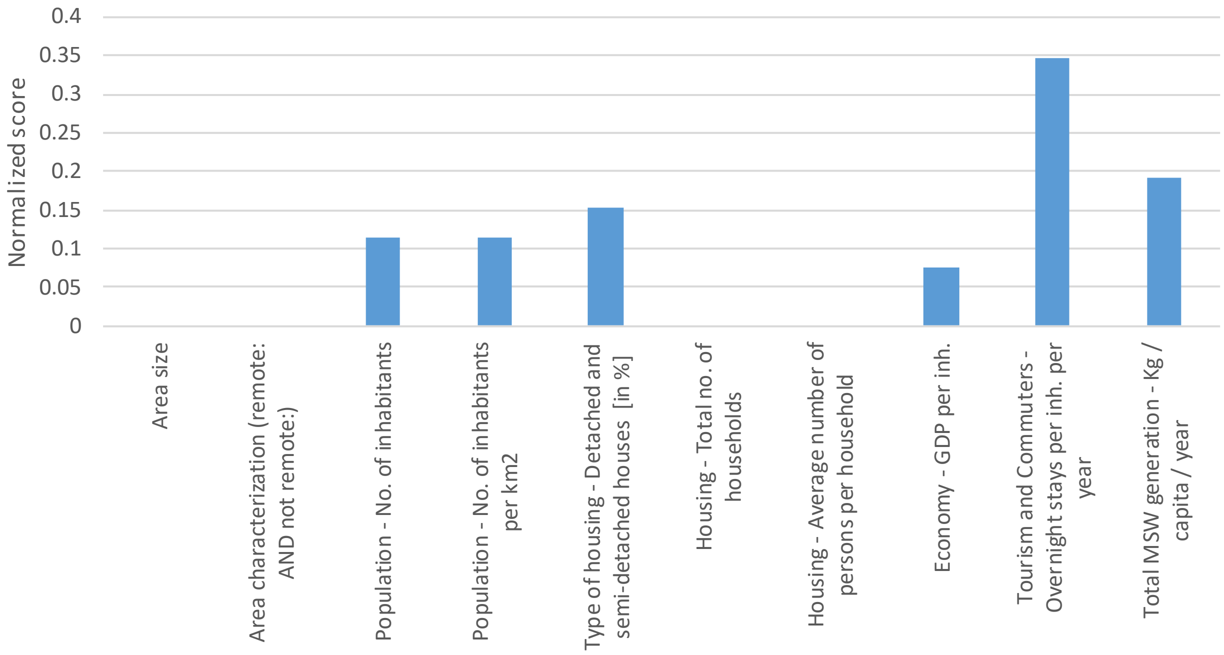

Figure 5: General parameter importance for PPW collection systems.

The distribution of the cases over and under the median values in both tourism and MSW generation is presented in Figure 6. According to Eurostat, the EU average value for total MSW per capita in 2015 was between 477-476 kg. This is rather close to the median value in the database, 466 kg MSW per capita.

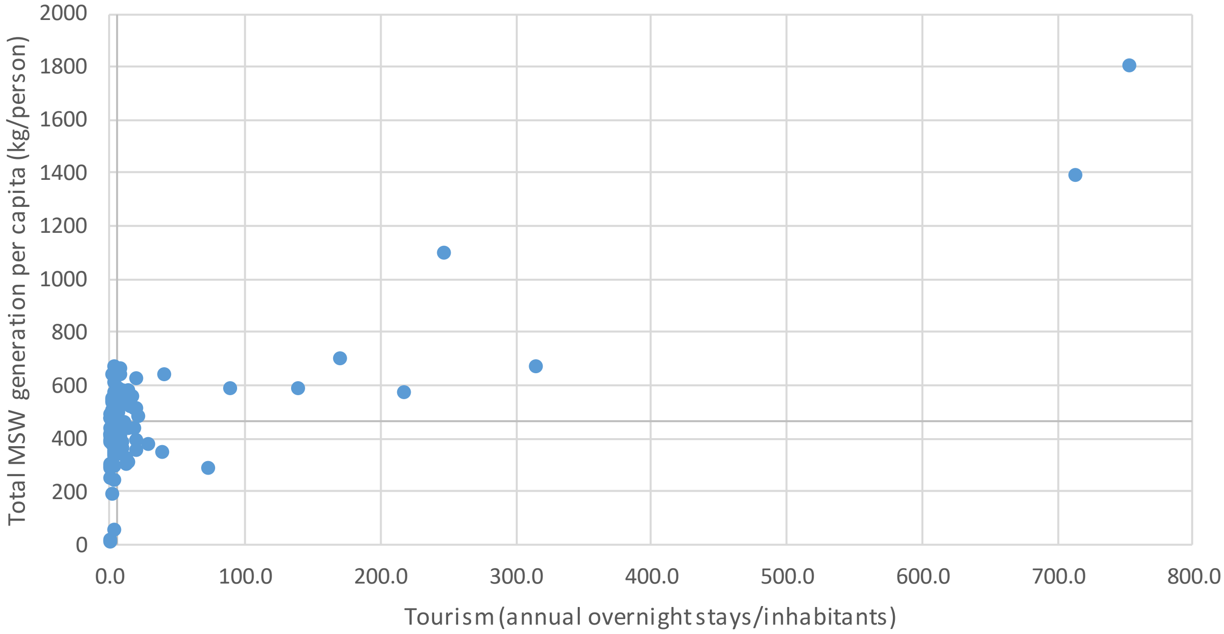

Figure 6: Distribution of values in the two most interesting general parameters for the PPW collection systems. Axes cross at median values. Median for the MSW generation per capita was 466 kg and Median for the number of overnight stays per inhabitant per year was 4.8.

Results from the CDW session

In the CDW stream, the case selection will follow a more qualitative approach due to lower number of cases within the database and lower data coverage compared to the PPW and WEEE streams. Only three performance related criteria could be included in the MCDM session for CDW. These criteria are presented in Table 5.

Table 5. List of performance criteria with data coverage for CDW collection systems.

Performance criteria	Unit	Coverage
1. Share of CDW in mixed residual waste	%	47 %
2. Number of inhabitants per CAS	No.	97 %
3. Existence of feedback gathering mechanisms (yes/no)		44 %

In addition to the criteria included in the database, the experts had a chance to suggest any other criteria that they considered important either for ranking of the systems or for characterising the two case studies that should be selected for further research. Criteria weights for all the discussed and proposed criteria are presented in Figure 7.

For the CDW case selection, the decision-makers considered the *Number of inhabitants per one civic amenity site (CAS)* as the most important performance criterion for the CDW case selection. Other important criteria included Availability of door-to-door collection and Annual waste fee paid by citizens for CDW. However, due to limited data and comparability issues, the only criteria included in the ranking of the CDW collection systems were *Number of inhabitants per CAS*, *Share of CDW in mixed residual waste* and *Existence of feedback gathering mechanisms*.

While the number of inhabitants per CAS is a useful indicator for considering accessibility of citizens to the waste collection (with rather good data coverage within the inventory), it does not take into account the area size or population density. Thus also the rankings according to this criterion need to be interpreted carefully, and taking into account local characteristics.

In general, the opinions of the decision-makers varied a lot regarding the CDW, and it was considered for example, that it would interesting to learn from good practices related to pricing of CDW, handling of hazardous waste and organisation of potential pickup service. Thus, it is likely that a combination of other potentially interesting aspects, together with availability of good quality data, need to be considered when selecting the two case studies for the CDW stream.

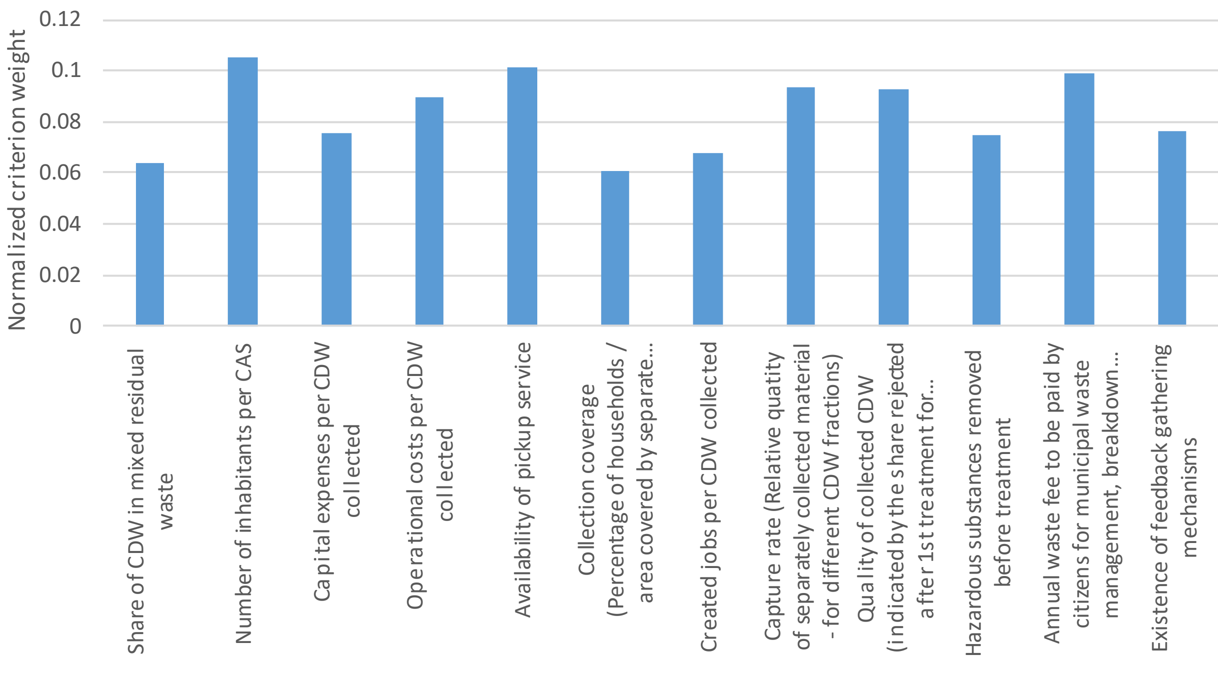

Figure 7: Performance criteria weights for CDW collection system selection, including criteria with incomparable or non-existent data.

Table 6. Background information on general criteria for CDW collection systems

General criteria	Unit	Min	Max	Coverage
1. Area size	km^2	44	5045	100 %
2. Area characterization	remote/not remote	-	-	-
3. Population	No. of inhabitants	7521	3 182 981	100 %
4. Population density	No. of inhabitants/ km^2	63	15 984	97 %
5. Type of housing - Share of detached and semi-detached houses	%	0.87	83	79 %
6. Housing – Total number of households	No.	3 336	1 262 282	97 %
7. GDP per inhabitant	€	5736	92 800	97 %

Regarding the collection of CDW, the decision-makers voted the *GDP per inhabitant* as the most important non-performance-related parameter (Figure 8). On the other hand, it was noted that GDP as a single indicator might not reflect what is important and interesting from construction point of view, and thus for example growth rate of GDP or population growth might be more informative or useful in this context. The second most important criterion was the *Type of housing*, as large share of detached and semi-detached housing was considered important for potential waste flows originating from households and similar sources.

The distribution of the GDP per inhabitant values in the inventory of CDW collection systems is presented in Figure 9. Within the EU, the average GDP per inhabitant is 32 600 eur. For the CDW systems, the average value for the regions included in the database was 31 693 eur/capita. However, the median value was somewhat lower (26 044 eur/capita).

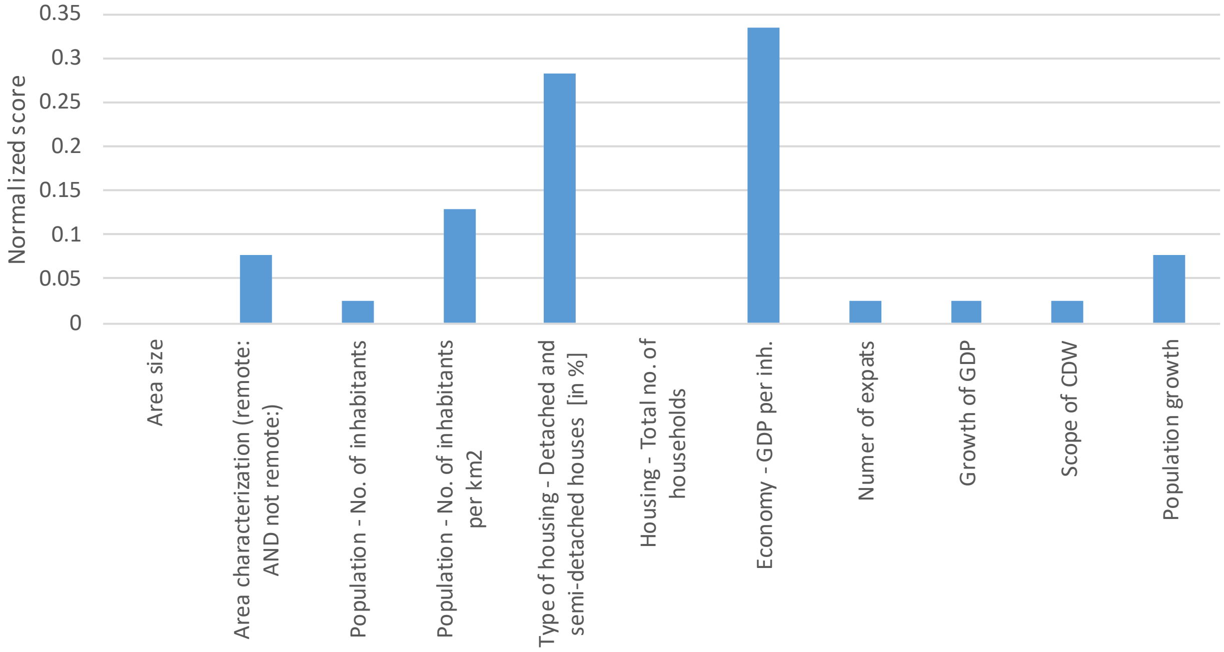

Figure 8: General parameter importance for CDW collection systems, including proposed parameters with non-existent data.

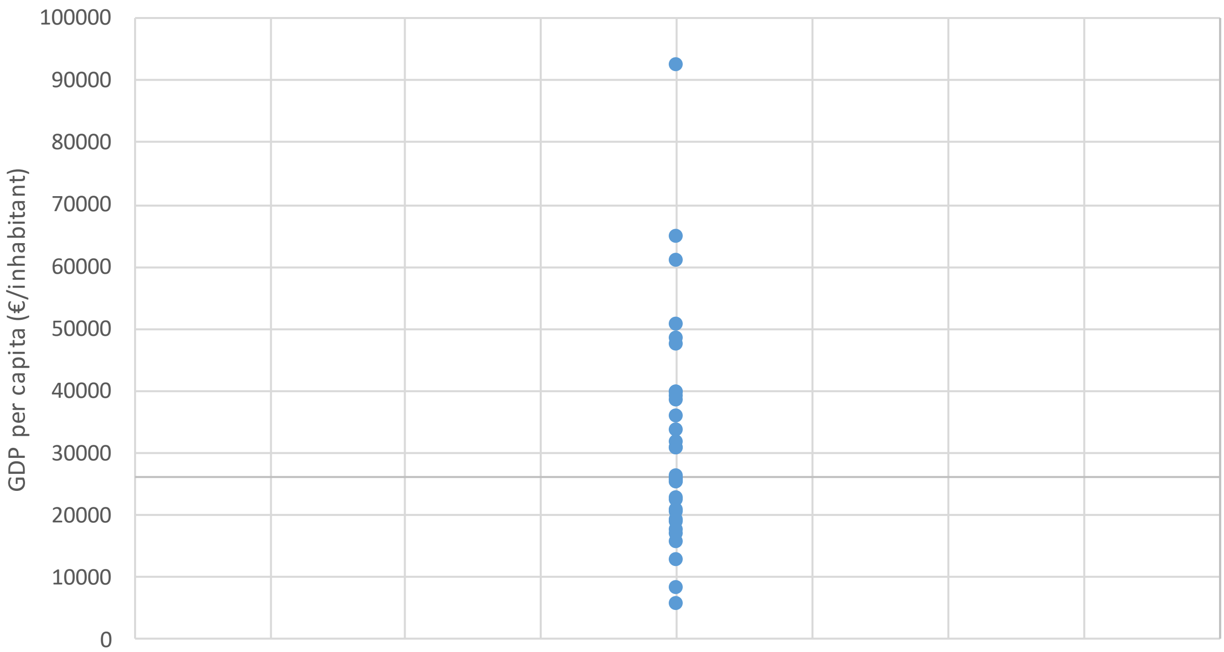

Figure 9: Distribution in the most defining general parameter for CDW collection systems. Median value = 26 044 eur/capita.

3. Conclusions and discussion

The discussions held during the MCDM sessions provided valuable feedback for the project, and clearly highlighted the challenges in comparing systems operating in different local conditions. However, the discussions also highlighted that there is interest and need for sharing information of different systems and how they are operating, even though they could not be directly compared. Additionally, the results from the MCDM indicated that the importance of a criterion might be dependent of a local context but also of the context in which the decision-maker is working (regional authority or producer responsibility organisation). Use of MCDM allowed merging their opinions, and considering the importance of different criterion one at a time.

While only a very brief overview of the discussions is presented in this report, analysis of the gathered feedback will continue in the context of the case studies in work packages 2 and 3, and recommendations to be produced as part of work packages 3 and 4 (forthcoming Collectors deliverables 3.4 and 4.3). Thus a more detailed analysis of the results will take place during the remaining phases of the project.

In this first phase of the project, the input collected from the regional working group was used for ranking the waste collection systems included in the inventory, with the aim of selecting interesting case studies that would represent good practices in different regional contexts. MCDM methods were applied for organising the systems according to criteria considered interesting and important by the participating stakeholders. Proposed case studies with several potential backup cases are listed in the following chapter.

3.1 Proposed cases

Results from the ranking of the waste collection systems based on the criteria weighing are presented in the following tables. In the context of MCDM, it is important to remember that it is an interactive process, and as such the results are dependent of the context (such as discussions held during the session). With different participants, data or background assumptions, the results might be different. Thus the results have to be interpreted in relation to the goal of the process, but also in relation to the context in which they were created, and available data.

The final case selection will take into account the availability of data for the case studies, interest and possibility of the regions to participate in the study, and the balanced distribution of the case studies between different European countries. As it is expected that not all regions have a possibility to participate, several backup cases have been considered.

As a conclusion from the MCDM analysis and based on the data available in the inventory of the waste collections systems, five highest-ranking cases for both WEEE and PPW collection, and two cases for CDW collection were proposed, assuming the following constraints:

1. Only one collection system per country allowed.
2. All permutations of higher-than- and lower-than median values in the two most important general parameters are represented. Regarding CDW, higher-than- and lower-than-median values in the most important general parameter are represented.
3. Number of occurrences of missing data must be same or lower than median.

Further expected data availability and willingness of the region to participate and provide information for the case studies affect the final selection of the case studies. To facilitate the process, two backup cases were identified for each proposed case, taking note that the procedure does not guarantee fulfilling the constraint of only one case allowed per country. This needs to be considered when making the final selection for each waste stream.

By the time of the MCDM excercises, the data availalable in the database included some uncertainties and inconsistencies. This was mostly due to mistakes (typos and misunderstandings) in filling in the data, but also some inconsistencies in the original data sources. Since a large amount of people contributed to the data collection using various information sources, occurring of human errors could not totally be avoided. However, the data will be double-checked when proceding with the case selection. In addition, all regions will be provided a chance to check and compelement their own data, before the publication of the database.

Proposed case studies together with potential back up cases are presented in tables 7, 8 and 9.

Table 7: Proposed cases for WEEE collection. All municipalities collect above 4 kg/WEEE per inhabitant (EU min target for WEEE collection per inhabitant by 2015).

City (Country)	Justification	1st backup case	2nd backup case	Remarks
Lille (FR)	High population density, high GDP per inhabitant.	Aosta (IT)	Strasbourg (FR)	
Helsinki (FI)	Low population density, high GDP per inhabitant.	Clermont (FR)	Nice (FR)	
Siauliau (LT)	High population density, low GDP per inhabitant.	Kaunas (LT)	Klaipeida City (LT)	All have possible uncertainties & lack of data.
Pembrokeshire (UK)	Low population density, low GDP per inhabitant.	Corato (IT)	Maribor (SL)	
Bologna (IT)	Ranking	Pula (CR)	Luxembourg (LUX)	Lajes das Flores (PT) a potential island.

Table 8: Proposed cases for PPW collection.

City (Country)	Justification	1st backup case	2nd backup case	Remarks
Parma (IT)	Low tourism, high MSW generation per inhabitant.	Liège (BE)	Werkendam (NL)	
Gent (BE)	Low tourism, low MSW generation per inhabitant.	Wuustwezel (BE)	Sittard Geelen (NL)	
Innsbruck (AU)	High tourism, high MSW generation per inhabitant.	IVOO (BE)	Salzburg (AU)	

Tubbergen (NL)	High tourism, low MSW generation per inhabitant.	Brussels (BE)	Doesburg (NL)	
Stuttgart (DE)	Ranking	Stockholm (SE)	Maribor (SL)	Krakow (PL) is another suggested backup case from Eastern Europe.

Table 9: Proposed cases for CDW collection.

City (Country)	Justification	1st backup case	2nd backup case	Remarks
Cakovec (HR)	Low GDP per inhabitant.	Oosterhout (NL)		Oosterhout is one of the few systems in the database with mobile collection availability for CDW
Allgaeu (DE)	High GDP per inhabitant.	Vienna (AU)		Vienna has 60% share of detached and semi-detaced houses.

For CDW, the cases with highest rankings are the ones with smallest number of people per CAS (Cakovec (HR) & Allgaeu (DE), as that was considered as the most importan criterion among the criteria with decent data coverage. However, this indicator does not take into account the size of the area nor population density, and thus is unfavourable towards big cities with high population density. This is an aspect that needs to be considered in the final case selection.

Appendix 1. Cities and regions included in the inventory of the waste collection systems

In September 2018, the inventory database included information of altogether 242 waste collection systems. In the proposal stage 250+ systems were identified, however not for all WCS sufficient data was available. The partners organized an additional telco with partners and stakeholders to determine additional data sources or alternative WCS. Implementation of this mitigation measure resulted in a total of 242 WCS with good data availability that were selected and added to the webportal.

For the WEEE stream, the database included 73 systems from 18 different countries. For PPW, 135 systems from 25 countries were included and for CDW, the database comprised of 34 systems from 17 different countries. Data for a city or a region may include also neighbouring areas or municipalities, depending on how waste collection is organised and how the data has been reported and collected.

PPW collection systems (Total 135)

City/Region	Country	City	Country
Innsbruck City	AT	Delf	NL
Brugge	BE	Deventer	NL
GENT	BE	Doesburg	NL
IOK	BE	Groningen	NL
IVOO	BE	Hengelo	NL
Intradel (Liège)	BE	Land van Cuijk en Boekel	NL
Linkeroever, District of Antwerp	BE	Landgraaf	NL
Wuustwezel	BE	Leek	NL
Burgas Municipality	BG	Lochem	NL
Mezdra Municipality	BG	Maastricht	NL
Plovdiv Municipality	BG	Nijkerk	NL
Sofia Municipality	BG	Oost Gelre	NL
Nicosia	CY	Putten	NL
Prague	CZ	Rhenen	NL
Allgaeu (Oberallgäu, Lindau, Kempten)	DE	Schiermonnikoog	NL
City of Aschaffenburg	DE	Sittard-Geleen	NL
Berlin	DE	Terschelling	NL

Traunstein, administrative district	DE	Tubbergen	NL
District Wittmund	DE	Utrecht	NL
City of Barcelona	ES	Vlieland	NL
Leon	ES	Werkendam	NL
Mancomunidad de Pamplona	ES	Winterswijk	NL
Sevilla	ES	Zuidhorn	NL
Helsinki Capital region	FI	Krakow	PL
Oulu region	FI	Warsaw	PL
Beauvais	FR	Malmö	SE
Bordeaux	FR	Stockholm	SE
Brest	FR	Celje	SI
Clermont-Ferrand	FR	Koper	SI
Dijon	FR	Maribor	SI
Guadeloupe	FR	Velenje	SI
Lyon	FR	Bratislava	SK
Marseille	FR	Aberdeen	UK
Montpellier	FR	Dundee	UK
Nantes	FR	Edinburgh	UK
Nice	FR	Falkirk	UK
Orléans	FR	Glasgow	UK
Paris	FR	Perth and Kinross	UK
Pau	FR	Cardiff	UK
Rennes	FR	City of Ljubljana	SI
La Réunion, Territoire de la Côte Ouest	FR	Logroño	ES
Rouen	FR	Madrid	ES
Toulouse	FR	Copenhagen	DK
Koprivnica	HR	Stuttgart, city	DE
Island Krk	HR	Rastatt, administrative district	DE
City of Čakovec	HR	Split	HR
Nine (9) local level units from the region Međimurje*	HR	Athens	EL
Rab	HR	Pallars Sobirà	ES
Zagreb	HR	Maia	PT
Rijeka	HR	Osijek	HR
Budapest	HU	Oldenburg, administrative district	DE
Veszprem	HU	Salzburg City	AT
PPW Bologna	IT	Mannheim	DE
Genova	IT	Munich	DE
Bolzano	IT	Bochnia (Malopolska region)	PL
Cagliari	IT	Wroclaw	PL
Castelrotto	IT	Brussels	BE
Contarina (group of municipalities in Treviso Province)	IT	Ajaccio	FR
AMSA (Milano)	IT	Magdeburg	DE
Parma	IT	Darmstadt	DE

Roma	IT	Lille	FR
Kaunas city municipality	LT	Schladming	AT
Šiauliai city	LT	Steyr, city	AT
Vilnius municipality	LT	Vienna, capital	AT
City of Luxembourg	LU	Hamburg	DE
Malta	MT	Strasbourg	FR
Amsterdam	NL	Granada	ES
Beesel	NL		

*including: town Prelog and municipalities: Kotoriba, Donja Dubrava, Donji Vidovec, Sveta Marija, Goričan, Donji Kraljevec, Belica, Dekanovec

WEEE collection systems (Total 73)

City	Country	City	Country
Burgas Municipality	BG	Klaipeda City	LT
Maritsa Municipality	BG	Šiauliai city	LT
Plovdiv Municipality	BG	Vilnius municipality	LT
Ruse Municipality	BG	City of Luxembourg	LU
Sofia Municipality	BG	Krakow	PL
Stara Zagora Municipality	BG	Warsaw	PL
Cyprus	CY	Maribor	SI
Allgäu (Oberallgäu, Lindau, Kempten)	DE	Belfast City	UK
Traunstein, administrative district	DE	Cardiff	UK
Leon	ES	Liverpool City Council	UK
Sevilla	ES	Pembrokeshire	UK
Helsinki Capital region	FI	Swansea	UK
Oulu region	FI	Ljubljana	SI
Brest	FR	Madrid	ES
Clermont Auvergne Metropole	FR	La Rioja	ES
Grenoble-Alpes Metropole	FR	Copenhagen	DK
Ca Havrais (Codah)	FR	Pula	HR
Metropole Europeenne De Lille	FR	Bonn	DE
grand Lyon Metropole	FR	Pallars Sobirà	ES
Nantes Metropole	FR	Usurbil	ES
Nice Cote D'azur	FR	Viladecans	ES
Paris	FR	Aosta	IT
Eurometropole De Strasbourg	FR	Corato	IT
Zadar	HR	Pantelleria	IT
Zagreb	HR	Lajes das Flores	PT
Budapest	HU	Maia	PT
Cork County Council	IE	Esporles	ES
Donegal County Council	IE	Capannori	IT
Wexford County Council	IE	Stadt Köln	DE

Wicklow County Council	IE	Split	HR
Bolzano WEEE	IT	Osijek	HR
CONTARINA (Treviso)	IT	WEEE Bologna	IT
AMIU (Genova)	IT	Aschaffenburg	DE
AMSA Spa (Milano)	IT	Berlin	DE
ASM - Ambiente Salute Mobilità (Rieti)	IT	Vienna, capital	AT
AMA S.p,a. (Roma)	IT	Hamburg	DE
Kaunas city municipality	LT		

CDW collection systems (Total 34)

City	Country	City	Country
Wuustwezel	BE	Budapest	HU
Plovdiv Municipality	BG	Genova	IT
Allgaeu (Oberallgäu, Lindau, Kempten)	DE	Contarina (group of municipalities in Treviso Province)	IT
La Rioja	ES	Vilnius municipality	LT
City of Madrid	ES	City of Luxembourg	LU
Barcelona	ES	Nederweert	NL
Intercommunale voor de Ontwikkeling van de Kempen (IOK)	BE	Oosterhout	NL
Helsinki Capital region	FI	Reimerswaal	NL
Clermont-Ferrand	FR	Krakow	PL
Dijon	FR	City of Ljubljana	SI
Lyon	FR	Copenhagen	DK
Rennes	FR	Vienna, capital	AT
Nantes	FR	Hamburg	DE
Orléans	FR	Palma	ES
Čakovec	HR	Pantelleria	IT
Zagreb	HR	Maia	PT
Rijeka	HR	Warsaw	PL

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