Deliverable 2.1
Methodology report

TASK 2.1 IDENTIFICATION OF MAIN BOUNDARY
CONDITIONS FOR BETTER-PERFORMING WASTE
COLLECTION SYSTEMS

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Credits

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1. Introduction

About 500 kilogrammes of municipal waste per capita are generated every year in the EU. These wastes contain large volumes of valuable materials for Europe's industrial base. Proper collection of waste is a pre-condition for their optimal recovery. The current trend of increasing higher collection rates is promising, but progress is uneven between Members States and between regions.

Good regional practices have the potential to serve as good practice examples for other regions. So far, however, results of existing studies and good practices have not been effective enough in supporting the implementation of better-performing systems elsewhere. The main objective of the COLLECTORS project is to overcome this situation and to support decision-makers in shifting to better-performing collection system.

COLLECTORS will therefore:

1.   Increase awareness of the collection potential by compiling, harmonising and presenting information on systems for Packaging and Packaging Waste (PPW), Waste Electrical and Electronic Equipment (WEEE) and Construction & Demolition Waste (CDW) via an online information platform.

2.   Improve decision-making on waste collection by the assessment of twelve good practices on their performance on:

     (1) quality of collected waste;

     (2) economics;

     (3) environment;

     (4) societal acceptance.

3.   Stimulate successful implementation by capacity-building and policy support methods that will increase the technical and operational expertise of decision-makers on waste collection.

4.   Engage citizens, decision-makers and other stakeholders throughout the project for validation of project results and to ensure the usability of COLLECTORS-output.

The COLLECTORS project covers the following waste groups/streams:

- **Packaging and Paper waste from private households (and similar sources):**
  - Paper & cardboard (both packaging and non-packaging);
  - Plastic packaging;
  - Metal packaging;
  - Glass packaging;
- **Waste Electrical and Electronic Equipment from private households and similar sources;**
- **Construction and demolition waste with a focus on wastes that are managed by public authorities.**

2. Goal and scope of WP2

Work Package 2 (WP2): Boundary conditions and solutions for implementation of waste collection systems

In Work Package 2 (WP2, Boundary conditions and solutions for implementation of waste collection systems) we will focus on the role of the waste collection system within the waste recycling value chain, helping to turn waste into a resource. So, we define **boundary conditions** as the specific assets of a waste collection system that enable the recycling value chain to produce more value, by producing more (quantitative) and/or better (qualitative) secondary materials.

Waste collection systems do not operate in isolation but are part of a social and economic reality. This means that optimal collection of waste requires seamless integration into the existing social situation as well as into the broader value chain.
In other words, the willingness of citizens to cooperate with the implemented system is essential and the collected waste needs to be useful for other value chain partners; especially, it needs to have sufficient quality. Therefore, focus for WP2 will be on role of the waste collection system within the waste recycling value chain (see Figure 1), rather than on the waste collection system itself.
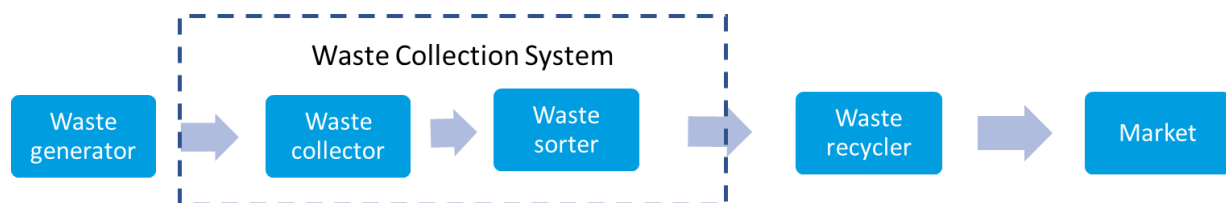

Figure 1: Waste Collection System within the waste recycling value chain

Furthermore, the introduction of the Circular Economy concept by the EU provided the framework to shift from sustainable waste management, being diverting waste from disposal over recovery to recycling ('waste push'), to sustainable resource management promoting the production of resources for which there is a market ('market pull') (see Figure 2). Where the waste push is mainly promoting to shift large quantities of waste from disposal and incineration to low level or low value recycling, the market pull is trying to promote to produce high value secondary materials from waste.
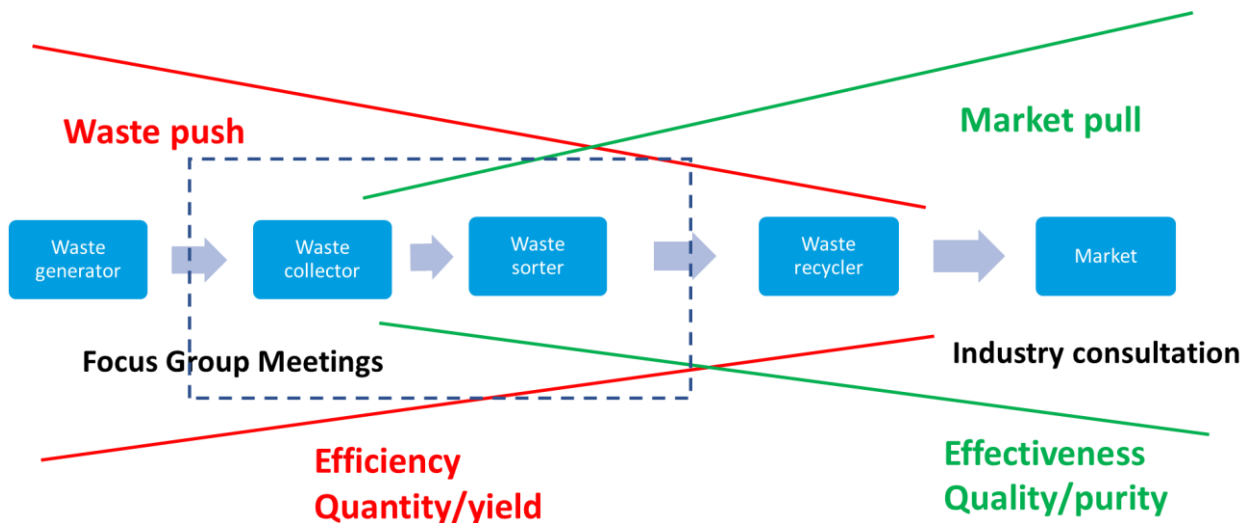
Figure 2: Circular Economy concept shifts recycling from waste push to market pull

> The objectives of WP2 are to identify the main boundary conditions for implementation of effective waste collection systems specifically from the perspective of recyclers on the one hand and from the perspective of citizens on the other hand, and then to gain insight into successful solutions and key elements for implementation.

In Task 2.1 (T2.1) we will identify the boundary conditions for effective recycling of secondary materials at a generic European level. These boundary conditions are the specific assets of a waste collection system that enable the recycler to produce better quality, resulting in more value.

In Task 2.2 (T2.2) and Task 2.3 (T2.3) we will evaluate to which extent these boundary conditions have been met for specific waste collection systems (being the selection of 12 case studies), including listing specific solutions as applied in the case studies and potential solutions to improve the effectiveness of the waste collection system.
This will be done both from a technical and systemic point of view (in Task 2.2) and from a societal point of view (in Task 2.3).

The scope for Task 2.1 are the waste streams under investigation, being:
- Packaging and Paper waste from private households (and similar sources):
    - Paper & cardboard (both packaging and non-packaging);
    - Plastic packaging;
    - Metal packaging;
    - Glass packaging;
- Waste Electrical and Electronic Equipment from private households and similar sources;
- Construction and demolition waste with a focus on wastes that are managed by public authorities.

For Tasks 2.2 and 2.3 the scope is the selection of case studies as good practices for waste collection of these waste streams.

The remainder of the report describes the approach we will use to do these analyses.

3. APPROACH

3.1.Introduction

The identification of the boundary conditions for waste collection systems to enhance effective recycling will be done on a generic level, being the EU level, for the waste streams within the scope of the study in Task 2.1.

After that, for the 12 case studies, selected as good practices of waste collection, will be evaluated to what extent and how these boundary conditions are met.
This evaluation will be done from 2 perspectives:

(1) from a circular economy perspective: to what extent does the output of a waste collection system effectively meet the quality requirements for input for recyclers, and how can it be enhanced (Task 2.2);
(2) from a societal acceptance perspective: to what extent do waste collection systems effectively fit with citizens' behavior and opinions on waste recycling (Task 2.3).

3.2.Generic analysis of boundary conditions (T2.1)

The identification of the boundary conditions will be done from 2 perspectives, being:

1. The circular economy perspective;
2. The societal perspective.

For the circular economy perspective (see also Figure 3), we will look at the waste recycling chain starting from the end applications for secondary materials and ask ourselves how the waste collection system could contribute more or better to meet the market for secondary materials.
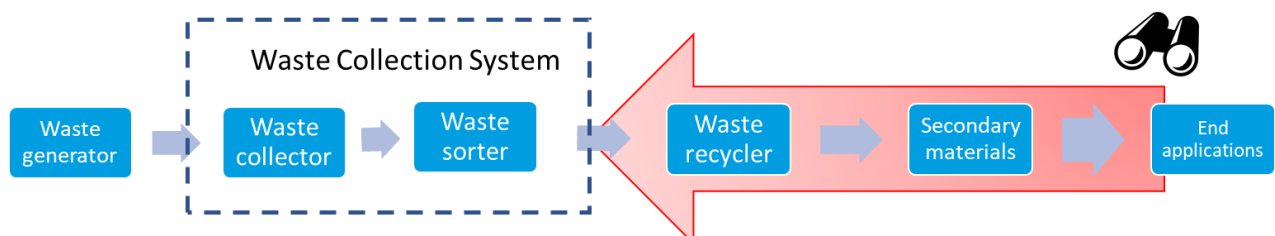

Figure 3: Illustration of the Circular Economy perspective

For the societal perspective (see also Figure 4), we will look at the waste recycling system starting from the perception of citizens as waste producers and check how and to what extent waste collection systems could provide a better service for citizens, where the service is not only

considered as an efficient way to get rid of waste but also as the starting point to contribute to a sustainable society by recycling waste and therefore calling on the societal responsibility of citizens.
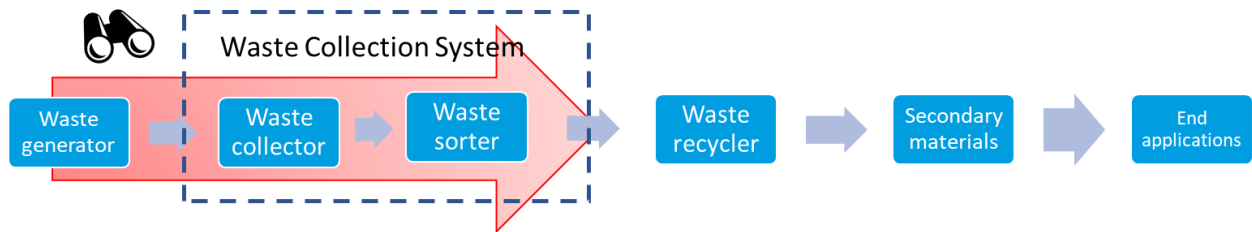

Figure 4: Illustration of the societal perspective

The approach for the identification of the generic boundary conditions will depend on the respective perspective, and is described in the next paragraphs.

3.2.1.   Circular Economy perspective

To identify the boundary conditions from the circular economy perspective, we will follow a 3-step approach for the generic analysis:
1. Outputs of the WCSs;
2. Overview of potential end applications for the outputs;
3. Identification of boundary conditions.

The inventory of the outputs of the WCSs will allow us to delineate which are the most relevant output streams from waste collection going to recycling. Based on this inventory, a qualitative overview will be made of potential end applications where these outputs generally end up in, providing insights how the waste entering the recycling value chain finally contributes (or can contribute) to a circular economy.

Finally, this allows in first instance to identify the boundary conditions to be fulfilled for secondary materials to end up in actual end applications and additionally to select to which of these conditions a WCS can contribute.
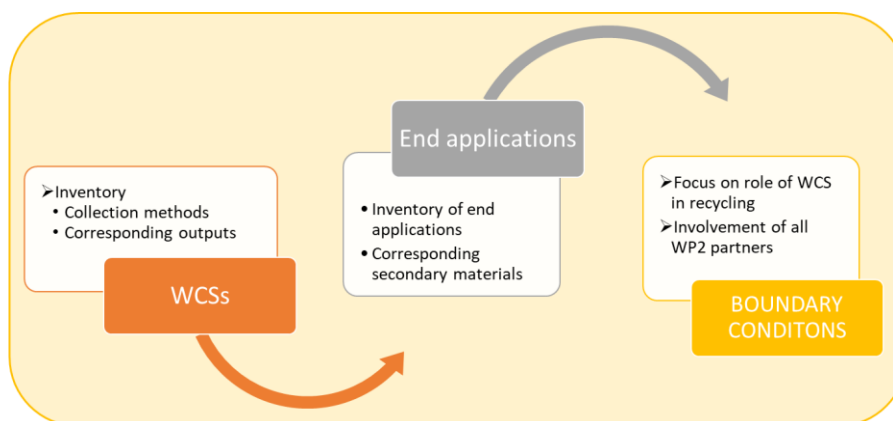

Figure 5: WP2 approach

a) Step 1: Outputs of the waste collection systems

What comes out of the waste collection systems?

In this first preparatory step, we will make an overview of all the collection methods as in the WP1 database, providing an overview per waste stream of how frequent different collection methods (door-to-door, bring points, CAS, …) appear in the database, as well as their corresponding outputs.

This overview will provide insights in the relevance of specific collection methods per waste stream, both for single collection and co-mingled collection, and the corresponding outputs, as illustrated in Table 1.

The (only) data source for making this overview will be the WP1 database.

Focus on →	Paper waste		
	single collection		
DtD	45		
Bringpoints	25		
CAS	85		
…	xx		
	co-mingled collection		
	number	other waste	output
DtD	12	plastics	Paper+plastics
	4	metal + plastics	…
Bringpoints	0		
CAS	0		
…	yy		

Table 1: Illustration of the outcome (fictitious example)

b) Step 2: Overview of end applications

Where does the output of the waste collection systems finally ends up?

Based on the inventory of outputs of waste collection systems from Step 1, a list will be made up of all (final) end applications these outputs could end up in, based on current recycling practices in Europe. These end applications are the final products that are put on the market.

We will make this overview based on information available in literature (reports, publications).

This analysis will focus on qualitative information only, and not include information on the actual recycling processes nor on the respective quantities.

The result of this analysis will be a list, per waste stream, of current end applications, consisting completely or partly of secondary materials made from the outputs as from Step 1, as illustrated in Figure 6 for plastic packaging waste.
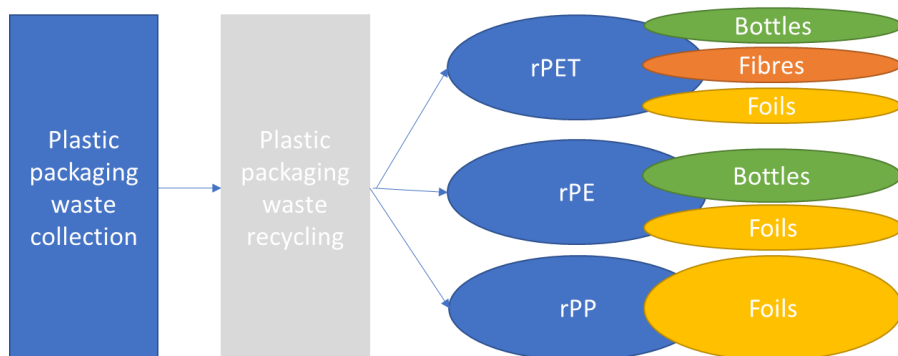
Figure 6: Illustration of end applications for plastic packaging waste (fictitious)

c) Step 3: Identification of boundary conditions

What is the role of the waste collection system with respect to the determination of the end application?

Based on our knowledge and expertise with respect to drivers and barriers for recycling, we will identify the main boundary conditions for a waste collection system as part of the recycling value chain.

In first instance, we will list the boundary conditions that make that collected waste gets recycled into an end application on the level of the total recycling value chain (see Table 2).

Secondly, from this first list we will select the conditions that can be impacted by the waste collection system (how can a WCS contribute to this condition?) (see Table 3).

So, we end up with a list of requirements related to the waste collection system that enable (or hinder) the recycling value chain to produce more value, by producing more (quantitative) or better (qualitative) secondary materials.

Making this list of boundary conditions will be done by organising 2 internal workshops with researchers with specific expertise in waste management in general and in recycling specifically.

Boundary conditions from recycling	Boundary conditions related to WCS
Quality: technical requirements (physical, chemical, …)	Quality: technical requirements (physical, chemical, …)
(Local) market demand	/
Capacity	/
…	…

Table 2: Boundary conditions for recycling   Table 3: Boundary conditions for WCS

3.2.2. Societal perspective

The generic analysis of the societal perspective of waste collection systems intends to identify the main boundaries for waste collection systems and the societal requirements that they need to meet in order for them to fully develop and to succeed. This part of task 2.1 will analyse citizens' perspectives and attitudes towards separate collection of waste and waste in general, as well as specific approaches to the waste streams under the scope of this project.

The societal analysis of boundaries to separate collection in this task has as point of departure the theory of planned behavior (TPB, Ajzen 1985), by which we assume that citizens behavior with regard to handling waste in a desired way is evidence for their acceptance of the system. This TPB proposes that intention is the key driver for behavior. Knussen and Yule (2008) have more specifically researched people's behavior with regard to household waste and found that past behavior and the habit (not) to separate waste is a strong predictor for their future behavior. Cialdini et al. (1990) posits that an important driver for behavior is what other members of the same social group do. Obviously other factors like coercive force (e.g. legal pressure) and financial incentives may influence people's behavior. In general, we understand that both internal (intention, habit) and external factors (group behavior, coercive pressure, financial incentives) determine the actual behavior with regard to waste collection systems.

To some extent, specific aspects of a country, region or city – such as cultural behavior, history or political context – might influence citizen participation in separate collection. The analysis of those factors as potentially relevant to the report will be undertaken through the reading of academic literature. If outcomes of those researches appear to be insufficient or not relevant enough to actually affect participation in separate collection, they will not be taken into account. On the other hand, if they are proven to be relevant, they will be included into the report. Hence focus groups will be organized so as to reflect those factors.

The generic analysis of the boundary conditions will identify the assets of the waste collection system that anticipate on the behaviour and opinion of citizens on waste collection, with special attention for the waste streams in the scope of the project.
For that, we will follow a two-step approach so as to complete the analysis:
1. Identification of factors impacting citizens' behavior and attitude towards waste and separate collection;
2. Study of the interrelation of these factors and the level of sufficiency and necessity.

a) Step 1: Identifaction of factors impacting citizens' behavior

What makes citizens participate in separate collection? What determines their attitude towards waste?

In this first step, we will gather and analyse information on citizens' opinions and attitudes so as to identify the assets that impact on their participation on separate collection. This will be done through two main ways, on the one hand we will organize a focus group with citizens on generic boundary conditions of waste collection systems that will take place in M4. On the other hand, we will analyse surveys on citizens' attitudes towards waste and main concerns around collection, including Eurobarometers and waste stream-specific surveys from PROs, particularly for paper and packaging waste and for WEEE. Other potential sources of information are national surveys, as well as satisfaction analysis surveys from waste management companies.

b) Step 2: Study of the interrelation of factors

How do these factors affect citizens?

The second step of this task aims at understanding how these factors impacting citizens' behavior interact among each other and to what extent they are necessary or sufficient to drive virtuous behaviors. This analysis will be mostly undertaken through a review of existing academic literature, with the aim of further understanding the interrelation between these assets.

The output will be a synthesis report with a list of generic boundary conditions (see Table 4) along with a short description of the way they interact with each other.

Boundary conditions from societal perspective
Sorting message has to be easy
Minimal nuisance/inconveniences
Economic incentives
…

Table 4: Illustration of generic boundary conditions from societal perspective

3.3. Assessment of solutions in the case studies for tackling systemic and technical boundary conditions (T2.2)

The purpose of Task 2.2 is to make the generic analysis of boundary conditions specific as in the selection of the 12 case studies.

This will be done by checking the actual solutions implemented in the waste collection systems in the case studies to meet or take into account the boundary conditions, based on the output of Task 2.1 (collection outputs, end applications, boundary conditions; see Figure 7).

Collection outputs		End applications		Boundary conditions related to WCS
mixed glass		building applications		Quality requirements
colored glass		glass cullets for container glass		/
mixed plastic packaging		bottles from rPET		/
paper and plastic		fibres from rPET		...
...		...		

Figure 7: Elements from Task 2.1

For each of the case studies, we will list how and to what extent the generic boundary conditions have been met in the specific case study, for example by linking and comparing the quality characteristics of the collection output with the quality requirements of secondary materials (see Figure 8).

Collection outputs	Quality characteristics		Quality Requirements	End applications
mixed glass	3% stony materials ...	Case City A	mechanical strength ...	building applications
colored glass	...		max. 2% stony materials ...	glass cullets for container glass
mixed plastic packaging			xxx	bottles from rPET
paper and plastic			...	fibres from rPET
...				...

Figure 8: Illustration of case study analysis

The output of this task will be an overview per case of implemented solutions at the level of waste collection systems to contribute to the circular economy.

This information will be used in WP4 to help to develop guidelines for succesfull implementation of efficient and effective waste collection solutions and providing input for future policy development.

3.4.Assessment of solutions in the case studies for societal acceptance (T2.3)

The purpose of Task 2.3 is to test the generic societal boundaries regarding waste collection against the 12 case studies selected, with the aim of checking the solutions having been implemented in the waste collection systems of the case studies. This task assumes that the 12 case studies have been selected, among other reasons, based on high performance, hence participation of citizens, and, therefore, this task intends to check how the 12 case studies managed to meet or take into account the boundary conditions.

Based on the synthesis report of T2.1 (and the corresponding boundary conditions) and the selection of the 12 cases, we will gain insight into solutions and challenges from a societal perspective. This will be done through the organisation of 3 Focus Group Meetings[1] that will serve to test and capture the solutions applied to engage citizens to source separate their waste, along with a general analysis of the public consultation processes having taken place in the 12 case studies.

The involvement of citizens will be organized in consultation with the members of the Regional Working Group (subtask 5.2.2). Focus group research will follow the method and procedures of www.voicesforinnovation.eu, which is suitable for unpredictable outcomes. The method provides the opportunity to gain in-depth insight into ideas, values, wishes and concerns of participants and stimulates shared creative thinking. A specific characteristic of the focus group method is that it seeks understanding of a research topic from a particular perspective.

Generally, the Focus Group meeting will have the following structure:
- Introduction of the subject by the facilitators
- Explanation of the rules of the focus group meeting
  - Use of the outcome in the report(s)
  - Different roles of people present
  - The desired way to discuss the issues
  - No right or wrong answers, rather a free-flowing discussion is what we look for
  - Recording and privacy details
- Actual discussion
  - Opening questions
  - Transition questions
  - Core questions
  - Closing questions
  - Deepening questions throughout the meeting
- Thanking participants and closing of the meeting

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[1] The first Focus Group Meeting already was organised along with the meeting of Regional Working Group in Treviso (IT) in the beginning of 2018.

The specific approach of the 2 Focus Group Meetings to be organized will be decided upon after the selection of the 12 case studies. Then we will decide whether to focus on a specific waste stream, a specific waste collection system or a specific group of citizens.

For each Focus Group Meeting we will compose an interview guide to guide the process for smooth practical execution. In addition to contributing to other WP, the Focus Group Meetings will have one main outcome in the form of minutes (deliverable D2.3) that will serve as written evidence of societal concerns and perceptions on different waste collection systems.

4. Planning & Resources

4.1. Planning

The planning of WP2 activities and deliverables:

- D2.1 Methodology report (M9, August 2018)
- D2.2 Report on boundary conditions (M13, December 2018)
- D2.3 Minutes of three focus group meetings (M20, July 2019)
- D2.4 Report on solutions tackling systemic and technical boundary conditions (M20, July 2019)
- D2.5 Report on implemented solutions and key elements in selected cases for societal acceptance (M20, July 2019)
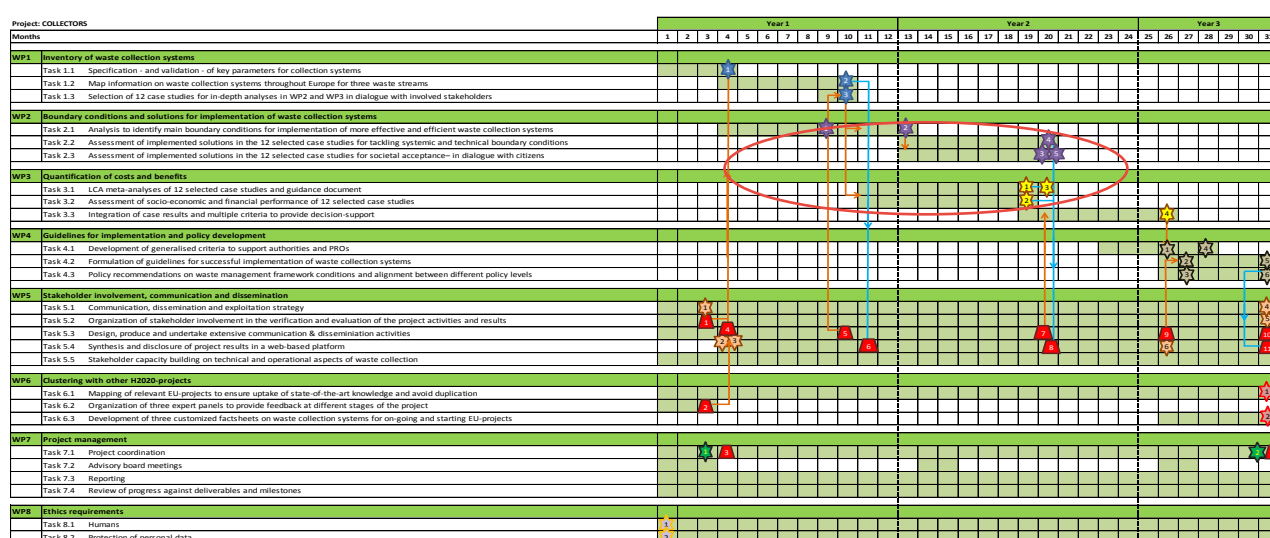
4.2. Resources

The contribution of partners in WP2 as foreseen in the proposal is summarized below:

PM	Total	PNO	BIPRO	VTT	VITO	LDE	ACR+	ZWE	WF	EUR
Total	24	1	2	0	9	4	2	5	1	0
T2.1	12,5	1	2	0	(4,5)	(1)	(1)	(2,5)	(0,5)	0
T2.2	6	0	0	0	(4,5)	0	(1)	0	(0,5)	0
T2.3	5,5	0	0	0	0	(3)	0	(2,5)	0	0

We invite all partners to contribute to the specific tasks in proportion to their foreseen contribution, for example on reviewing (draft) deliverables, contributing to specific information

requests, or providing support in the access to literature, surveys and other documents reporting citizens' opinions.

5. References

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- A focus theory of normative conduct: Recycling the concept of norms to reduce littering in public places. Journal of Personality and Social Psychology, 58(6), 1015-1026. Cialdini, R. B., Reno, R. R., & Kallgren, C. A., 1990.