WaysTUP!

VALUE CHAINS FOR DISRUPTIVE TRANSFORMATION OF URBAN BIOWASTE INTO BIOBASED PRODUCTS IN THE CITY CONTEXT

D4.2: Toolkit: intervention for change

WP4 – A behavioural change approach for the collection of urban biowaste and usage of biowaste derived products with citizens & communities

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Lexicon

Concept	Definition	Source
Bioeconomy	Production of renewable biological resources and the conversion of these resources and waste streams into value added products, such as food, feed, bio-based products and bioenergy	European Commission (2012)
Biowaste	Biodegradable garden and park waste, food and kitchen waste from households, restaurants, caterers and retail premises and comparable waste from food processing plants.	European Parliament (2008)
Broker	Any undertaking arranging the recovery or disposal of waste on behalf of others, including such brokers who do not take physical possession of the waste.	European Parliament (2008)
Circular Economy	A circular economy describes an economic system that is based on business models which replace the 'end-of-life' concept with reducing, alternatively reusing, recycling and recovering materials in production/distribution and consumption processes, thus operating at the micro level (products, companies, consumers), meso level (eco-industrial parks) and macro level (city, region, nation and beyond), and aiming to accomplish sustainable development, which implies ensuring environmental quality, economic prosperity and social equity, to the benefit of current and future generations.	Kirchherr et al. (2018)
Collection	The gathering of waste, including the preliminary sorting and preliminary storage of waste for the purposes of transport to a waste treatment facility.	European Parliament (2008)
Dealer	Any undertaking which acts in the role of principal to purchase and subsequently sell waste, including such dealers who do not take physical possession of the waste.	European Parliament (2008)
Waste	Any substance or object which the holder discards or intends or is required to discard.	European Parliament (2008)
Waste management	The collection, transport, recovery and disposal of waste, including the supervision of such operations and the after-care of disposal sites, and including actions taken as a dealer or broker.	European Parliament (2008)

Executive summary

This is the second deliverable of the Work Package 4 that focuses on defining, designing and implementing a behavioural change approach for the collection of urban biowaste and usage of bio-based derived products with citizens and communities. This deliverable focuses on **developing the behavioural change toolkit** that will be implemented in the behavioural change intervention of the three pilot cities: Athens (Pilot 5), Barcelona (Pilot 6) and Valencia (Pilot 1).

To do so, **Chapter 1 starts with a review of the behavioural change interventions** that have already been implemented and that specifically target selective biowaste sorting. Each intervention is described and their results are reported. So far, the interventions have mainly focused on nudges, incentives, information provision and persuasive communication.

Chapter 2 describes in more detail the Social Marketing approach to behavioural change, and how the approach has been implemented so far to encourage pro-environmental behaviours and selective biowaste sorting more specifically. The eight components of the Social Marketing approach are then detailed, namely: (1) behaviour; (2) theory; (3) consumer orientation; (4) insights; (5) exchange; (6) competition; (7) segmentation; and (8) methods mix.

Chapter 3 then applies the eight components of the Social Marketing approach to the WaysTUP! framework. Each component is developed specifically for selective biowaste sorting in the context of the pilot cities of WaysTUP!. After descriptions are provided for the 'behaviour' component in section 3.1 and the 'theory' component in section 3.2, section 3.4 'consumer orientation' details the methodology that was followed in order to cover the rest of the components, while the analysis can be found in Annexes 2 and 3. The main results are discussed in section 3.4 insights, 3.5 exchange, 3.6 competition, 3.7 segmentation and 3.8 methods mix.

Chapter 4 finally details the behavioural change toolkit based on the idea of an information-based campaign. The main tools, developed based on the knowledge acquired in Chapter 3, are: environmental restructuring through stickers and posters, persuasion through social media posts; behavioural modelling through video-clips; incentivisation through badges; and enablement through provision of bags and bins. Finally, the organisation and agenda of "Join the loop" events are discussed.

Introduction

This deliverable is the second report of Work Package 4 "A behavioural change approach for the collection of urban biowaste and usage of biowaste derived products with citizens and communities". In this framework, a behavioural change campaign is designed and executed in close collaboration with the pilots (pilots 1, 5 and 6 – WP3), to achieve the following objectives:

- Objective 1: to improve the current **perception** of citizens and local communities on urban biowaste as a local resource – target goal: improved perception > 80%
- Objective 2: to enhance the **active participation** of citizens in the **separate collection** of urban biowaste – target goal: enhanced participation > 60%
- Objective 3: to improve **customer acceptance** of **urban biowaste derived products**, including food and feed ingredients – target goal: improved customer acceptance > 75%

To understand the dynamics of these behaviours, a close collaboration is set up with the following pilot partners:

Table 1: Participating pilots in the behaviour change study

	Pilot 1 VALENCIA	**Pilot 5 ATHENS**	**Pilot 6 BARCELONA**
Pilot coordinator	SAV	NTUA	IMECAL
Processing partners	SAV	NTUA, TUC, DRAXIS	IMECAL
Community coordinator for WP4	VAL	HSPN and SUST	AMB

The three pilots are involved in the behavioural change intervention through the Modular Behavioural Analysis Approach (**MBAA**). The MBAA entails several steps: from the initial scoping of the study, and the design of the behavioural change intervention to the eventual analysis of the behavioural change results. This model was specifically developed by IMEC and builds upon the principles of community-based social marketing. More information about the MBAA can be found in D4.1 "Scope of the behavioural change campaign".

It is to be noted that Pilot 6 (Barcelona) was confronted to a change in its waste stream of Pilot. Indeed, the COVID-related restrictions have forbidden the collection of diapers from nurseries and elderly care homes. Following this change in the waste stream, the target audience for the behaviour change track had to be modified, and AMB had foreseen to involve the citizens of Barcelona as a mitigation track. However, in a near future (end of May 2021), a door-to-door biowaste collection scheme and an associated awareness raising campaign targeting citizens are planned to be implemented by the Barcelona City Council. Therefore, it was decided to modify the engagement of AMB in the behaviour change intervention, aiming to find synergy with the Barcelona City Council rather than to launch a track parallel to theirs. More information can be found in the amendment and in the technical report for Period I. This change and its impacts will also be addressed in D4.3 and D4.4.

This deliverable reports the **results of Phase II of the MBAA**, which sets the scope of the behavioural change intervention in the three pilots. The end-goal of this report is to provide the three pilot cities with a **behavioural change toolkit.**

Phase II: Understanding behaviour

The second step of the MBAA is devoted to better grasp the targeted behaviour and what it encompasses. Determinants of the behaviour, whether personal, social, environmental or contextual, are highlighted. To deepen the understanding of the target audiences, research is set up to discuss the current knowledge, beliefs, attitudes and practices. In this stage, contacts are taken with the target audience to explore the following variables through empirical inquiry:

- **Perceived barriers**: reasons why the target groups did not perform yet the desired behaviour, might not do it in the future, or don't think they can
- **Desired benefits:** reasons why the target groups would like to perform the desired behaviour, this could be tangible or intangible desired benefits
- **Potential motivators**: reasons why the target groups would increase the likelihood of adopting the desired behaviour
- **Competing behaviours**: other behaviours which the target groups are preferring instead, other behaviours which are routines, or other behaviours that are opposed to the desired behaviour

This document therefore details the **intervention toolkit for behavioural change.** It was decided to focus the scope of the toolkit on selective biowaste sorting specifically (objective 2). This decision was taken based on several elements: first, while selective biowaste sorting is already in place in most of the areas of the pilots cities, the availability of bio-based products are on the other hand very limited, as highlighted during the experts' interview conducted in T4.1 and reported in D4.1, Chapter 4. Due to its relative unavailability in the pilot city, the investigation several of the determinants reported from the literature review, such as past behaviour; product's features; subjective norm and perceived behavioural control, appear irrelevant as the population has yet to come in contact with the biobased derived products such as developed within WaysTUP!. Second, other determinants of the acceptance of biobased derived product appear to overlap with the determinant of selective biowaste sorting, such as specific knowledge on the industry (i.e. bioeconomy). Further, the toolkit aim to take a comprehensive approach in regard to biowaste and the circular economy, highlighting the importance of the sorting step within the "loop" and describing the transformation of biowaste into biobased products as a main motivation for the behaviour.

Therefore, the toolkit, through its **comprehensive approach and emphasis on the "loop" of the circular economy** (e.g. through the "*Join the loop*" tagline), will also aim to impact citizens and local communities' perception of urban biowaste as a resource (objective 1) and improve customer's acceptance of bio-based derived product (objective 3). The documents is structured as follows:

- In **Chapter 1**, existing intervention targeting selective biowaste sorting that have been implemented through an experimental set-up are reviewed. Their methodology is described and the results are discussed.
- In **Chapter 2**, the Social Marketing approach is introduced and its application in waste sorting is detailed.
- In **Chapter 3**, the eight components of the Social Marketing approach are reviewed according to the investigated behaviour. First, the investigated behaviour is specified, together with its particularities. Second, theories and models of behaviour change are reviewed. Third, the elements of the consumer orientation and their methodology are

detailed, namely the literature review, the experts interviews (both undertaken in D4.1), the community assessment survey and the co-creation workshops. Their results are then detailed in the four, filth, sixth and seventh components: insights, exchange, competition and segmentation. Finally, the methods mix approach for the behaviour is detailed.

- In **Chapter 4**, the intervention toolkit for behavioural change is described, based on the knowledge acquired during the previous sections of the report.
- Finally, **Chapter 5** provides a concluding summary of the work.

1. Interventions targeting selective biowaste sorting: a literature review

Behaviour change has been widely studied and there exist a vast array of behavioural change interventions. Mainly, interventions have four basic approaches to try and change behaviours: (1) making a desired behaviour easier to do; (2) making a competing behaviour harder to do; (3) trying to get a user to want to perform a desired behaviour; and (4) trying to decrease a user's inclination to perform a competing behaviour (Niedderer et al., 2014). In these approaches, interventions can target different individual components, such as explained by Michie et al. (2011) in their COM-B model. The authors indicate that behaviours are influenced by three components: capability, opportunity and motivation. **Capability** refers to the psychological and physical capacity to engage with the behaviour; **opportunity** refers to the external factors (physical and social) that make the behaviour possible; **motivation** refers to the brain processes (reflective and automatic) that direct the behaviour. Michie et al. (2011) further made use of the COM-B model to classify behavioural change interventions that they came across through their systematic literature review. They identified nine intervention functions and analysed on which of the COM-B components each had an effect on (see Table 2). For example, "education" interventions have an effect on the psychological capability and on the reflective motivation but not on the physical capability nor on the automatic motivation (and have zero effect on the opportunity whether it is physical or social).

Table 2: Interventions classification according to Michie et al. (2011), examples are our own.

Intervention	Definition	Effect on	Example
Education	Increasing knowledge or understanding	Psychological capability Reflective motivation	Provision of information through a leaflet
Persuasion	Using communication to induce positive or negative feelings or stimulate action	Reflective motivation Automatic motivation	Imagery and visual prompt
Incentivisation	Creating an expectation of reward	Reflective motivation Automatic motivation	Badges for participation or reaching a target
Coercion	Creating an expectation of punishment or cost	Reflective motivation Automatic motivation	Tax on competing behaviours
Training	Imparting skills	Psychological capability Physical capability	Hands-on sessions and workshops
Restriction	Using rules to reduce opportunity to engage in the target behaviour	Physical opportunity Social opportunity	Laws and regulations
Environmental restructuring	Changing the physical or social context	Automatic motivation Physical opportunity	Provision of physical material such as bins

		Social opportunity	
Modelling	Providing an example for people to aspire to or imitate	Automatic motivation	Demonstrative video-clip of the behaviour
Enablement	Increasing means/reducing barriers to increase capability (beyond education)	Psychological capability Physical capability Automatic motivation Physical opportunity Social opportunity	Support groups

In order to asses to what extent these intervention functions have been implemented to target selective biowaste sorting as well as their effectiveness, we have reviewed the literature on interventions targeting selective biowaste sorting. The articles reviewed have been selected from the pre-identified pool of articles that were selected for the systematic literature review reported in D4.1. From the 34 articles identified for this analysis, 16 were selected after a more in-depth screening. The inclusion criteria were: interventions targeting individual behaviour and interventions targeting selective biowaste sorting specifically (as opposed to the general "recycling behaviour").

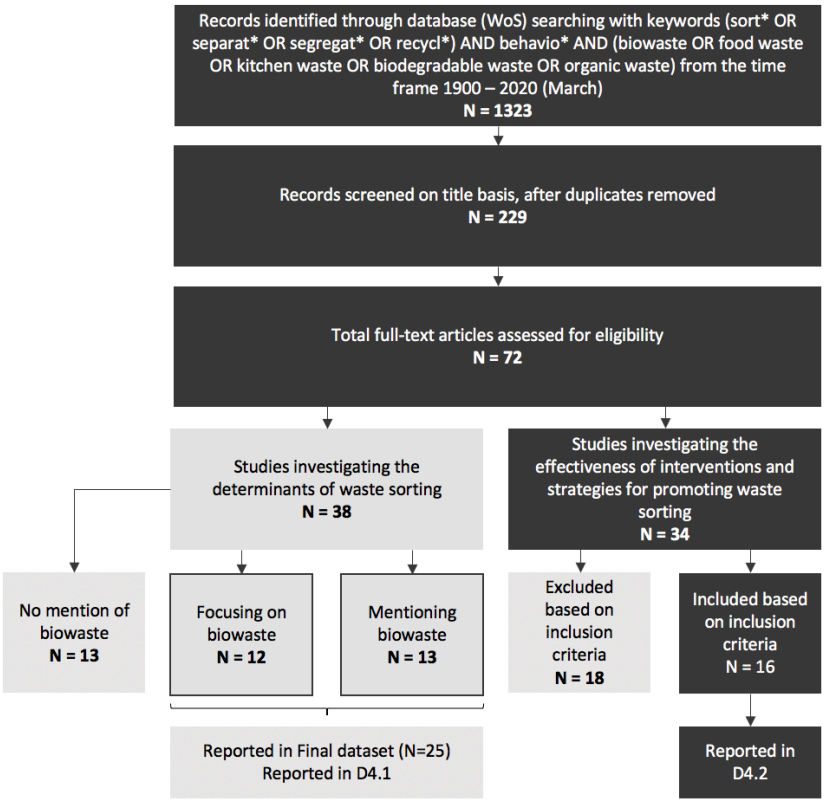

Figure 1: Steps in the literature search process

After a first screening, the articles were classified according to the intervention functions implemented in the study. An overview can be found in **Table 3** which also indicates which elements of the interventions were successful (in italic and bold), while the studies are described in more detail in the sub-sections below according to their main intervention's instruments (i.e.: visual nudges; incentives; textual information and communication; ambassadors; and persuasive technology).

Table 3: Articles included in the systematic literature review of studies investigating the effectiveness of interventions and strategies for promoting biowaste (food and kitchen waste) sorting (N= 16) and classified by the authors (IMEC) according to the COM-B model. Elements in bold were found successful in the studies.

Authors	Title	Experiment	Main intervention instrument	Intervention functions								
				Education	Persuasion	Incentivisation	Coercion	Training	Restriction	Environmental restructuring	Modelling	Enablement
Bernstad et al. (2013)	Door-stepping as a strategy for improved food waste recycling behaviour Evaluation of a full-scale experiment	(1) written information campaign; ***(2) oral information; (3) provision of vessel and bags***	Textual info	***V***						***V***		***V***
Bernstad (2014)	Household food waste separation behavior and the importance of convenience	Written information (leaflets) and **installation of equipment**	Textual info	***V***						***V***		***V***
Boonrod et al. (2014)	Enhancing organic waste separation at the source behavior: A case study of the application of motivation mechanisms in communities in Thailand	***(1) common bins; (2) small bins + common bin x2; (3) reward incentive; (4) economic incentive per kilo***	Incentive			***V***				***V***		***V***
Comber and Thieme (2013)	Designing beyond habit: opening space for improved recycling and food waste behaviors through processes of persuasion, social influence and aversive affect	**Persuasive technology** (BinCam)	Persuasive technology		***V***	***V***	***V***			***V***	***V***	
Dai et al. (2016)	Information strategy failure: personal interaction success, in urban residential food waste segregation	Information strategy vs ***personal interaction***	Ambassador	V	***V***					***V***	***V***	
Geislar (2017)	The new norms of food waste at the curb: Evidence-based policy tools to address benefits and barriers	Use of ***social norm*** marketing	Textual info		***V***							
Huang, Tamas & Harder (2018)	Information with a smile - Does it increase recycling?	Information provision vs ***personal interaction***	Ambassador	***V***								

Authors	Title	Experiment	Main intervention instrument	Intervention functions								
				Education	Persuasion	Incentivisation	Coercion	Training	Restriction	Environmental restructuring	Modelling	Enablement
Lin et al. (2016)	Visual Prompts or Volunteer Models: An Experiment in Recycling	*Presence of volunteer near waste station vs 'bin sleeve'*	Visual nudge and ambassador	V						V	V	
Li et al. (2017)	Incentives for food waste diversion: Exploration of a long term successful Chinese city residential scheme	*'Green Account' point reward system*	Incentive			V						
Linder, Lindahl & Borgström (2018)	Using Behavioural Insights to Promote Food Waste Recycling in Urban Households-Evidence From a Longitudinal Field Experiment	*Provision of information through a leaflet*	Textual info	V	V							
Luo, Zelenika & Zhao (2019)	Providing immediate feedback improves recycling and composting accuracy	*Educational game*	Incentive	V				V				V
Murase et al. (2017)	Quantitative analysis of impact of awareness-raising activities on organic solid waste separation behaviour in Balikpapan City, Indonesia	*Volunteer and provision of bags*	Ambassador	V							V	V
Pinto et al. (2018)	A simple awareness campaign to promote food waste reduction in a University canteen	*Provision of information* ('injunction' posters)	Visual nudge	V	V							
Rousta et al. (2015)	Quantitative assessment of distance to collection point and improved sorting information on source separation of household waste	*Informative stickers on new provided trash cans*	Visual nudge	V						V		V
Shearer et al. (2017)	A problem unstuck? Evaluating the effectiveness of sticker prompts for encouraging household food waste recycling behaviour	*Visual nudge (sticker)*	Visual nudge		V					V		
Slavik et al. (2019)	Biowaste Separation at Source and Its Limitations Based on Spatial Conditions	*Information campaign (leaflets and a website)*	Textual info	V								
			N	11	7	3	1	1	0	8	4	6
			%	68	43	19	6	6	0	50	25	37

1.1. Visual nudges

In their experiment, Shearer et al. (2017) made use of visual nudges in the form of **stickers** apposed on the residual waste bin. The A5 sticker presented the message "NO FOOD WASTE PLEASE" followed by "Remember to use your food recycling caddy", and displayed the picture of the food waste bin together with a web URL that could be visited by households for further information. The treatment group (approx. 30k households) was exposed to the sticker for approximately 15 weeks. The authors observed a significant **positive increase of 20% of food waste tonnages collected** from the treatment group, while there was no change for the control group. The authors also investigated if this effect was sustained over time, in the short, medium and long term. They found out that, contrary to the control group, for which the tonnage fluctuated over time, the treatment group displayed a clear increase for each measure point. Practically, the authors also conducted a cost-benefit analysis, and accounting for their specific criteria (cost of disposal in the UK, etc.): **this type of policy intervention had a payback period of just 23 weeks**.

Figure 1: Visual nudge (sticker) from Shearer et al. (2017)

Figure 2: Visual nudge (sticker) from Rousta et al. (p.25, 2015)

Likewise, Rousta et al. (2015) conducted a study on the effect of **informative stickers** (providing clear figures of correct sorting information) affixed on households' trash can usually located in their kitchen. The authors observed that one month after the start of intervention **the capture rate of food waste increased** (increase of correctly sorted food waste, decrease of missorted food waste) and there was a **significant decrease (70%) in weight of the missorted residual waste** in the bags intended for food waste (more specifically: diapers). The authors attribute the success of the intervention to the nature of the stickers: easily understandable information that is seen every day at the relevant time (i.e. when individuals are undertaking the action of waste sorting).

In another experiment, Pinto et al. (2018) made use of another visual nudge in the form of simple injunction "Contribute to a selection collection" on a poster displayed next to the collection bins. Although they do not report if the change was significant, the average weight

of separated waste did increase and the initiative achieved an average participation of 70.45% of the users.

Figure 3: Visual nudge (injunction) from Pinto et al. (2018)

1.2. Incentive

Li et al. (2017) found that the **allocation of points** for each bag of food waste selectively placed in the dedicated containers was a good incentive for Nanjing (China) residents. They could then exchange their collected points with goods (e.g. eggs) and services (e.g. sharpening knives). In follow-up interviews that took place 22 months after the start of the incentive scheme, participants were asked about their initial and continued participation. Respondents indicated that the nature of the exchanged good (in particular the eggs) was the best reward for their action and it was the reason for their initial participation (n= 15/35), followed by social norm (my friends, families and neighbours do it; 8/35) and most of them (n= 26/35) indicated that even if this incentive stopped they would probably continue to sort their food waste because it had become an habit (n= 15/26), it would keep the community clean (n= 5/26) and it was a good action for future generations and the environment (n= 4/26). Interestingly, when asked about continued participation, the incentive only comes in third position, after "habit" and "cleaned community". **This emphasizes the role of incentive to initiate a new behaviour and its progressive lack of influence over time**. The author also interviewed persons that did not sort and asked the reason for their non-participation. Most cited 'inconvenience' as the main reason, with the waste station being too far or open at inconvenient times (n= 15/18) and some did not trust the relevance of food sorting (n= 5/18).

In their study, Boonrod et al. (2015) investigated the **differential effect of non-economic incentive and economic incentive**. The non-economic incentive encompassed (1) a traditional mechanism, where organic waste collector tanks are placed next to common collection bins; and (2) a voluntary mechanism, where an educational step (seminars and brainstorming sessions), an establishment step (small bins and twice coverage of the traditional mechanism for organic waste collector tanks) and an encouragement step (commendation and acknowledgment, such as flags of honour indicating household involvement in the programme) were implemented. The economic incentive included (3) a reward mechanism (calculated according to the household's ability to separate organic waste) and (4) a community business mechanism (the community received money for each kilogram of waste they separated). These mechanisms were implemented one after the other in the same community, each for a period of 28 days. The authors observed that the first mechanism yielded a capture rate of 20%, the second mechanism a capture rate of 35% (an increase of

182% from mechanism 1), the third mechanism led to a capture rate of 51% (increase of 145% from mechanism 2), and finally the fourth mechanism yielded a capture rate of 58% (or an increase of 300% compared to mechanism 1, 165% compared to 2, and 113% compared to 3). While it is clear from this results that mechanism 4, the community business economic incentive, lead to the best results, the authors point out that the cost for this mechanism is 3.12 times higher than the cost of the 3rd mechanism (reward mechanism) but it performs 'only' 1.13 better.

In their study, Luo et al. (2019) investigated the effect of immediate feedback on participants' (1) sorting accuracy and (2) weight of compost material collected and contamination rate. Participants were invited to **play a digital game** through a computer interface where they were asked to sort items into four bins (food scraps, recyclable container, paper and residual garbage) and where they received immediate feedback after each attempt (either "*Correct!*" or "*Wrong! This should go to [correct bin]*"). The authors observed that the provision of immediate feedback did not only improve their (digital) sorting accuracy, but it also had a significant impact on the weight (increase) and contamination rate (decrease) of compost materials collected. The authors attribute this effect to three properties of the feedback: (1) its immediacy; (2) the fact that it not only indicates if the answer is correct or not but that it also gives the correct answer if wrong; (3) it may facilitate the creation of a new sorting concept in people's mind.

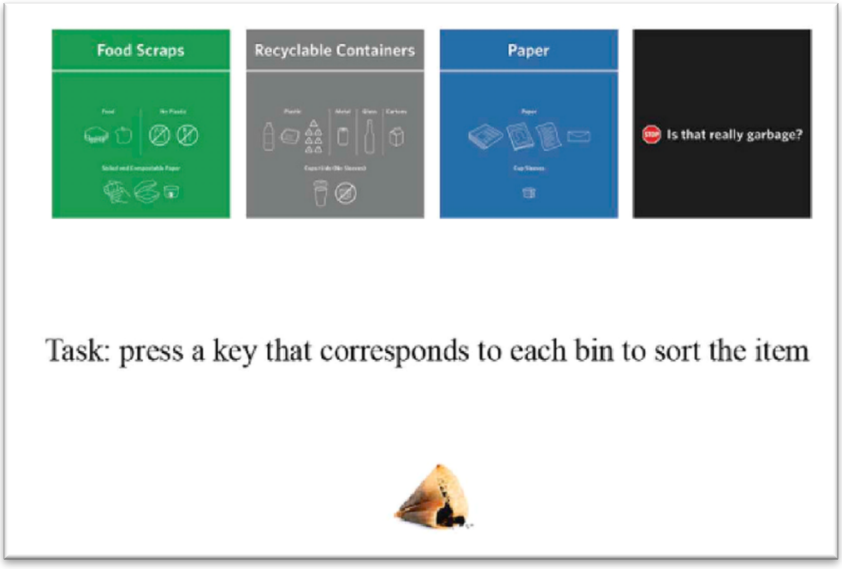

Figure 4: Sorting task from the digital game of Luo et al. (p.448, 2019)

1.3. Textual information and communication

In their experiment, Slavik et al. (2019) introduced an **information campaign targeting instrumental knowledge** (list of suitable waste, location of container, details on when the container was emptied). Although the authors report **a significant improvement in purity** of the biowaste collected, they are unable to confirm that the campaign led to an increase in the weight of biowaste collected.

Bernstad et al. (2013) aimed to observe the difference of effect in an information campaign that would provide (1) written information on *how* to sort (minimize risk of leakage, avoid attracting flies, etc.) and on *why* to sort (information on environmental benefits from anaerobic treatment of food waste, the amount of produced biogas per kg of food waste, etc.) as well as (2) oral information (repetition of written) and provision of vessel and bags through door-stepping. In their experiment, **group 1 was presented with written and oral information together with a vessel and bags**, while group 2 was only presented with **written information**. They observed a significant **increase of the food waste weight collected for Group 1** compared to Group 2. **Group 1 also displayed a significantly better purity rate** that Group 2, however this ratio decreased over time and became similar in both groups after 18 months, emphasizing the low durability of oral information in regards to the purity of the waste collected.

In a follow-up study, the same author aimed to observe the differential effect of: (1) information provision through a leaflet that presented '*why*-information' on the transformation of biowaste into biogas, the use of biogas as alternative to fossil energy, how nutrients are recycled through anaerobic digestion, and '*how*-information' in the form of sorting instructions and contact details of the municipal waste management department, as well as their webpages; (2) the installation of source-segregation equipment for food waste that consisted of a metal hanger and a vessel for paper bags used for the separate collection of food waste. Both the informative leaflet and the equipment installed by facility managers in kitchens were distributed to all household of the investigated area. Bernstad (2014) observed that while the effect of campaign (1) **'information provision through leaflet' had no significant effect**, campaign (2) **'provision of equipment' had a significant positive effect** on both the amount of separately collected food waste (kgs) with an increase of 49%, and a positive significant increase in source-separation ratio and decrease in the ratio of mis-sorting. The author conclude that education, awareness raising and information were not effective intervention functions to enhance recycling performances, at least in the format that was presented to the participants of this specific study, but that **convenience** was.

Figure 5: Equipment provided to households in Bernstad (p.1319, 2014)

Persuasive communication can make use of different elements to try and influence one's behaviour. In his study, Geislar (2017) used norm communication, also called **social norms marketing, in the form of descriptive norms** messages such as "'*75% of households in Costa Mesa separated all of their food scraps this week*." (p.575) where the specified percentage would vary at random between 75-84% (that participants would receive either via emails or on a magnet/sticker). The author observed that, although the effect size is small, **the group that received the descriptive norm messages increased significantly their (self-reported) food sorting behaviour in comparison to the control group**. Further, the treatment group was significantly more likely to continue separating their food waste compared to the control group (the drop-out rate was significantly lower for the treatment group than for the control group). He also observed that the norm-based message had a differential effect on different participant's profile and validated Schultz's theory (2014) that "low benefit – low barrier" profiles (individuals who would perceive selective waste sorting as having few barriers but also

as having few benefits) would increase their participation more than other profiles when presented with norm-based communication.

In their study, Linder et al. (2018) investigated the effect of an informative leaflet on food waste recycling. The leaflet was designed to address the two main barriers identified through a pilot study: lack of information about the new recycling station, and the difficulty the residents had to tell the difference between the two sorting stations. The **leaflet** made use of **contextualised, tangible information** such as "*If all households in Hökarängen would sort their food waste it would be enough biofuel to support 15 garbage trucks for a year*" or "*A bus can drive 2.5 km on only one bag of food waste*" and "*Every Swede produces on average 100 kilos of food waste per year"* (p.5). The leaflet also presented a **descriptive norm**-based message "*Join your neighbours on Hovmästargatan,, recycle your food waste*" and **injunctive norm** "*People in Hökarängen believe recycling food waste is the right thing to do*". Further, the leaflet was accompanied by two bags for food waste sorting to counter other pre-identified barriers, such as inconvenience and laziness. The authors observed that the ATE (average treatment effect) was significantly positive for the amount of food waste collected (+26%) and significantly negative for residual waste (-48%) while it remained unchanged for the control group. Further, the authors observed that the effect of the intervention lasted even 8 months after the intervention. **The authors attribute the success of the intervention to its tailored nature to the specific context and target group**.

Figure 6: Guide presented to participants in Linder et al. (2018)

1.4.Ambassadors

Dai et al. (2016) contrast in their study the format of information provision by comparing a government-led strategy with a NGO-led strategy. Although both strategies made use the same information-provision activities, the government strategy transmitted the information in a neutral manner whilst the **NGO-led strategy was more personal, making use of personal interaction, door-to-door, public meetings and ambassadors** to communicate the information. The authors observed that the communities presented with the government-led strategy did not display a statistical difference in their ratio rate between the 'wet waste' bin and the 'residual waste' bin (both bins presented the same % of food waste) while the communities presented with the NGO-led strategy displayed a significant difference in their ratio rate (95% for 'wet waste' bin and 43% for 'residual waste bin). By comparing both strategies they also observed that ratio rate was statistically higher for the NGO-led strategy than for the government-led strategy. The authors attribute this effect to the lack of salience of the

government's message in comparison to the **modelling** undertaken by ambassadors in the NGO-led strategy. They also suggest that personal interaction might be effective in the sense that it makes group identify and social norms more salient for participants.

In a follow-up study, Xu et al. (2016) identified through in-depth, semi-structured interviews the key operational elements for the success of the NGO-led campaign. These elements included the usefulness of a "broker" (the NGO), the existing intention of the local government to implement the policy, the clarification of roles and responsibilities of the stakeholders, the relationship with the local government and the use of volunteers. Focusing more specifically on the use of volunteers, the authors propose that the use of such interventions was successful due to its multiple influence on behaviour through: a tailored personal interaction, social influence, emotion, role clarification, messenger of the request from the government, behaviour modelling, knowledge provision and prompting (Lin et al., 2016; Xu et al., 2016). Based on these results, the same team of researchers wanted to investigate the effect of social influences by comparing the effect of (1) **volunteers on site** (presence of social influence with (2) **bin covers** (absence of social influence). Lin et al. (2016) observe that the experimental groups (both conditions) presented both low contamination level (<19%) and high effective capture rate (23%-42%), and that these results were statistically different from the control group. However, when comparing both conditions, the results were not statistically different from each other, indicating that both interventions were **equally successful**. The authors therefore recommend the implementation of the 'bin cover' intervention rather than the 'volunteer' intervention due to their difference in costs (almost a 10 factor).

Figure 7: Bin cover as visual prompt from Lin et al. (p.5, 2016)

In the same vein, Huang et al. (2018) investigated the differential effect of providing information with no personal interaction (through **a leaflet**), providing it through neutral interaction and providing it with positive interaction. Although they did not conduct a statistical analysis, they observed a meaningful increase in the capture rate of food waste when the information was presented through **positive personal interaction**. The authors underline that this finding pinpoints a gap in the theories and models around behavioural change, as none of the six social influence mechanisms suggested by social influence theories and principles (social networks, commitment making, behaviour modelling, social norms, social comparison, group performance) were applied in this intervention.

In another study, Murase et al. (2017) investigated the effect of an awareness raising campaign through the use of **volunteers** (also called 'ambassadors') on the waste stations location. The volunteers were requested to be on location, standing next to the waste station and make sure residents disposed of their waste correctly. If not, volunteers were to guide residents to dispose of their waste according to the rules. The authors observed that in the communities where the intervention was implemented, the amount of properly separated organic waste increased by 6% while in the communities without intervention, this amount decreased by 3.6%.

1.5. Persuasive technology

Comber & Thieme (2013) tested the effectiveness of an **augmented bin** (BinCam) and its custom application on Facebook. Participants who used this 'smart' bin were instructed to use it as their normal residual waste bin. The BinCam would automatically take a picture (through a smartphone installed on the underside of the lid which was activated through its integrated accelerometer) and upload it to the application on Facebook where the picture would be available to all BinCam members. On the app, the BinPictures were labelled according to their composition. Further, a BinLeague was created to visualise the scores of the participants: leaves on a tree represented recycling achievements (decrease in recyclable material in the bin) and gold bars represented prevented food waste (decrease in food waste in the bin) with the score calculated on a weekly basis (compared to the previous week). Although the authors do not report on the actual changes of the sorting behaviour, the participants do report an improvement in their recycling behaviour through the **reflection** engaged with the BinPictures. Participants also reported a sudden **increased awareness** of their own bin habits, of which they were not conscious about before (e.g. the number of times per day they put something in the bin), emphasized by the 'clic' sound emitted by the camera of the smartphone each time the lid of the bin was closed. The social aspect of the Bin app created a climate of social influence where participant did not want to be seen as 'bad sorters' (shame avoidance) and acted as a normative influence. This social element also influenced participants to re-evaluate their own behavioural control; by observing that other participants that were in many ways similar to them, they realised that they too could perform better and that they had 'no excuse', which elicited feelings of guilt and competition, with a will to do better.

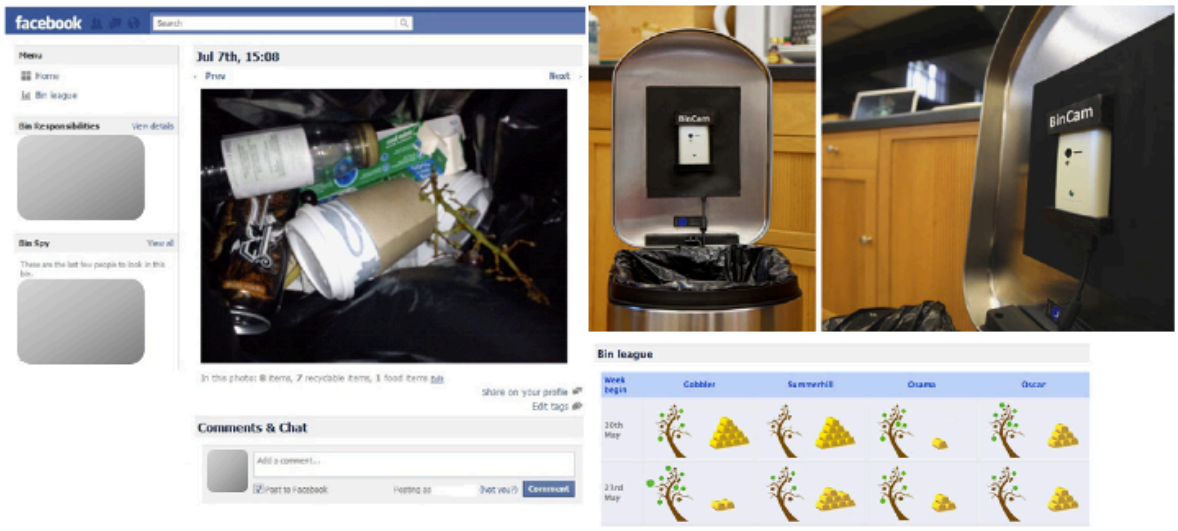

Figure 2: BinCam device (right up), content of the BinCam app on Facebook with a BinPicture (left) and a visualization of the BinLeague (bottom right) from Comber and Thieme (2013)

1.6.Concluding summary

The systematic literature review on intervention targeting selective waste sorting has emphasized several elements. First, from Table 3, we observe that experimentations so far have investigated the effect of:

- **Visual nudges** such as short-message stickers (e.g. "No food waste please"; "Contribute to a selective collection"); informational stickers displaying pictures of the items that are accepted in the biowaste bins; and even 'bin cover' where biowaste bins are dressed with a colourful sleeve to draw attention. All of these studies have concluded that the use of visual nudges is successful.
- **Incentives** such as the allocation of point that participants can exchange for goods (e.g. eggs), monetary incentive and non-monetary incentive such as gratification through a game. All authors found the use of incentive successful, although some noted that their influence faded over time.
- **Textual information and communication** through leaflets, emails or magnet. The type of information included in the intervention also varies from descriptive information related to biowaste sorting such as 'how' and 'why' to sort, to norm-based messages (descriptive and injunctive). The success of this strategy varies depending on the type of message used: norm-based messages appear to be successful in both cases, while the results for the descriptive information provision is less clear. We can observe that when this strategy is successful, it is always accompanied by the provision of a vessel bag, and it is rather the increase of convenience that has an impact on participant's behaviour.
- **Ambassadors** such as through a positive face-to-face interaction with a volunteer. Although all interventions were found to be successful, one author noted that this strategy was as successful as a 'bin cover' and, therefore, recommended the latter as the cost is lower.
- **Persuasive technology** such as the use of a bin with a camera connected to a Facebook group. Although requiring extensive effort to put into place, this strategy appeared to be successful in increasing the awareness of participants to their habit of waste disposal.

Second, we observe that some intervention functions, such as education (68%) and environmental restructuring (50%), are used more frequently than others; persuasion (43%), enablement (37%) and modelling (25%) are applied to a lesser extent, followed by incentivization (19%), training (6%) and coercion (6%) while the function of restriction has never been put into practice. Although '**education'** is the most frequently used intervention function, we note that it does not always reach its goals: when it is successful, 'education' appears to work because the information given is either contextualised and tangible information or because it is delivered through an ambassador who makes the experience personal and striking, which also plays a role on the '**modelling'** function, while strict descriptive information ('how' and 'why' to sort) on their own through impersonal communication means (e.g. leaflets) has no significant effect. '**Environmental restructuring**' through visual nudges was found to be as successful as the use of behaviour modelling through ambassadors and it is therefore regarded as the preferred option to implement between the two, considering the difference in costs. Both '**persuasion',** through the use of norm-based messages and other social norm mechanisms (e.g. shame and normative influence), and '**enablement**', through the provision of vessel bags, were found to be highly

successful. Finally, although less frequently put into practice, **'incentivisation'** through the use of monetary and non-monetary incentive was found to be successful but its effect appears to fade over time; '**training'** through the use of a computer game was also found to be successful.

2. The Social Marketing approach to behaviour change

2.1 Introduction to Social Marketing

Social Marketing is a distinct marketing discipline that focuses on influencing behaviours that would, amongst others, improve health, prevent injuries, protect the environment, contribute to communities and even enhance financial well-being. Lee & Kotler (2015), leading authors in the discipline, identify in their book "Social Marketing: Changing behaviours for good" four central characteristics of Social Marketing: (1) it influences behaviours, (2) using a systematic planning process that applies marketing principles and techniques, (3) by focusing on priority target audiences segments, (4) to deliver a positive benefit for individuals and society. In this sense, **Social Marketing is different from commercial marketing**: whereas the latter aims to achieve financial gain for a corporation, the former contributes to societal and individual improvement. In turn, this influences the segmentation of the target audience according to a different set of criteria, as well the identification of what constitutes the 'competition' of what is being marketed (Lee & Kotler, 2015).

Social Marketing also stands out from other forms of behavioural change. First, by recognizing the concept of value-exchange where individuals choose a behaviour in exchange for benefits they consider valuable and/or to reduce barriers that they consider to be important. Second, it recognizes possible competition to the behaviour created by alternatives that the intervention will seek to outweigh. The goal of the intervention will therefore be to create an exchange offering that is being perceived by the audience as having greater value than the existing alternatives. Third, Social Marketing uses the 4Ps of marketing: product, place, price and promotion. These tools are considered as central to reduce the barriers and increase the benefit of behaving in a certain way. Finally, Social Marketing differentiates itself by its sustainability that results from the continuous monitoring and adjustment of the behaviour change intervention and which is critical to achieve long term behavioural change (Lee & Kotler, 2015).

In 2010, building on Andreasen's (2002) six-benchmark criteria, the UK National Social Marketing Centre (NSMC) introduced eight criteria outlining the defining characteristics of Social Marketing:

Table 1: The eight criteria of Social Marketing - adapted from the UK NSMC (2010)

1. Behaviour	Aims to change people's behaviour, not just knowledge, attitudes or beliefs. Specific and measurable behavioural goals are set, with baselines and key indicators established.
2. Theory	Uses behavioural theories to understand behaviour and inform the intervention, and more specifically the **methods mix**.
3. Consumer orientation	Focuses on the audiences to understand their lives, behaviour and the studied issue, using a mix of data sources and research methods, such

	as gaining stakeholder understanding and feeding it into the **methods mix** development.
4. Insight	Identifies actionable insights that will lead to the development of the intervention. Insight is generated from **customer orientation** work and used to develop an attractive **exchange** and suitable **methods mix**.
5. Exchange	Considers benefits and costs of adopting and maintaining a new behaviour by conducting a comprehensive analysis of the perceived and actual costs and benefits. It offers incentives and rewards based on **customer orientation** and **insight** findings, and replaces benefits the audience derives from the problem behaviour and **competition**. The exchange is clearly linked to 'price' in the 4Ps of the **methods mix**.
6. Competition	Seeks to understand what competes for the audience's time, attention and inclination to behave. It develops strategies to minimize the impact of competition by being clearly linked to the **exchange** offered, and learns from competing factors to develop the **methods mix**.
7. Segmentation	Identifies audience segments from **customer orientation** and **insight** work based on behavioural and psychographic data, then tailors interventions appropriately.
8. Methods mix	Uses a mix of methods to bring about behaviour change, including the 4Ps of marketing mix and/or other intervention methods.

2.2 Social marketing applied

Social Marketing has been applied to a vast array of behaviours, from adopting a more active lifestyle to contraceptive use, with a **predominant focus on health-related issues** (Truong & Dang, 2017). However, the term "social marketing" has been used quite loosely to describe the type of behavioural change approaches used in programmes. For example, Stead et al. (2007) report that from 310 individual studies retrieved on alcohol, tobacco and drug intervention that included the term "social marketing" only 11% met all of the criteria (Andreasen's six criteria). Likewise, from the 110 articles on physical activity intervention that included the label "social marketing", only 20% met all the criteria. The authors observed that the term "social marketing" is often misused to describe the sole use of advertising or other form of media communication in the intervention. When used correctly and wholly, the authors found that the social marketing approach programmes yield significant behaviour change results.

Pro-environment behaviours have received less attention from social marketers (Truong, 2014), and, until recently, the extent to which social marketing principles were applied to the field of food waste was unknown. To compensate for this lack, Kim and colleagues (2019) conducted a systematic literature review on the usage of social marketing in **food waste reduction** programmes. During their research, they found out that some of the major components of social marketing approaches were lacking in the domain, with non-voluntary approaches dominating food waste prevention efforts, which can lead to community criticism

(Kim et al., 2019). In their paper, they examined the extent to which the eight elements of social marketing were being included in food waste programmes. They found that **none of the interventions focusing on food waste were applying all eight criteria**. This represents a important gap, especially as the authors also identified that the more social marketing components were used in food waste programmes, the more successful the programs were: programmes that mentioned the use of several elements reported a greater effect (Cohen's coefficient) than programmes that did not.

The extent to which social marketing has been applied to **food waste sorting** is even lower, with only 12 articles (out of 23 on food waste) since 2000 (Kim et al., 2019). Of these interventions, all applied the criteria of "marketing mix" but only four applied the criteria of "theory", only one applied the criteria of "consumer orientation", one the criteria of "insight", none the criteria of "segmentation", none the criteria of "exchange" and none the criteria of "competition". This emphasizes the **inadequate and weak use of social marketing principles in food waste sorting programmes to date**.

To counter the lack of (correct) application of social marketing within biowaste source-separation interventions, the following chapter will detail each criterio integrated within the WaysTUP! behavioural change study targeting selective biowaste sorting.

3. Social marketing for selective biowaste sorting: building the WaysTUP! behavioural change toolkit

As explained in the previous chapter, Social Marketing-based interventions benefit from the application of all eight of the criteria identified by the UK NSMC. Therefore, in the following section, each criterion is reviewed and elaborated upon, to create the behaviour change toolkit for the three pilot cities of the WaysTUP! project.

3.1 Behaviour

The specific behaviour that is targeted by the behaviour change intervention of the WaysTUP! project is the selective sorting of biowaste. **Selective biowaste sorting** is the process by which biodegradable garden, park, food and kitchen waste is separated from other types of waste and placed in a specific repository (see D4.1, Chapter 3.1.1 for more information).

3.1.1 Nature of the behaviour

Selective biowaste sorting is embedded in the larger behaviour of waste discard. Like many of our daily behaviours, waste discarding, due its high frequency and repetitive nature, can be considered as a **habit**. Habits are automatised behaviours performed with minimum cognitive effort. The automaticity of the behaviour allows for a more effective use of our limited cognitive capacities but because they are performed without a full conscious reasoning, they are also less susceptible for change than other, more reasoned behaviours (Jager, 2003; Knussen & Yule, 2008). When a specific action has become a habit, individuals are less likely to seek new information regarding the action, or take the new information into account (Jager, 2003). However, contextual changes have been found to have a significant impact on habits (Wood et al., 2005).

Selective biowaste sorting is also considered as a **pro-environment behaviour**. A specific challenge of forming a new pro-environment habit is that the formation of any habit is influenced by reinforcement learning. Reinforcement learning occurs when favourable outcomes occur in the short run (called 'reinforcement') as a result of performing a particular behaviour in a specific situation (Jager, 2003). However, it is assumed that the experience of satisfaction from the reinforcement is dominated by short-term personal outcomes, which is often not the case with pro-environment behaviours. In fact, engaging in pro-environment behaviours is most of the time considered costly for the individual who has to change its lifestyle for a reward that is only partially – and often not at all – enjoyed by the individual itself (Pongiglione, 2020). Further, the intertemporal and spatial dimensions of environmental issues' causes and consequences provide a strong incentive toward non-participation in a pure self-interest motivation. This combination of (1) individual cost vs collective interest and (2) present action for future consequences, contributes to what is referred to as a "**perfect moral storm**" (Gardiner, 2006, p. 398).

The behaviour change intervention targeting selective biowaste sorting is therefore confronted by three challenges associated with its nature:

1) The habitual nature of the competing behaviour (discarding biowaste into the residual waste bag).
2) The collective interest of the consequences of performing the behaviour vs the individual cost for the individual.
3) The temporal separation between the (future) consequences and the (current) behaviour.

3.1.2 Behavioural objectives

The behavioural objectives that have been set as goals for the behaviour change intervention are:

- > 80% of improved perception of urban biowaste as a local resource
- > 60% active participation in separate collection of urban biowaste
- > 75% of improved acceptance of urban biobased products

The end goal of the behaviour change intervention is to improve the participant's selective biowaste sorting behaviour, however, through its comprehensive approach, WaysTUP! will also aim to impact the perception of urban biowaste as a resource and the acceptance of biobased products. In the literature, several methods to measure the improvement of selective waste sorting have been recorded

- **Self-reported participation rate**: generally consisting of self-reported answers in a survey based on the subjects' own appreciation of their behaviours, this measure assess the participation of individuals or households. However, the measure is criticized due to its possible lack of validity, following several studies documenting inconsistency between self-reported behaviours and actual behaviour (Perrin and Barton, 2001; Williams and Kelly, 2003);
- **Participation rates**: these consist of the number of participants compared to those who do not participate for a given location (municipality, community, city, etc.). However, this measure is confronted by practical issues in multiple family units and does not account for individual participation rate, as the unit of analysis is the location;
- **Recycling tonnages**: they represent the amount in kg of waste selectively sorted. However, this measure does not account for the contamination of the waste (participants could have heavier biowaste bags, but the content of the bags could very well include other type of waste than biowaste). While this measure does not usually account for individual participation rate as the unit of analysis is the location (municipality, community, city, etc.), it could be envisioned that participants are asked to weight their biowaste bags and report it in a tracking journal;
- **Source separation ratio**: the recycling rates take into consideration the amount of biowaste selectively sorted compared to other waste. This measure is already a step ahead of the recycling tonnages, but presents the same gap regarding contamination. Again, this measure does not usually account for individual participation rate, but, as for the recycling tonnages, it could be envisioned that participants are asked to weight both their biowaste bags and residual waste bags and report the weights in a tracking

journal. Further, a possible solution mitigating the lack of a contamination measure could be to retrieve the known ratio of food waste/residual waste for the location and apply this ratio for the source separation ratio;

- **Purity of waste**: this measure takes a look at the composition of the selectively sorted biowaste and assess its purity by analysing which components are correctly and faulty placed in the bags. Although interesting, this measure is extremely time and effort-consuming, even when only representative samples are selected.

These elements will be further elaborated upon in D4.4 "Evaluation methodology for measuring the change".

3.2 Theory

The integration of theory within the intervention provides information as to why the behaviour may or may not occur. In this sense, behavioural theories can be used to inform and guide the development of the behaviour change intervention. In the following section, we will briefly review some of the most recognised and applied **(1) theories and models of behaviour** are reviewed and explained, such as the theory of planned behaviour (TPB), the Fogg Behavioural Model, the Social Norm Theory; the (extended) Norm Activation Model; followed by **(2) models of behavioural change** such as the Diffusion of Innovation Theory and the Trans-theoretical Model (or the Stages of Change) and finally some **(3) models of pro-environmental behaviours** such as the Value-Belief-Norm of environmentalism, the Model of Pro-environment behaviour and the Pro-Circular Change Model (P-CCM).

This review will highlight that behaviours are influenced by different elements such as **attitudes, norms,** and **perceived behavioural control** (Azjen, 1991). Norms have a particularly high influence and misperceptions of norms can lead individuals to act in a way that is not in line with their true beliefs or to justify their wrong doings (Mendes et al., 2017; Pollard et al., 2000). Further, individuals appear to need a **motivation**, the **ability**, and an **effective trigger** to act in a certain way (Fogg, 2009). In selfless behaviours, individuals would further need to be **aware of the need**, **aware of the consequences** and **aware of the responsibility** that falls on them (Schwartz & Howard, 1981). Pro-environmental behaviour appears to be specifically influenced by **values, norms, awareness of consequences, awareness/ascription of responsibility** (Stern et al., 1999) as well as **knowledge, attitude** and **feelings** while being restraints by **old (competing) behaviours, insufficient feedback, lack of internal and external incentives** and a **lack of environmental consciousness** (Kollmuss & Agyman, 2002).

The literature also explains that the adoption of a behaviour depends on its a **relative advantage, trialability, observability, compatibility** with existing elements of the individual's life and low **complexity** of the task. Further, individuals go through several stages of change to achieve a total behaviour change, such as: pre-contemplation; contemplation; preparation; action; maintenance and termination.

3.2.1 The Theory of Planned Behaviour

The Theory of Planned Behaviour (TPB) postulates that the intention to perform a behaviour is the main antecedent of the actual behaviour, and that this intention is, in its turn, influenced by three components: the attitude towards the behaviour, the subjective norm around the behaviour and the perceived behavioural control regarding the behaviour (Ajzen, 1991). Historically, the TPB is the extension of the theory of the reasoned action (TRA) developed by Ajzen and Fishbein in the 70', following the limitations of this first model that did not allow to report behaviours on which individuals did not have full volitional control (Ajzen, 1991).

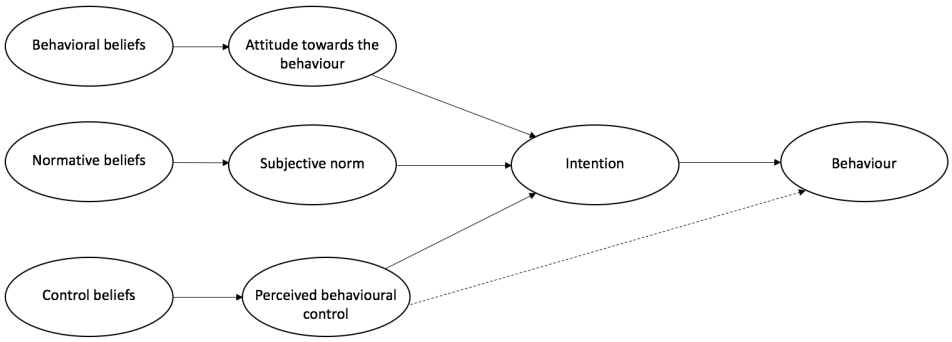

Figure 3: Theory of Planned behaviour

In this model, beliefs are key determinants as they influence the formation of the attitude, subjective norm and perceived behaviour control. Taking these beliefs into account allows to understand the reason why those components (behavioural attitude, subjective norm and perceived behavioural control) play a role in the prediction of the intention to perform a behaviour (Greaves et al., 2013). **By analysing the role and weight of these belief, behaviour change programmes can identify points of action for their intervention** (Morris et al., 2012).

3.2.2 Fogg Behavior Model

The Fogg Behavior Model (FBM) states that for a target behaviour to happen, people must present or be exposed to three factors: sufficient motivation, sufficient ability, and an effective trigger, with all three factors being present at the same time for the behaviour to occur (Fogg, 2009).

Graphically represented, the model can be seen as a two-axis structure. The horizontal axis represents the ability of people to perform the behaviour and the vertical axis represents their motivation to do it. It can be seen that the target behaviour, represented by the green star, is at the intersection of "high ability" and "high motivation" next to a trigger (Fogg, 2009). As Fogg (2009) indicates, this representation is conceptual, and, while the axes are fixed, the target behaviour as well as the trigger could occur anywhere on the graph depending on the situation.

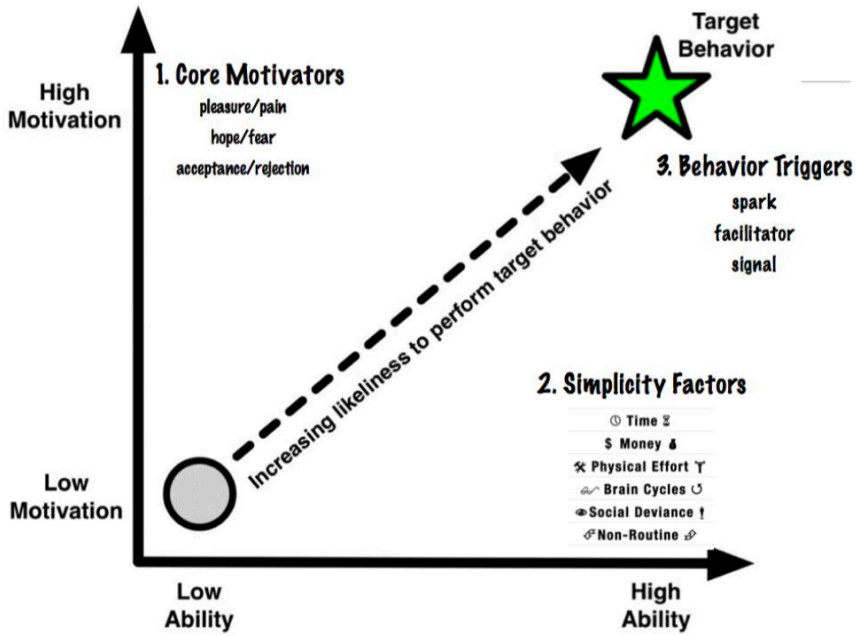

Figure 4: Fogg Behaviour Model. Source: Fogg (2009, p.2)

3.2.3 Social Norm Theory

The Social Norm Theory emerged from the study of misperceptions about peer norms in regard to alcohol abuse (Perkins, 2003). This theory was developed to describe the situation where individuals wrongly perceive the attitudes and/or behaviours of others, leading them to express or inhibit behaviours (Berkowitz, 2003). Two phenomenon can be observed: (1) "**pluralistic ignorance**" where an individual believes that the opinions of other are different from their own, leading them to act in a way that is not in line with their true beliefs (Mendes et al., 2017); (2) "**false consensus**" where an individual wrongly believes that their behaviour is normative, allowing them to deny any wrong-doing or to justify their actions (Pollard et al., 2000).

If these phenomenon are observed during a baseline measurement within the target population, the misperceptions can be countered by (intensively) presenting individuals with the correct information about the actual norm during an intervention (Berkowitz, 2003), as it can be observed in Figure 8. Communication strategies can include posters, targeted mailing, ads, radio announcements and other media communications (Perkins, 2003).

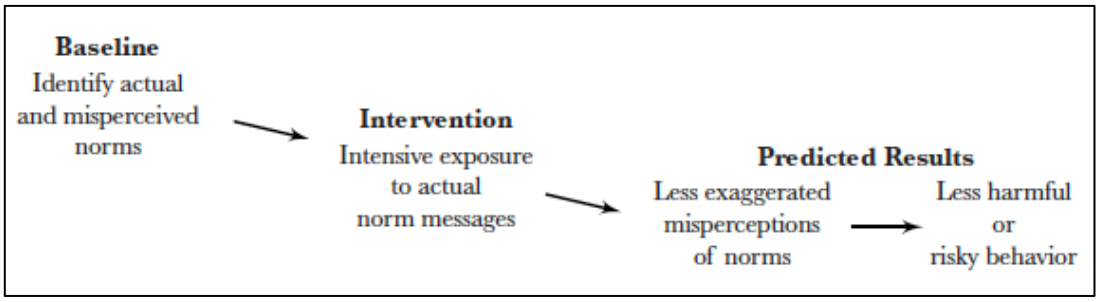

Figure 8: Model of social norms approach to prevention, retrieved from Perkins (2003, p.11)

3.2.4 (Extended) Norm activation model

Schwartz and Howard's (1981, 1982 as cited in Blamey, 1998) Norm Activation model states that the activation of norms regulating helping behaviours is activated when one is aware of a need (**awareness of need** - AN), of the positive consequences of one's own action (**awareness of consequence** - AC) and when one feels responsible for acting (**awareness of responsibility** - AR). The process by which manifestations of AR and AC are brough together takes place in five stages:

(1) **Attention**: one must first notice a need and assess its seriousness (step 1a); if selected, relevant actions to satisfy the need are identified (step 1b), one must feel confident in one's personal ability in order to proceed further (step 1c).
(2) **Consequences of action for self** (cost and benefit analysis): one identifies the physical, material and psychological implications; the implications for one's value and the social implications of the action, which together will form a feeling of obligation.
(3) **Anticipation evaluation** (cost and benefit evaluation): once identified, the implications are weighted to evaluate whether or not the action is justified. If there is a clear-cut imbalance, one will proceed depending on the imbalance (step 5: action or inaction), if however there is balance in the evaluation, one will proceed with step 4.
(4) **Defense**: this stages encompasses altering perceptions of the preceding stages such as denial of need, denial of effective action, denial of ability and denial of responsibility.
(5) **Behaviour**: action or inaction.

An important addition to this model regarding pro-environment behaviours has been made by Blamey (1998), who rightfully points out that, in the case of environmental problems, the question is not only whether an individual will perform a certain behaviour but whether enough individuals will, introducing the notion of **shared responsibility** with the related notion of cooperation and coercion. However having an incentive to cooperate and being assured that others will contribute is not enough for one to perform in a pro-environmental way. In this respect, the author introduced the notion of "**acceptance of policy initiatives**" (AP).

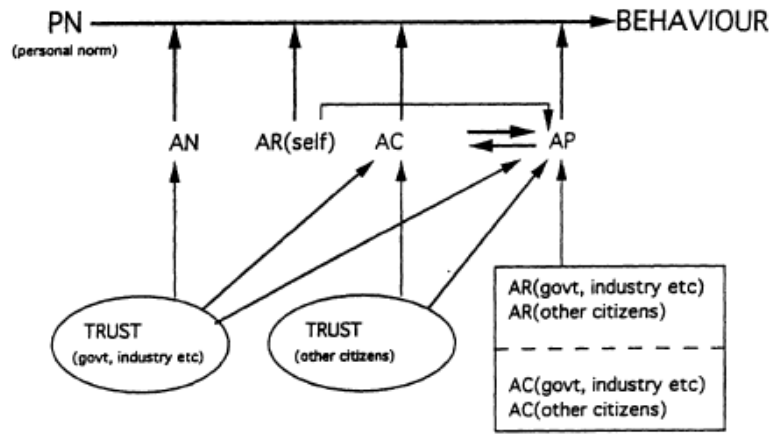

Figure 9: Extended Norm-Activation Model, retrieved from Blamey (p.689, 1998)

3.2.5 Diffusion of Innovation Theory

The Diffusion of Innovation (DoI) is the process by which people adopt an "innovation", which is defined by Rogers (2003, p.12, cited by Sahin, 2006) as "an idea, practice, or object perceived as new". According to the Diffusion of Innovation Theory, an innovation will diffuse through the population more rapidly if certain conditions are met (Cain & Mittman, 2002; Sahin, 2006):

- Relative advantage: if the perceived value gained through the adoption of the innovation is greater than previous options.
- Trialability: if individuals have the possibility to try the innovation without too much investment.
- Observability: if individuals have the possibility to witness the adoption of the innovation by someone else as well as the results of the said innovation.
- Compatibility: if the innovation is able to coexist with existing norms, rules and social networks.
- Complexity: if the innovation is easy to understand and use.

Generally, there are only a few people interested in a new idea and willing to adopt it. Once those people, called "early adopters", have adopted the new idea, they will "spread the word" to other people, first to the "early majority", then to the "late majority" and finally to the "laggards", driving them into adopting the idea, reaching "critical mass". The new idea will then spread into the population until a saturation point is met (Kaminski, 2011).

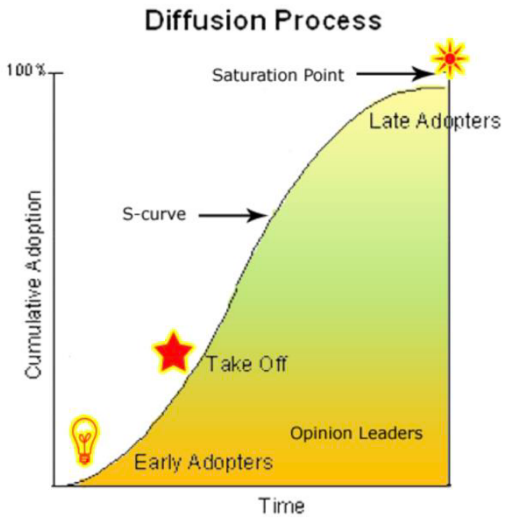

Figure 10: The diffusion process. Source: Kaminski (2011, p.4)

Based on this typology, social marketing has developed three profiles to classify people regarding their position towards an innovation. First, the "**show me**" group is composed by innovators and early adopters from the DoI Model. These people usually do not need anything more than an example through education and information to follow the lead (Lee & Kotler, 2015). Second, the "**help me**" group is composed by the early and late majority from the DoI. These people are not opposed to the innovation or new behaviour but there are barriers to take actions. They need incentives, opportunities and convenient external factors to take action (Lee & Kotler, 2015). This group is generally the main one targeted by social marketing. Finally, the "**make me**" group is composed by the laggards from the DoI. Those people show no interest at all to adopt the innovation or the new behaviour. It will take laws and fines to make them comply (Lee & Kotler, 2015).

Selective biowaste sorting can be considered as an innovation in the sense that it represents a new behaviour to some individual. The specific situation in the pilots cities will be evaluated and the intervention will be tailored to the state of the population.

3.2.6 Trans-theoretical Model or the Stages of Change

The Stages of Change Theory describes a model of six stages that people have to go through in order to change their behaviour (Lee & Kotler, 2015 ; Morris et al., 2012):

1) Stage 1: pre-contemplation. At this stage, people have no intention to change their behaviour in the near future, have little to no awareness about the problem and are typically in denial. Possible strategies for change to the next stage would be conscious raising, dramatic relief, social liberation or environmental re-evaluation.
2) Stage 2: contemplation. In this stage, people acknowledge the problem and are thinking about solving it but are not quite ready to act yet. Self re-evaluation is a possible strategy for change.
3) Stage 3: preparation. Here, people have the intention to take action but are not yet making actual changes and might have experienced an unsuccessful attempt in the past. Helping relationships who provide support, and an increase in self-efficacy might help in moving towards the next stage.
4) Stage 4: action. In this stage, people are overtly modifying their behaviours. In this case, reinforcement management is needed with rewards provided for positive behaviour.
5) Stage 5: maintenance. Here, people are working towards consolidating their gains and efforts, aiming to sustainably changing their habits. In this process, reminder and cues are important to sustain the behaviour.
6) Stage 6: termination. People in this stage have completed the behaviour change process.

The model indicates that the transitions between stages are dependent on self-efficacy and on a decisional balance between pros and cons regarding the change (Morris et al., 2012). A linear progression through these stages is possible but relatively rare, with people usually going back and forth between stages (Lee & Kotler, 2015). As individuals in the same stage could face the same barriers, change procedures could target people present in the same stage with the same intervention.

3.2.7 Value-Belief-Norm Theory of environmentalism

Stern and colleagues (1999) have developed, based on values and norm-activation processes, the Value-Belief-Norm (VBN) Theory of movement support. The authors distinguish "movement support" from activism and present three types of "less intense" kind of support: (1) low-commitment active citizenship, such as writing letters to political officials; (2) support and acceptance of public policies, such as paying higher taxes; and (3) changes in behaviours in the personal or private sphere, such as the reduction of energy use.

The authors propose that the support for a movement, such as environmentalism, lies in the conjunction of values, beliefs and personal norms, as displayed in Figure 11. However, their influence on behaviour is tied to the individual's capabilities and constraints.

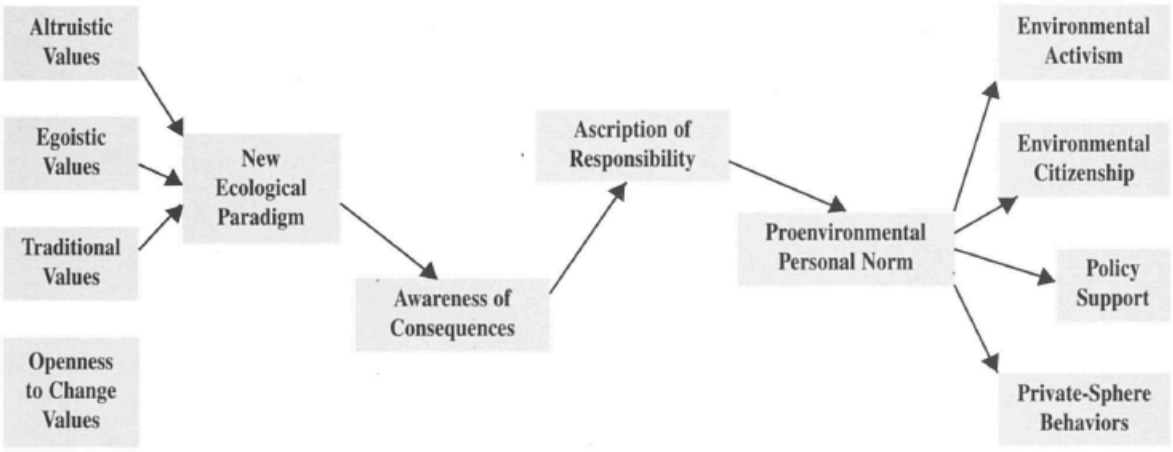

Figure 11: Schematic model of variables in the Value-Belief-Norm theory as applied to environmentalism from Stern et al. (p.84, 1999)

3.2.8 Model of Pro-environmental Behaviour

Kollmuss & Agyeman (2002) have developed their Pro-environment Behaviour model with the aim of incorporating the factors that have been found to have a significant influence on pro-environmental behaviours. They offer their model as an alternative to the early linear model that would assume a linear progression from environmental knowledge to environmental awareness to pro-environmental behaviour –which was proven wrong– and as a synthesis of the relevant existing models. However, the authors acknowledge the question of what shapes pro-environmental behaviour as so complex that it probably cannot be visualised within one single framework, and it probably should not as it would be so complicated it would lose its practicality. To construct their model, the authors distinguish between three types of factors: demographics, external and internal factors.

(1) **Demographic factors**: the **gender** and **years of education** of individuals have been found to influence environmental attitude and pro-environmental behaviours.

(2) **External factors**: this encompasses **institutional factors**, such as the presence of the necessary infrastructure; **economic factors**: although poorly understood, economic incentives have an impact on individual's behaviour but they should be understood within a wider social, infrastructural and psychological framework; **social and cultural factors**, such as cultural norms play an important role in shaping individual's behaviour.

(3) **Internal factors**: the intensity and direction of **motivation** are the reasons around which a behaviour is organised and such motivation can be conscious or not; (environmental) **knowledge** has been widely discussed but it appears it only has a moderate effect on pro-environment behaviour; **values** shape intrinsic motivation and are influenced by different systems in one's life, such as the microsystem (e.g. family), exo-system (e.g. media) and macrosystem (e.g. cultural context); the influence of **attitudes** on behaviour has been a largely discussed subject and has been found to vary greatly; the influence of **environmental awareness** is limited to the non-immediacy of many ecological problems, the fact that the ecological destruction is slow and gradual, and the complexity of systems, all of which are elements that need to be countered in the intervention; **emotional involvement** is very important in shaping our beliefs, values and attitudes toward the environment; the strength of

one's internal **locus of control**, translating the fact that one feels that their action is significant, has an influence on one' behaviour; and one's feeling of **responsibility and priorities**, influenced by values, attitudes and locus of control, can increase one's motivation to perform a certain behaviour.

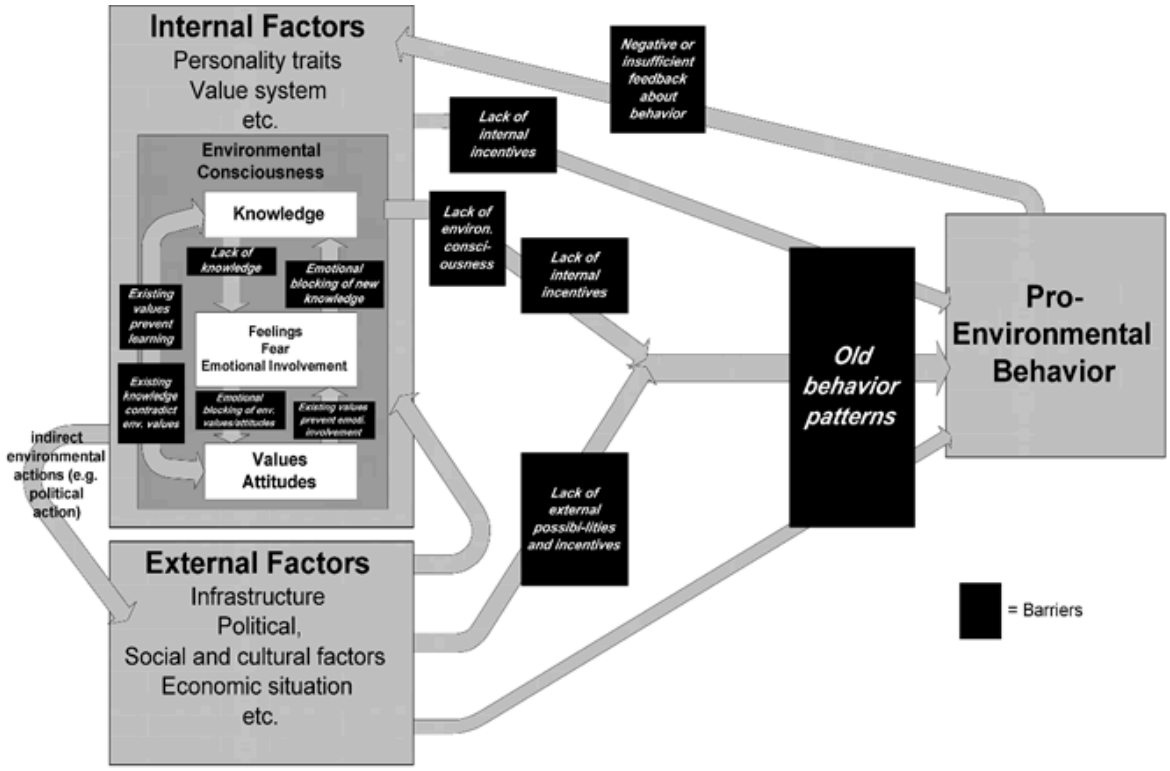

Figure 12: Model of pro-environmental behaviour from Kollmuss & Agyman (p.257, 2002)

3.2.9 Pro-Circular Change Model (P-CCM)

Muranko et al. (2018) have developed the Pro-Circular Change Model as a framework that aims to change consumer and organization behaviours that are typically against Circular Economy principles (i.e. that shorten the lifecycle of a functional product or component). The framework, based on the Theory of Planned behaviour, can be used to encourage pro-circular behaviours within a specific target group and a specific industry, using marketing interventions such as persuasive communication. The model is composed of three elements: (1) **Behavioural Intention** which, based on the Theory of Planned Behaviour estimates the probability of performing a pro-circular behaviour; (2) **Pro-Circular Values** which are social, economic and environmental values; (3) **Behaviour Change Intervention** which utilizes and targets the factors underlying the pre-identified intentions and values in its persuasive communication.

So far, the model has only been applied to the purchase of remanufactured refrigerated display cabinets where the use of persuasive communication has been found to have *some* positive impacts on participants' behavioural attitudes, product perceptions and behavioural intentions (Muranko et al., 2019). Further, the framework has been originally developed to support the adoption of pro-circular behaviours regarding technical goods rather than biological goods (Muranko et al., 2018) where it would need additional investigation.

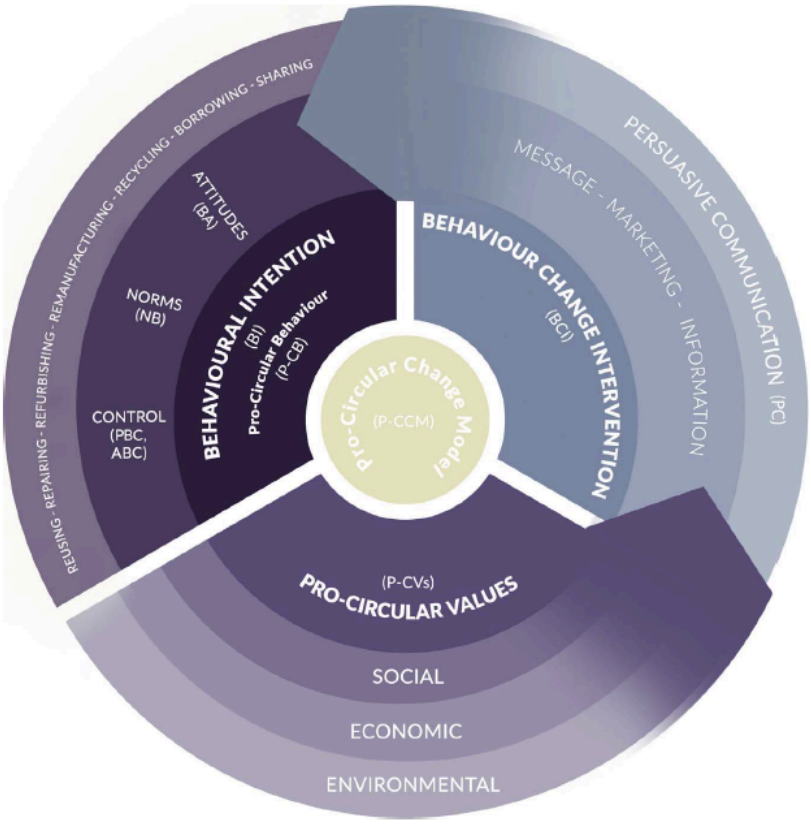

Figure 13: Reproduction of the Pro-Circular Change Model (P-CCM) from Muranko et al. (p. 134, 2018)

3.3 Consumer orientation

The consumer orientation of the Social Marketing approach uses a wide range of research analysis and sources of data to truly understand the audience's lives and behaviours, aiming to yield actionable insights. In the WaysTUP! behaviour change track, consumer orientation was addressed in several phases: a literature review (reported in D4.1), experts interviews (reported in D4.1), a community assessment survey and co-creation workshops. The following sections detail the methods that were used while the results are reported in section 3.4, 3.5, 3.6 and 3.7.

3.3.1 Literature review

First, a literature review was conducted, to get a first grasp of the **individual determinants of selective biowaste sorting**. Although this step does not address the WaysTUP! pilot communities specifically, it gives a first tangible basis to understand the mechanisms of individual's and households' selective biowaste sorting behaviour. This activity was part of T4.1 and was reported in D4.1, Chapter 3. **Error! Reference source not found.** provides a summary of the determinants identified during the systematic literature review.

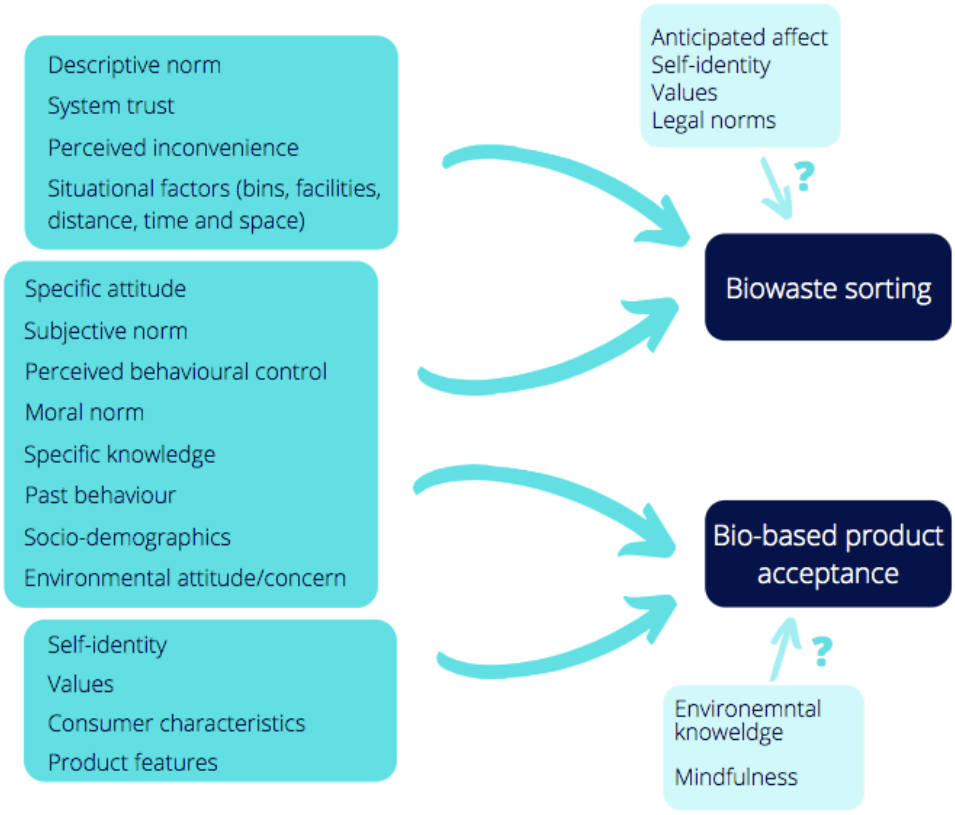

Figure 14: Selective biowaste sorting determinants based on systematic literature review

As can be observed from Figure 14, a lot of determinants have an impact on both the selective biowaste sorting and the acceptance of bio-based derived products. This is why the behaviour change intervention of WaysTUP! will aim to increase both components by developing a comprehensive toolkit. The identification of these determinants later informed the development of the 'community assessment survey' (see section 3.3.3).

3.3.2 Experts' interview

Second, experts' interviews were conducted with the different pilot communities' coordinators. This activity had as its objective to **identify and define the target audiences** for each pilot city, **gain initial insights** into these target audiences as well as to carry out an **early evaluation of their readiness** to perform selective biowaste sorting. From this activity reported in D4.1, Chapter 4, the following profiles have been created:

PILOT COMMUNITY 1: VALENCIA, SPAIN (coordinator: SAV)

Target communities: local business federation, restaurants, (food) markets (i.e. VLC central market, MercaValencia), fishermen cooperatives, as well as households.

Presence of selective sorting: yes, through external containers.

Current sorting performance: can be improved. Young adults have been identified as early adopters that could drive the adoption of the behaviour.

Bio-based product acceptance: no data available.

Readiness to change: no data available.

PILOT COMMUNITY 2: ATHENS, GREECE (coordinator: SUST & HSPN)

Target communities: households, schools, hotels, restaurants, bakeries, farmers.

Presence of selective sorting: depending on the municipality; Vari-Voula-Vouliagmeni has external containers; Elliniko-Argyroupoli does not (biowaste is generally disposed of unsorted - bins have started to be placed but the network is extremely coarse). It is to be expected that target communities will be lacking the necessary equipment and the daily practice of biowaste separation.

Current sorting performance: households somewhat perform the behaviour, schools, bakeries and open markets do not.

Bio-based product acceptance: no data available.

Readiness to change: lack of economic benefits, knowledge about (bio-)waste management practices and experience; absence of a single system providing information; difficulties faced by local municipalities in ensuring procurement for biowaste separation equipment.

PILOT COMMUNITY 3: BARCELONA, SPAIN (coordinator: AMB)

Target communities: households (in Tiana and Bon Pastor municipalities)

Presence of selective sorting: yes, through door to door pickup or community bins.

Current performance: good, high engagement.

Bio-based product acceptance: no data available.

Readiness to change: no data available.

3.3.3 Community assessment survey (online)

Third, to gain a deeper understanding of the pilot communities' target audiences, an online survey was launched. The goal of the survey was twofold: (1) understand the audiences to better design the behaviour change interventions; (2) evaluate the current status regarding biowaste in terms of attitude, knowledge and behaviours amongst other. For each aspect investigated by the survey, the results are analysed on the level of each pilot (Athens, Barcelona, Valencia). The survey was composed of several parts and can be found in "6.1 Annex 1: Community assessment online survey: questionnaire". The questionnaire was built on the insights collected in D4.1 "Scope of the behavioural change campaign: a behavioural mapping exercise" in regard to the determinants highlighted in the literature (see also section 3.3.1, Figure 14).

The online assessment survey was distributed in the three pilot cities over a period of 3 months (December 2020 to February 2021). SUST, HSPN, AMB and SAV translated and disseminated the survey through their network, notably through WhatsApp, LinkedIn, Twitter, newsletters, Facebook, direct emails and Instagram. In total, more than 1000 citizens

were reached and accessed the survey. In total, **439 citizens** completed the survey entirely, 214 from Athens, 148 from Barcelona, 77 from Valencia. Further, **37 businesses** completed the survey entirely, 16 from Athens (through phone interviews conducted by HSPN, mainly through the Green Key network), 8 from Barcelona and 13 from Valencia (it is to be noted that some of these businesses are business chains, e.g. hotel chains, and therefore represent several establishments at once).

(1) Segmentation

The first part of the survey was composed of the 'Six Americas Short SurveY' (SASSY), a 4-item survey derived from the longer 36-item Global Warming's Six Americas (GWSA), slightly modified to fit the pilot's situation (i.e. when "in America" was mentioned in items, it was systematically replaced by "in your country"). The 36-item GWSA is a widely used segmentation tool developed by Maibach et al. (2009) that accounts for the variation of responses in the population regarding climate change, translating the need for a tailored approach for each segment. Recently, the scale was shortened to a 4-item version which was tested and validated by the same team of researchers - its segmentation performance being comparable to the longer version of the survey (Chryst et al., 2018) - which we selected for our assessment.

The GWSA identifies six distinct groups in regards to their beliefs about global warming, their engagement with the issue, their actions and how they believe their government should handle the issue. Ranking from the segment that holds the highest belief in global warming and is the most concerned and motivated, to the one that hold the lowest belief in global warming and is the least concerned and motivated, the segmentation goes as follows: (1) alarmed, (2) concerned, (3) cautious, (4) disengaged, (5) doubtful, (6) dismissive. From this segmentation arises a distinct informational need and media use that should be taken into account to deliver effective communications to the audience. Table 4 lays down a summary of Roser-Renouf et al. (2014)'s methods for effective communication with each segment.

Table 4: Summary of the Global Warming Six Americas segmentation, characteristics, communication challenges and solutions based on Roser-Renouf et al. (2014)

Segment		Characteristics	Challenge	Solution
High Involvement - high attitude	**Alarmed**	Convinced of the reality of climate change, they seek **solutions and actions** to undertake. They actively follow environmental news and pay close attention to global warming information.	Motivate to take **action**	Using centrally processed arguments Building perception of efficacy: response-, self- and collective-efficacy Activating leadership potential
	Concerned	Although they seek **solutions and actions** to undertake, they are also looking for **scientific proof** of the reality of global warming. They pay attention to environmental news.		

Low involvement	Cautious	They'd like **scientific proof** of global warming and the human role in it, however **they do not seek answers**.	**Gain attention** through effortless methods	Require only peripheral/heuristic information processing Promote positive social norm Show rather than tell Show impact 'close to home' Use narratives
	Disengaged	They are not sure about global warming and pay **little attention** to it or other type of news.		
High involvement - low attitudes	Doubtful	Climate change might be happening but is **not an important issue** to them. They'd like to have **scientific proof** of it, however, they do not pay attention to the topic themselves.	**Persuade** them that their suspicion and beliefs **are incorrect**, but with the risk of a boomerang effect	Indirect approach by appreciating the underlying motivational structures (e.g. values of individualism and respect for established order) Show impact 'close to home' Use health-related argumentation
	Dismissive	They are confident **global warming is not happening** and is not an issue. They'd like to have **scientific proof** of it, but are unlikely to trust it.		

By applying the GWSA segmentation to the WaysTUP! Pilot communities, we will be able to understand the type of audiences we are addressing and how they should be addressed. Depending on whether a pilot's community will be majorly "high involvement – high attitude", "low involvement" or "high involvement – low attitude", the communication included in the intervention can be tailored.

(2) Circular Economy assessment

This part of the survey focused on Circular Economy (CE) as a holistic concept. First, the **awareness** of the concept of CE is assessed then the **role of citizens** in the CE is also assessed. The goal of this was not only to have an idea of the awareness about CE and of the role of citizens within it in each pilot city, but also to investigate if the use of such concepts/wording in future communication would make sense, or if some educational material were needed.

(3) Biowaste sorting

In this part, we built upon the literature review conducted for D4.1 and the different factors that were identified as having an influence on selective biowaste sorting. From there, we elaborated several items assessing[1]: citizen's **sorting and biowaste sorting behaviours**, together with possible **competing behaviours** they are undertaking instead of selective biowaste sorting; **attitude** regarding selective biowaste sorting; **subjective norm; personal norm; descriptive norm; self-efficacy** and **perceived behavioural control** regarding selective biowaste sorting; **instrumental knowledge**; **awareness of consequences/benefits;** and **awareness of responsibility** together with **perceived inconvenience** and **system trust** regarding

[1] All reliability analysis of the scales were conducted and can be found in Annex 2.

selective biowaste sorting (for more information regarding these factors, see D4.1). This specific part of the survey helps us to identify points of interest for the interventions by highlighting the areas that have an influence on the citizens' behaviour and which might currently rank low or negative. For example, we could see after statistical analysis that one pilot community's evaluation of the subjective norm is negative and, based on literature, we know that subjective norm is influencing selective biowaste sorting behaviour (i.e. people who believe that their neighbours are not sorting their waste, are in turn not sorting their own waste). Based on this result, an avenue for the behaviour change intervention would be to promote a positive social norm (e.g. through social media communication "*Your neighbours are already sorting their biowaste. Join them!*").

(4) Community involvement

This part of the survey enabled us to recruit participants for the rest of the project by giving them the possibility to let us know if: (1) they'd like to be engaged in future activities of the project; (2) they'd like to be active in their community; (3) they'd like to receive more information on biowaste sorting.

(5) Demographics

Finally, the survey ended by several demographic questions such as: age, gender, income, level of education and household composition. Results per pilot can be found in "6.2 Annex 2: Community assessment online survey: analysis".

3.3.4 Co-creation workshop with community members

Finally, four co-creation workshops were organised in order to collect more insights and co-create the behaviour change intervention with the local communities. Two workshops per pilot city were organised (in Athens and Valencia). The aim of the co-creation workshops was to understand participant's experience with biowaste and biowaste sorting, and especially to identify the costs and benefits of the sorting behaviour, as well as competition with it. During the focus groups, different methods of intervention and communication were also investigated. The workshops were held online and used the platform 'aha slides' as an interactive interface and basis for more in-depth discussion. This track was pursued as a mitigation track after in-person workshops were ruled out due to COVID-related restrictions. Participants attended the workshops through a telecommunication platforms such as Zoom where the workshop's organisers (SUST or SAV) shared their screen displaying the aha slides. The 'aha slides' displayed some interactive content and participants were invited to take part by answering with their smartphones. Each slide was followed by a more in-depth discussion based on the responses of the participants on the 'aha slide' platform. The slides and results of the workshops can be found in Annex 3.

In Athens, SUST carried out two workshops with citizens through Zoom, one with citizens of the Municipality of Vari-Voula-Vouliagmeni (VVV) and one with citizens of the Municipality of Elliniko -Argyroupoli, which are both located in the Attica Region. The first Focus Group for citizens of the Municipality of Vari-Voula-Vouliagmeni, was held on Tuesday 16/02/2021, 12:00 CET and involved 6 citizens. The second Focus Group for citizens of the Municipality of Elliniko-Argyroupoli, was held on Tuesday 16/02/2021, 14:30 CET and involved 6 citizens.

In Valencia, SAV carried out two workshops, one with citizens and one with businesses through Zoom. The workshop with citizens counted four participants, two students and two middle-

age citizens. The workshop with businesses had four participants as well, one market wholesaler, one restaurant owner, one bar owner and one tavern manager.

The pilot of Barcelona did not conduct any workshops due to a change in the waste stream of Pilot 6. Indeed, the COVID-related restrictions have forbidden the collection of diapers from nurseries and elderly care homes. Following this change in the waste stream, the target audience for the behaviour change track had to be modified, and AMB had foreseen to involve the citizens of Barcelona as a mitigation track. However, in a near future (end of May 2021), a door-to-door biowaste collection scheme and an associated awareness raising campaign targeting citizens are planned to be implemented by the Barcelona City Council. Therefore, it was decided to modify the engagement of AMB in the behaviour change intervention, whereby AMB would focus on a collaboration partnership and synergy with the City Council, rather than implementing a parallel intervention. As AMB will no longer lead the implementation of the behaviour change intervention in Barcelona, the co-creation workshops were cancelled.

3.4 Insights

This component of the Social Marketing approach refers to the identification and verification of actionable insights of the target audience, and overall enables the insight on the individuals' psychological and behavioural means of adopting the behaviour. In this section, we will mainly report on the analysis from the 'community assessment survey' and focus groups which can be found in 6.2 Annex 2: Community assessment online survey: analysis" and 6.3 Annex 3: co-creation workshops" of this report.

The **citizens in the Athens pilot** currently display the lowest rate of self-reported selective biowaste sorting, with more than 44% of respondents in our community assessment survey reporting they never sort their biowaste, and only 31.9% indicating they do so more frequently than half of the time (and this even though their municipality does have a collection scheme in place). However, Athenians appear aware of the concept of CE with more than 66% of respondents indicating being aware of the concept and more than 83% indicating that they believe citizens have an active role to play in it.

Overall, Athenians also display a positive attitude regarding biowaste sorting per se (68.2% of them), appear aware of the consequences (positive and negative) of biowaste sorting (69.5%) and believe they are personally capable of sorting their biowaste (78%). More than 93% of them also believe that they should sort their waste but only 50% of them believe others think they should sort their waste, only 51% would feel bad if they did not and only 58% of them believe they have a responsibility for the negative consequences of non-sorting. **Only a minor percentage of respondents believe that others are actually sorting their waste (8.4%)**, which is understandable given the actual low frequency reported before. Athenians also perceive that they do not have all the elements in their power to sort their waste (only 18.7% do), do not perceive sorting their biowaste as convenient, nor trust that their authorities actually recycle their biowaste. Similarly, only 38.6% of the participants displayed a positive instrumental knowledge, indicating that **lack of knowledge on what to sort**, element which was also reported during the co-creation workshop. It appears that the items that are most commonly missorted are 'pizza box' (missorted by 95.3% of respondents) and 'paper tissues' (missorted by 88.4%) followed by 'bones' (missorted by 42.3%), 'expired food' (missorted by 36.3%) and 'unwanted cooked food' (missorted by 31.2%).From these elements we observe that the fact that Athenians report not sorting their waste more frequently does not relate to a lack of positive

attitude regarding biowaste, personal norm, awareness of consequences nor self-efficacy. Rather, **the lack of biowaste sorting might come from their perception of external elements such as the (un)convenience related to biowaste sorting, the perception that they are not provided with everything they need to recycle and their perception that their biowaste is not actually being recycled**. Athenians declared during the workshops that they were aware and environmentally conscious, and they were willing to sort biowaste, but that they do not receive information from their Municipality on the brown bin network, whether it be on location of the bins, time of collection, what to sort and what happens to biowaste after collection. Further, it appears from the workshops that **it is not the act of sorting that requires the most effort from citizens but rather the act of taking their bags to a point of collection (the brown bins)**.

Businesses of the Athens pilot report sorting their waste rather frequently with 56.3% of them indicated they do so more than half of the time. Businesses mostly do not believe that other businesses do selectively sort their biowaste, nor that their employees or clients would like them to sort their biowaste (only 33.3% and 40% respectively). Likewise, only 37.5% of businesses have a positive attitude regarding biowaste sorting and only 1/3 perceive biowaste sorting as convenient or trust their local authority to actually recycle the sorted biowaste. Just about half of the businesses appear aware of the consequences of non-sorting and only 40% perceive it as their responsibility. However, the large majority of businesses does think they should sort their biowaste (66.7%) and believe that they are able and have everything in their power to do so (both 73.3%), but only 53.3% of them display a satisfying level of instrumental knowledge regarding biowaste sorting. Overall, businesses seem to be aware of the concept of CE, but only 56.3% of them believe that businesses have a role to play in it.

The intervention strategy for Athens should therefore work towards **increasing perception of subjective and descriptive norm, convenience (information on bin location and time of collection), instrumental knowledge and of the relevance of the behaviour (information on outcomes and personal responsibility)**. Specifically for the businesses, communication should emphasise the **active role of businesses in Circular Economy**.

The **citizens of the Barcelona pilot** currently display the highest rate of self-reported selective biowaste sorting, with almost 65% reporting they selectively sort their biowaste all the time. Barcelonans also appear quite aware of the concept of CE, with more than 72% indicating that they knew of it, while more than 76% thought citizens had an active role to play in it.

They displayed a very positive attitude towards biowaste sorting (81.1% of them) as well as a high personal norm (91.9%), positive moral guilt in case they would not sort (78.4%), positive behavioural control (72.3%) and self-efficacy (85.1%), as well as a good awareness of consequences (76.4%) and instrumental knowledge (75.8% - although knowledge regarding 'paper tissues' and 'pizza box' could however be increased as there are missorted respectively by 66.4% and 96.6% of the respondents). To a lesser extent they trust their authorities to actually recycle their sorted biowaste (62.2%) and also believe that others think they should sort their waste (58.1%). However, only 49% perceive selective biowaste sorting as convenient, only 42% believe that others are actually sorting their waste and only 42% feel a personal responsibility regarding the negative consequences of non-sorting.

On the contrary to what was observed for citizens, **businesses in Barcelona** appear to sort their biowaste quite infrequently with only 33.3% indicating doing so more than half of the time. Accordingly with that fact, businesses display a lack of descriptive norm: **none of the businesses believe that other businesses sort their biowaste**. However, they do believe that

their employees and clients would like them to sort their biowaste (80%), and also believe they should do so (60%). Businesses in Barcelona have a very positive attitude regarding biowaste sorting (80%), and all businesses agreed that they were individually able (100%) and that everything was in their power to sort their biowaste (100%). Although only half of them seemed aware of the consequences of non-sorting, and half of them displayed a satisfying level of instrumental knowledge regarding biowaste sorting, 61.5% of them did believe that the they were jointly responsible for the negative consequences of non-sorting. Finally, only half of the businesses thought that biowaste sorting was convenient and only 25% trusted that their local recycling facility were actually recycling the sorted biowaste. Businesses in Barcelona are aware of the concept of CE (71.4%) but only 57.1% believed that businesses have a role to play in it.

The intervention strategy for Barcelona should focus on elements of **perceived personal responsibility, descriptive norm, subjective norm, perceived convenience and system trust**. Specifically for the businesses, communication should emphasize the **active role of businesses in Circular Economy.**

The **citizens of the Valencia pilot** do not display a trend in terms of selective biowaste sorting: while 46.1% indicates selectively sorting their biowaste less than half of the time, 41.2% indicated sorting its biowaste more frequently than half of the time. Unlike the other pilots, only 38.2% of the respondents indicated being aware of the concept of CE, which might suggest that an awareness raising campaign could be undertaken in the city. However, 68.4% of the respondents believed that citizens had an active role to play in it.

Valencians display a positive attitude towards biowaste sorting (64.9%) as well as high perception that they should sort their waste (94.8%). Likewise, they believe that they are personally able to sort their biowaste (81.8%) and that they have all the elements they need to do so (81.8%). Further, they display a good perception of the consequences of selective biowaste sorting (79.2%) and also think they are partly responsible for some of the negative consequences of non-sorting (81.8%). In a lesser extent, they feel guilty when they do not sort their waste (62.3%). While only 56% think that selective biowaste sorting is convenient, only 48% trust their authorities in actually recycling their sorted biowaste. This was also corroborated in the workshop, were citizens indicated that the most inconvenient factor was the time required to bring the biowaste bag to the container. Participants in the workshop also mentioned that they were not sure sorting was worth it as they were not sure waste was appropriately treated once collected. Only a few Valencians believe that others are actually sorting their biowaste (36.4%) or believe that others think they should sort their biowaste (42.9%). Finally, only 28.6% of respondents displayed a positive instrumental knowledge translating a real **lack of knowledge regarding what to sort**, element which was also reported by the participants of the co-creation workshop. We observe that the items which appear the most confusing to the respondents are 'paper tissues' (missorted by 92.2%), 'pizza box' (missorted by 87.0%), 'leaves' (missorted by 61.0%) and 'tea leaves' (missorted by 55.5%).

As was the case with the citizens, the **businesses of the Valencia pilot** do not display a trend in terms of selective biowaste sorting: 23.1% do so less than half the time, 30.8% do so half the time and 46.2% do so more than half the time. Businesses were all very positive regarding biowaste sorting, with all investigated elements scoring positively. Most specifically, the attitude, perceived behavioural control, self-efficacy, instrumental knowledge and awareness of consequences of non-sorting all scored very high (more than 80% agreed on these elements). As was the case with the other pilots, the elements that scored the lowest was the

descriptive norm (53.8%), with businesses believing that other businesses do not sort their biowaste. Although only 53.8% of the businesses indicated being aware of the concept of CE, 61.5% believed that businesses have a role to play in it and only 61.5% believed it is their personal responsibility.

For Valencia, the intervention strategy should therefore focus on **increasing citizen's instrumental knowledge, descriptive and subjective norm, perceived convenience and system trust**. Communication efforts should also be directed towards increasing both citizens and businesses **awareness and understanding of Circular Economy** and on the role of each actor in it.

3.5 Exchange

The project should highlight that taking part in the new behaviour will lead to an exchange in costs and benefits, where the benefits outweigh the costs (Kim et al., 2019). As with most pro-environment behaviours, the exchange involved in the selective biowaste sorting behaviour represent a challenge as there is, at first sight, no direct benefits for the participants. Individuals are asked to perform a sequence of actions: (1) if applicable, buy a biowaste bag recognised by the municipality; (2) if applicable, find a place for the bag/bin in their home; (3) mentally assess whether the waste item is considered a biowaste or not according to the municipality's directions; (4) dispose of the item in the bag/bin; (5) take out the bag/bin at the correct time of the correct day for pick up; (6) if applicable, fetch the bin after waste pick up. However, the direct advantage for individuals is not clear. This combination of (1) individual cost vs collective interest and (2) present action for future consequences, contributes to what Gardiner calls the "**perfect moral storm**" (2006, p. 398) and leads to a low perception of the "consequences of action for self" from the Extended Norm Activation Model of Schwartz and Howard.

This imbalance between the costs and the benefits was highlighted during the co-creation workshops for both citizens and businesses. When asked to describe advantages and disadvantages of selective biowaste sorting, elements of responses from participants display a conflict in their locus: while most of the perceived advantages are external to the individual (environmental protection), the disadvantages are all internal (time consuming, inconvenient). **The balance between the costs and the benefits of the behaviour is therefore challenged**.

In relation to this, another element that became clear during the workshops is that citizens only had a weak feeling of trust towards their local authorities regarding biowaste sorting and recycling: they are not sure that their municipality is actually treating the waste correctly and are afraid their efforts are in vain. They also mentioned that they lack knowledge regarding the rest of the cycle: where is the biowaste transferred being sorted? How is it treated? What is the outcome of the process? **This would also create an imbalance in the costs and benefits where citizen are enduring the costs of the behaviour but have no guarantee that their action will result in benefits**.

In the case of selective biowaste sorting behaviour, we can therefore say that citizens perceive **high barriers to the behaviour while perceiving low (individual) benefits.** A way to rectify the imbalance between the costs and the benefits would therefore be to:

(1) **Decrease the perception of the barriers**: provide easy-to-understand information on how to sort their biowaste, location of points and time of collection; decrease feeling

of inconvenience; and provide examples of the behaviour so that individuals will perceive it as easier to undertake.

(2) **Increase the perception of the benefits**: emphasize the relevance of the behaviour in terms of collective outcomes (treatment of biowaste and results of it) and individual outcomes (moral gratification and environmental consciousness) – as highlighted during the workshops – compared to the competing behaviour. The relative advantage of the action must be emphasized, as described in the Diffusion of Innovation Theory: the perceived value gained through the adoption of the innovation (here: selective biowaste sorting) must be greater than other options. Another possible way to increase the benefits, as suggested by the participants of the co-creation workshop would be for the authorities to provide **incentives** for the behaviour. This is in line with the recommendation of Schultz (2014) on behaviour change tools in function of the perceived barriers and benefits of the said behaviour: Schultz indicated that for behaviour with high barriers and low benefits, incentives and contests are appropriate tools.

3.6 Competition

The consideration of the competition to selective biowaste sorting behaviour is crucial to convert non-sorters into sorters. The goal is to understand what non-sorters are doing instead of selectively sorting their biowaste, and why, in order to counter it. This section will therefore focus on "competing behaviours" (Kim et al., 2019).

Competing behaviours to selective biowaste sorting can encompass the following:

- Not sorting waste (all waste in the residual waste bag/bin)
- Composting/feeding domestic animals
- Disposal in the toilet
- Disposal in a public bin
- Disposal in the nature

From our community assessment survey, we observe that the most preeminent competing behaviours are the same for all three pilot cities, whether for citizens or businesses: disposing of the biowaste into the **residual waste bag** and **into a public 'street' bin** (see also Annex 2). Further, as explained in section 3.1. not sorting one's biowaste (i.e. discarding it in the residual waste bag) can be considered as a habit due to its high frequency and repetitive nature. In this sense, 'fighting' the competing behaviour also means fighting a habit well-embedded in the individuals' life. When a specific action has become a habit, individuals are less likely to seek new information regarding the action or take new information into account (Jager, 2003), whereas contextual changes have been found to have a significant impact on habits (Wood et al., 2005).

Elements of the intervention should therefore first focus on **gaining the attention of the participants within their habitual behaviour**, e.g. by changing contextual factors on the sorting location. The content of the intervention should focus on **highlighting the impact of non-sorted biowaste** such as the fact that if not sorted, biowaste ends up landfills, that its valuable nutrients are lost and that it cannot be recycled into valuable products.

3.7 Segmentation

The intervention should select the target consumers by segmenting the population according to their characteristics (Kim et al., 2019). As suggested by Schultz (2014), different types of people respond differently to different type of messages, therefore, tools and communication should match the audience.

To better understand the type of audiences existing in the pilot cities, the community assessment survey included the SASSY scale, as explained in section 3.3.3. As we can observe in Table 5, the distribution between the different segments is relatively similar in all three pilot cities, with 75% of respondents being classified as 'alarmed', followed by 'concerned' and a very small percentage as 'cautious'. From this distribution, we can conclude that approximately **95% of the population of each pilot city is considered as "high involvement – high attitude"**: Citizens from Athens, Barcelona and Valencia are overall convinced of the reality of climate change although some are still looking for scientific proof of the reality of global warming. Most of them already pay close attention to environmental news and information.

Table 5: Segmentation of Pilot's population based on SASSY

Segmentation	Valencia	Barcelona	Athens
Alarmed	75%	75.8%	75.3%
Concerned	18.1%	17.4%	21.4%
Cautious	5.6%	2.7%	1.9%
Disengaged	-	-	-
Doubtful	-	0.7%	0.9%
Dismissive	-	-	-

In this sense, the audience is very much in line with the second "**help me**" group of the early and late majority from the Diffusion of Innovation model. As we observed from the community assessment and workshops, these people are not opposed to selective biowaste sorting but there are barriers to take actions. They need incentives, opportunities and convenient external factors to take action (Lee & Kotler, 2015).

The intervention should therefore focus on **motivating participants to take concrete action** by building self and collective efficacy, presenting the population with centrally processed arguments (such as information provision) and activating leadership potential.

3.8 Methods mix

The intervention applies all the marketing mix elements, namely the 4Ps: product, place, price and promotion (Kim et al., 2019).

The **product** element of the marketing mix consists of three components: the core product which represents the benefit to the audience for performing the behaviour; the actual product

which consists of the tangible good or service being promoted; and the augmented product which encompasses the additional elements to support the behaviour (Kim et al., 2019).

In regard to the WaysTUP! behaviour change intervention:

- The "core product" would be **a convenient way to participate in the recycling scheme** of biowaste.
- The "actual product" in the case of selective biowaste sorting would be the **biowaste bag or bin** needed to undertake the behaviour.
- A possible "augmented product" would be the **tools of the behaviour change toolkit**.

The **price** associated with the behaviour can encompass four types of incentives: monetary incentives (coupons) and disincentives (fines), or non-monetary incentives (gratification) and disincentives (shame) (Kim et al., 2019). These incentives can be used in different ways to promote behaviour change such as increasing the monetary and non-monetary benefits of the desired behaviour; decreasing the monetary and non-monetary costs for the desired behaviour; decreasing the monetary and non-monetary benefits of the competing behaviour; and increasing the monetary and non-monetary costs for the competing behaviour. In the case of selective biowaste sorting behaviour, and within the WaysTUP! strategy, **we will specifically focus on nonmonetary (dis-)incentives**.

Therefore the price strategy undertaken could focus on (1) **non-monetary incentives such as commitment and badges** that would congratulate participants of selective biowaste sorting and (2) **non-monetary disincentives on the competing behaviours' location such as a warning sticker** on the public 'common' bins and residual bins.

The **place** of the marketing strategy refers to when and where the audience will perform the desired behaviour (Kim et al., 2019). For most citizens of the pilot cities, there are two successive places: first, citizens have to sort their biowaste at home in a specific bag, then they have to discard their biowaste bags in the appropriate bins (for those whose municipality do not offer a door-to-door model). As was observed during the co-creation workshop, it is mostly the second "place" that poses problems, as participants stated that the localisations of the appropriate bins were far from their homes and that it was inconvenient to transfer the biowaste bags there.

Although it is not a goal of the WaysTUP! behaviour change strategy to modify the network of biowaste bins within the pilot cities, the strategy could focus on the perception of inconvenience associated with the bins by **providing information on the location of the bins** and **providing tips on how to better transfer the biowaste from home to bins**.

Finally, the **promotion** aspect refers to persuasive communications and design to inspire the audience to take action (Kim et al., 2019). In order to develop a promotion strategy, one should identify (1) the **messages** to be communicated; (2) how these messages will be communicated (**creative strategy**); (3) the **messengers** that will deliver them and (4) where and when they will be communicated (**communication channels**).

In the following Chapter 4 "Behaviour change intervention toolkit" we describe the messages and the creative strategy of the intervention, based on the elements that have been analysed in Chapter 3. The messengers and communication channels will be defined and discuss more in depth in D4.3 "Local engagement plans".

The type of message communicated to the individuals should be based on contextualised and tangible information and should not rely on the sole 'education' aspect but should integrate aspect of 'modelling', 'environmental restructuring', 'persuasion', 'incentivisation' and 'enablement' which have been found to be successful in previous studies (see Chapter 1).

4. Behaviour change toolkit

This section describes the behaviour change toolkit developed as a result of the knowledge acquired, and described in the previous sections of this deliverable report.

Summary

Behavioural theories and models have shown that behaviours are influenced by different elements such as **attitudes, norms,** and **perceived behavioural control** (Azjen, 1991). Norms have a particularly high influence and misperceptions of norms can lead individuals to act in a way that is not in line with their true beliefs or to justify their wrong doings (Mendes et al., 2017; Pollard et al., 2000). Further, individuals appear to need a **motivation**, the **ability**, and an **effective trigger** to act in a certain way (Fogg, 2009). In selfless behaviours, individuals would further need to be **aware of the need**, **aware of the consequences** and **aware of the responsibility** that falls on them (Schwartz & Howard, 1981). Pro-environmental behaviour appears to be specifically influenced by **values, norms, awareness of consequences, awareness/ascription of responsibility** (Stern et al., 1999) as well as **knowledge, attitude** and **feelings** while being restraints by **old (competing) behaviours, insufficient feedback, lack of internal and external incentives** and a **lack of environmental consciousness** (Kollmuss & Agyman, 2002). The literature also explains that the adoption of a behaviour depends on its a **relative advantage, trialability, observability, compatibility** with existing elements of the individual's life and low **complexity** of the task. Further, individuals go through several stages of change to achieve a total behaviour change, such as: pre-contemplation; contemplation; preparation; action; maintenance and termination.

The behaviour change intervention within WaysTUP! is developed to target selective biowaste sorting, but through its comprehensive approach, the results pursued are broader:

- > 80% of improved perception of urban biowaste as a local resource
- > 60% active participation in separate collection of urban biowaste
- > 75% of improved acceptance of urban biobased products

Selective biowaste sorting can be characterised as a pro-environmental behaviour while its competing behaviour (disposing of waste in the residual bin or in the public street bin) can be characterised as a habit., The intervention will therefore be confronted to three main challenges: (1) the habitual nature of the competing behaviour (discarding biowaste into the residual waste bag); (2) the collective interest of the consequences of performing the behaviour vs the individual cost for the individual; (3) the temporal separation between the (future) consequences and the (current) behaviour. Elements of the intervention should therefore focus on **gaining the attention of the participants within their habitual behaviour**, e.g. by changing contextual factors on the sorting location. The content of the intervention should focus on **highlighting the impact of non-sorted biowaste** such as the fact that if not sorted, biowaste ends up landfills, that its valuable nutrients are lost and that it cannot be recycled into valuable products.

In general, we observed through our research activities that citizens perceive **high barriers to the behaviour while perceiving low (individual) benefits.** A way to rectify the imbalance between the costs and the benefits would therefore be to: (1) **Decrease the perception of the barriers**: provide easy-to-understand information on how to sort their biowaste, location

of points and time of collection; decrease feeling of inconvenience; and provide examples of the behaviour so that individuals will perceive it as easier to undertake. (2) **Increase the perception of the benefits**: emphasize the relevance of the behaviour in terms of collective outcomes (treatment of biowaste and results of it) and individual outcomes (moral gratification and environmental consciousness) – as highlighted during the workshops – compared to the competing behaviour. The relative advantage of the action must be emphasized, as described in the Diffusion of Innovation Theory: the perceived value gained through the adoption of the innovation (here: selective biowaste sorting) must be greater than other options. Another possible way to increase the benefits, as suggested by the participants of the co-creation workshop would be for the authorities to provide **incentives** for the behaviour. This is in line with the recommendation of Schultz (2014) on behaviour change tools in function of the perceived barriers and benefits of the said behaviour: Schultz indicated that for behaviour with high barriers and low benefits, incentives and contests are appropriate tools.

Athens, Barcelona and Valencia report drastically different frequency when it comes to selective biowaste sorting. However, all respondents were qualified as "high involvement – high attitude" in regard to climate change: they are therefore inclined to take action but need motivation. The intervention will therefore focus on **motivating participants to take concrete action** by building self and collective efficacy, presenting the population with centrally processed arguments (such as information provision) and activating leadership potential. Further, all cities display a positive attitude regarding biowaste sorting and are highly aware of the consequence of (non)sorting. They also all believe that they should sort their biowaste and generally feel guilty if they do not. The target audience therefore oscillates between the stage 3–preparation and stage 4–action of the Stages of Change. Convincing them of the merits of selective biowaste sorting is therefore not relevant here. Rather, the intervention should work on the lowest-scoring factors that individuals display in the three pilot cities, both for the citizens and business target groups: **descriptive and subjective norm, trust in their local authorities, perceived personal responsibility, perceived convenience** and **instrumental knowledge** (see Table 6).

Table 6: Summary table of the levels reached per city on the influencing factors of selective biowaste sorting (≤ 33.3% of positive respondents = low; ≥ 33.4% and ≤ 66.6% of positive respondents = medium; ≥ 66.7% of positive respondents = high)

	Athens		Barcelona		Valencia	
	Citizens	Businesses	Citizens	Businesses	Citizens	Businesses
Attitude	High	Medium	High	High	High	High
Subjective norm	Medium	Medium	Medium	High	Medium	High
Personal norm	High	High	High	High	High	Medium
Moral guilt	Medium	/	High	/	Medium	/
Descriptive norm	Low	Low	Medium	Low	Low	Medium
Perceived behavioural control	Low	High	High	High	High	High

Self-efficacy	High	High	High	High	High	High
Perceived personal responsibility	Medium	Medium	Medium	Medium	High	Medium
Awareness of consequences	High	Medium	High	Medium	High	High
Perceived convenience	Low	Low	Medium	Medium	Medium	High
System trust	Low	Low	Medium	Low	Medium	High
Instrumental knowledge	Low	Medium	High	Medium	Low	High

In this sense, the '**product'** of the WaysTUP! behaviour change intervention will encompass: (1) the "core product" which is a convenient way to participate in the recycling scheme of biowaste; (2) the "actual product" which is the biowaste bag or bin needed to undertake the behaviour; (3) an "augmented product" which includes the tools of the behaviour change toolkit. The '**price'** strategy will focus on (1) non-monetary incentives such as commitment and badges that would congratulate participants of selective biowaste sorting and (2) non-monetary disincentives on the competing behaviours' location such as a warning sticker on the public 'common' bins and residual bins. Seen it is not a goal of the WaysTUP! behaviour change strategy to modify the network of biowaste bins within the pilot cities, the '**place'** strategy will focus on the perception of inconvenience associated with the bins by providing information on the location of the bins and providing tips on how to better transfer the biowaste from home to bins. Finally, the '**promotion'** strategy should not rely on the sole 'education' aspect but should integrate aspect of 'modelling', 'environmental restructuring', 'persuasion', 'incentivisation' and 'enablement' which have been found to be successful in previous studies.

The behaviour change toolkit will be developed as **an information-based campaign** that should be tailored and implemented in **all pilot cities**. Although the literature points out that information provision has a limited influence on waste sorting, we have seen in section 1.6 that information that is contextualised and tangible leads to significant results. Further, the information used will not only make use of the "education" intervention function but will also – and rather – make use of the "persuasion", "environmental restructuring", "modelling", "incentivisation" and "enablement" functions to deliver the message, as well. **The information provided will be focused and practical, tangible and locally relevant, to motivate individuals to take concrete actions**. The information provided in this campaign will specifically work to improve several critical elements that have emerged as a red thread in all pilot cities:

- **Social norms**: on all three pilot cities and for both target groups (citizens and businesses) the component of **descriptive norm** scored very low. By thinking that no one else is sorting their biowaste, individuals might feel helpless and believe that their contribution will not be relevant. We see that the level of descriptive norm reported by participants is not in line with the frequency from self-reported sorting. For example, regarding the citizens, although the self-reported frequency varies greatly between cities, from a very high frequency in Barcelona, to a dispersed frequency in Valencia, and a very low frequency in Athens, we observe that still, in all three cities, less than 50% think that others are sorting their biowaste. Likewise, the **subjective norm** was also

low for the citizens of Athens and Valencia, and the businesses of Athens. By thinking that others (people that are close to them; other businesses and clients) do not think they should sort their waste, individuals will not conform to the behaviour, as explained in the Theory of Planned Behaviour by Azjen. The information campaign should emphasize that citizens and businesses are not alone in this activity, that they think others should sort, and that their combined effort will produce beneficial results.

- **Trust in local authorities and recycling facilities**: this component scored very low for the citizens of Athens and Valencia, as well as for the businesses of Athens and Barcelona. Participants were not sure what happened once their biowaste was collected, or if their local authorities treated it correctly. Information provision should focus on clearly explaining the process of biowaste treatment, and, if possible, do so in a contextualised manner (e.g. naming local stakeholders) to make the information as tangible to the individuals as possible. In Valencia, specifically, this would also help to raise awareness regarding the concept of Circular Economy which is currently quite low.
- **Perceived personal responsibility**: this component scored quite low for all target groups and pilot cities – except for the citizens of Barcelona. In regards to the elements that came up during the workshops, it might be hypothesized that citizens and businesses have a low perceived personal responsibility in regards to biowaste sorting as they aren't sure waste sorting is even worth it and don't know what happens with their waste once it has been collected. Emphasizing the role of selective biowaste sorting in the bioeconomy loop, as well as the individual role of citizens and businesses in it would help to raise the perceived personal responsibility.
- **Perceived convenience**: the evaluation of convenience by the respondents is another element that the information campaign should address as both citizens and businesses of Athens and Barcelona reported that selective biowaste sorting is not convenient. Although it will not address the actual convenience of the behaviour, the campaign can provide tips and tricks and more information regarding sorting locations and pick-up time. Providing information on how to sort by giving examples or through behavioural modelling could also help to tackle misconceptions about the behaviour, tackling the 'facility factor' of the Fogg Behaviour Model.
- **Instrumental knowledge**: the lack of information was a recurrent element mentioned during the co-creation workshops: citizens and businesses did not have enough information regarding selective biowaste sorting. This element was also observed in the community assessment with citizens of Athens and Valencia scoring low. Participants want to know more about the type of items that can be sorted, what happens after the biowaste is collected and why it is relevant for them to sort. They were also asking for more information about the locations of the containers (for those who were not in a municipality with a door-to-door scheme) and times of pick up. They also specifically mentioned that they did not receive enough information from their local authority and/or that they do not have an easy access to them.

In these activities, and as pointed out by Bernstad (2014), the level of knowledge of the individuals should not be overestimated. The campaign should make use of a simple language style and visual clues, but also be aware of the timing and localisation of the messages. From the co-creation workshops, we concluded that participants were particularly in favour of the idea of (1) stickers; (2) posters near the containers; (3) an informational sheet; and (4) social media posts. The information could therefore be adapted to each communication channel.

In the following sections, we detail the behaviour change toolkit developed based on the knowledge presented in Chapter 3. This toolkit will further be elaborated upon and tailored to each pilot city in D4.3 "Local engagement plans".

4.1 Environmental restructuring: stickers and posters

A nudging **sticker** to affix on the residual bin and/or public 'in-street' bins could be made, in the same fashion than in the study of Shearer and colleagues (2017) which displayed the message "No food waste please" in order to counter the most frequent competing behaviours identified in the community assessment study (discarding biowaste in the residual bin or in the public bin).

Figure 15: Visual nudge (sticker) from Shearer et al. (2017)

In the same line, an informational **sticker** to put on the citizens' or businesses' biowaste bin appears as highly appropriate, since many participants stated they were not sure what could go into the biowaste bin. Stickers are good prompts, as they are both time- and location-relevant: the individual has access to the practical information exactly when and where it is the most needed, decreasing the perception of "**complexity**" as described by the Diffusion of Innovation model, demonstrating that the innovation (i.e. selective biowaste sorting) is easy to understand and undertake. It can also act as a behaviour "trigger" as explained in Fogg's Behaviour Model. As an example, a sticker could be created based on Valencia's informational sheet (see Figure 16). Additionally some items that are often mistaken as biowaste could be added, with icons clearly displaying that they do not belong there (e.g. marked by a red cross).

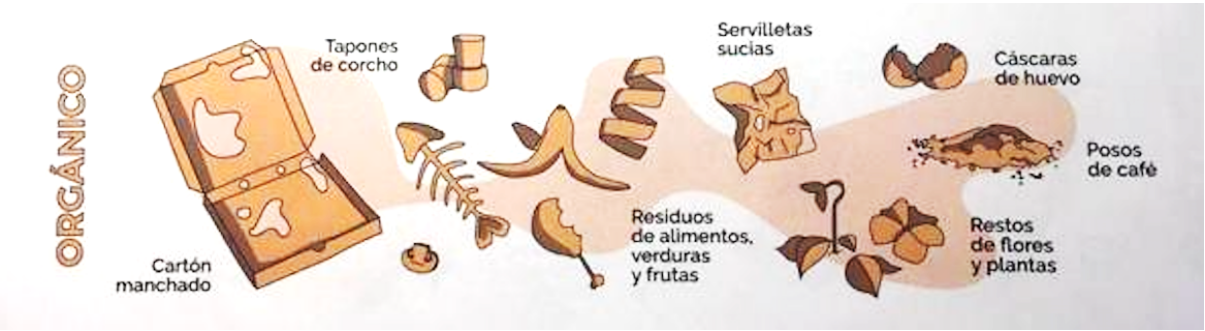

Figure 16: Section on biowaste from the informational sheet of Valencia

Similarly, **posters** located near the community containers and presenting the same information would provide a large number of citizens with the information they need to properly sort their waste. Motivational messages could also be displayed on the posters, to emphasize the relevance of biowaste sorting, such as "Help us recycle biowaste to create bio-solvent!". Thus would further emphasize the loop of the bioeconomy and deliver information on possible biowaste derived products. Additionally, a QR code could be displayed, which would lead the individual to the website of WaysTUP! or the municipal website where more information would be available.

Likewise, an **informational sheet** could also be distributed. Seeing that they are often perceived as junk mail by lay citizens, we would advise to only send those to businesses as they specifically requested them.

4.2 Persuasion: social media posts

Finally, different types of communication and information should be provided through **social media**. If possible, pilots could make use of the AD option of Facebook to make sure that the information reaches a maximum number of individuals. It is important that the messages provided are concise and use lots of visual cues. The content of the messages can be tailored to focus on all the elements that have been highlighted as important for the pilot cities (see section 3.1.4). More specifically, by displaying norm-based messages, the intervention enhanced the perceived "**compatibility**" (with existing norms, rules and social networks) of the behaviour as described by the Diffusion of Innovation model.

To create a common identity and coherence between the posts of the campaign, it is suggested to use the same font, colour and tag line in all posts. As the goal of the campaign is to get citizens and businesses to take part in the loop of the circular bioeconomy, we propose the tag line "*Join the loop!".* This tag line would further emphasize the relevance of selective biowaste sorting for the production of biowaste derived product, hence enhancing individual's knowledge on matter and perceived personal responsibility. Examples of messages are:

- **Descriptive norm**: "*Join your local community and start sorting your biowaste! Already 1 out of 3 of your neighbours are participating! Join the loop!*" in the case of Athens; for Valencia it can be replaced by "*half of your neighbours*", and for Barcelona by "*2 out 3*".
- **Subjective norm**: by displaying a message based on injunctive norm such as "*Athenians believe that sorting and recycling biowaste is the right thing to do. Are you already sorting your biowaste? Join the loop!".*
- **Perceived personal responsibility**: "*When you don't sort your biowaste, it ends up in the landfill and its valuable nutrients are lost. Join the loop!*"; '*By sorting your biowaste, you make sure that it can be turned into valuable products such as bio-plastic! Join the loop!*" or "*Non-sorted biowaste ends up in the landfill where it releases greenhouse gases. By sorting your biowaste, you contribute to its capture which can then be turned into bio-energy! Join the loop!*". A "learn more" option could be added so that interested citizens can learn more about the biobased derived products and the Circular Economy process.
- **System trust**: "*Once you have sorted your biowaste, it is picked up by a truck from (name of stakeholder) which takes it to (name of the stakeholder) where it will be treated. After treatment, your biowaste is transformed into (name of the biobased derived product). All of this is possible because you joined the loop!*". This message could be accompanied by a short video showcasing the activity of the local WaysTUP! technical partner.
- **Perceived convenience**: share tips and tricks on biowaste sorting at home, such as "*Little flies near your biowaste at home? Store it in a container with a lid and avoid placing it in the sun. Sorting is easy, join the loop!*" Messages can also share the localisation of the community bins and/or emphasised that the distance is not so long e.g. "*The biowaste container network is in place in (name of the city/municipality). Chances are, there is one in a xx meter radius from your home! Check out the map (link to map). Sorting is easy, join the loop!*"

- **Instrumental knowledge**: the stickers and posters can be converted into a social media post.

4.2 Modelling through video clips

Another way to address the matter of **convenience** would be through behavioural modelling, a type of behaviour change intervention that provides an example for people to aspire to or imitate (see COM-B model, section 1.2.10 of this document). It also related to the concept of "**observability**" of the Diffusion of Innovation model where individuals have the possibility to witness the adoption of the innovation (i.e. selective biowaste sorting) by someone else as well as the results of said innovation.

By showcasing a real-life example of someone selectively sorting one's biowaste at home, a short video clip could address different concerns related to convenience, such as the place required, the time it takes or the possibility of odours (e.g. we see the person cutting some vegetable and discarding it in the correct bin, we see where the bin is located in the kitchen/in the balcony, etc.). A citizen and/or business employee could explain how they proceed and address the concerns verbally. The video clips could be disseminated via social media and could be showcased on the WaysTUP! website.

4.3 Incentivisation: badges

Badges were seen by the respondents of the co-creation workshops as nice, but more relevant for younger participants. This strategy could be specifically implemented in schools, where children could learn about biowaste, place a biowaste bin in the classroom or school, and get a badges following these activities. The badges could also be used online, through the Facebook badge option, in complement with weekly challenges. There, participants of the WaysTUP! project could add the badge to their profile picture, creating awareness around the project's activities and a feeling of community participation. This can be done in concordance with weekly challenges, the badge indicating that the person is taking part in the challenge. The badges can also be declined in stickers that businesses can appose on their windows or doors to show their clients and others businesses that they are selectively sorting their waste.

It has to be noted that the effectiveness of incentive has been proven to fade over time. This strategy would therefore be more beneficial if introduced at the beginning of the campaign as a "kick-start" event that would increase the "**relative advantage**" perceived by citizens and businesses.

4.4 Enablement: distribution of bags and bins

If possible, the provision of bags, and more specifically of bins, would be beneficial. The bins were considered as a nice incentive by the citizens. However, as bins are more costly that bags, it is most likely that it will not be financially possible to distribute them to a large number of citizens in all pilot cities. However, bins could be provided as an incentive to the participation in the WaysTUP! intervention, which would require the completion of survey by participants.

The provision of bags and bins are in line with the concept of "**trialability**" in which individuals have the possibility to try the innovation without too much investment. This acts as a first easy

step in the behaviour change process, and also serves as a precedent which is highly effective since we know that past behaviour is a strong predictor of future behaviours (see D4.1).

4.5 "Join the loop" events

Starting from our findings that participants – both citizens and businesses – are not aware of the whole loop completed by biowaste within the Circular Economy process, and more particularly, in their local contexts, "Join the loop" events would put the emphasis on local actors and on the practicalities of CE within the WaysTUP! project. In addition to providing information, the goal is to showcase to participants the relevance of selective biowaste sorting for their specific cities, showcasing the different biowaste derived products that can be produced, and more importantly their role in this process. The aim is to make the benefits more tangible and relatable, thus counterbalancing the asymmetry between the costs and benefits of selective biowaste sorting (see section 3.5 Exchange). Additionally, these events provide a perfect opportunity to recruit participants for the behaviour change campaign that will take place in the three cities.

In this sense, each pilot city would organise events tailored to its local context (and audiences). These events should be fun and interesting for the public, avoiding long scientific explanation and rationale, rather using accessible layman's terms and focusing on hands-on activities, showcasing the 'what's in it for me' component. The events should be communicated through invitations (e.g. Mailchimp platform), Facebook events (with sponsored AD post) and through the project's network. While each pilot city should organise its own events with the aim to stay locally relevant for the attendees, they could also share the same agenda. This agenda could include the following:

1) Quick introduction of the speakers and stakeholders presentation.
2) Introduction of the project (e.g. "*We are xx partners and we work together to transform your biowaste into new products, so that it is not waste, but rather a resource, …*").
3) Introduction to the Circular Economy in accessible terms, specifically pointing out the role of citizens/businesses.
4) Introduction to biowaste (what it is, why it matters, what are the consequences of not sorting, what is your role as citizens/businesses, etc.).
5) The behaviour modelling video-clip (one specific per pilot – see section 4.2).
6) A short video clip from the technical partner (one per pilot, with the local technical partner). This would make it relevant and tangible for the participants, showing what happens to their biowaste after they sort it, therefore providing them with a reason to do so. The partner can show relevant infrastructure, explain in layman's term that biowaste can be treated, and is, therefore, not a waste but a resource, and explain what the (expected) output of the process is.
7) Specific speakers (e.g. speech from the local authority).
8) Presentation of the WaysTUP! intervention and recruitment of participants.

These events can be organized once or several times and can be tailored to the audience, e.g. citizens or businesses, as well as schools. Further, these events can be organized online or offline, depending on the audience (e.g. offline events may be more attractive for schools) and the COVID pandemic situation.

Although these events can be organized at any point during the project's life to maintain the WaysTUP! community engaged, they would be of particular interest at the start of the

behaviour change intervention as a kick-off event. Seeing the uncertainties for the future associated with the COVID pandemic, it appears that organising the events online, in a webinar format, would be the safest option. The webinar should be recorded and made available on an online platform such as YouTube for everyone to access at a later time.

5. Conclusions

This deliverable details the process of co-creation of the behaviour change toolkit developed for the behavioural change intervention of WP4. To do so, **Chapter 1** details the systematic literature review of the studies that have investigated the effect of diverse interventions on the selective biowaste sorting behaviour. It was found that the most frequently used interventions instrument were visual nudges, incentives, textual information, ambassadors and persuasive technology. These different instruments played differently on the interventions functions highlighted by Michie et al. (2011) through their COM-B model: '**education'** was the most frequently used intervention function, but did not always reach its goals: when it did, the information given was either contextualised and tangible or transmitted via ambassador also playing on the '**modelling'** function, while strict descriptive information ('how' and 'why' to sort) on their own through impersonal communication means (leaflets) had no significant effect. '**Environmental restructuring**' through visual nudges was found to be highly successful and to be preferred over the use of 'ambassadors' seen the difference in costs. '**Persuasion'** through the use of norm-based messages and '**enablement**' through the provision of vessel bags were also found to be highly successful. Finally, although less frequently put into practice **'incentivisation'** through the use of monetary and non-monetary incentive was found successful though its effect faded over time, and '**training'** through the use of a computer game was also found successful.

In **Chapter 2**, the social marketing approach to behaviour change is detailed and the 8 criteria – behaviour, theory, consumer orientation, insights, exchange, competition, segmentation and method mix – explained. The social marketing approach was found to be predominantly applied to health-related behaviour, and to a lesser extent to pro-environmental behaviour. Social marketing has been applied to food/kitchen waste sorting but none of the studies so far have applied all 8 criteria simultaneously, emphasizing the **inadequate and weak use of social marketing principles in food waste sorting programmes to this date**. In this sense, the use of the Social Marketing approach through the MBAA model represents an innovation in the domain.

Therefore, **Chapter 3** details all 8 criteria of the Social Marketing approach applied to the selective biowaste sorting in the framework of WaysTUP! and its three pilot cities (Athens, Barcelona and Valencia).

- In the **behaviour** section, the nature of selective biowaste sorting is discussed: it is characterised by its habitual nature (and habitual nature of the competing behaviour), its imbalance in terms of individual costs and collective interest, and the temporal delay of the consequences of the (in)action. Behavioural targets are also set for the intervention: (> 80% of improved perception of urban biowaste as a local resource; > 60% active participation in separate collection of urban biowaste; > 75% of improved acceptance of urban biobased products).
- In the **theory** section, the main behavioural theories and models are reviewed and later support the development of the toolkit.
- The **consumer orientation** presents the different research activities that have been conducted such as a literature review (reported in D4.1), expert's interviews, (online) community assessment and co-creation workshops.

- The **insights** section regroups most of the insights collected during the consumer orientation steps. They are detailed on the level of each pilot city.
    - We found that Barcelona presented the higher frequency of sorting, with almost 65% reporting they selectively sort their biowaste all the time, and scored positively on all factors investigated, though the descriptive norm, perceived personal responsibility and perceived convenience could be increased. On the contrary, businesses of Barcelona sort their waste quite infrequently (only 33.3% indicating doing so more than half of the time). Interestingly, no business believed that others sort their waste (descriptive norm). Only half present a positive perceived convenience and ¼ trusted their local authorities.
    - Athens on the other hand displays the lowest score, with only 31.9% indicating they do sort their biowaste more frequently than half of the time. Athenian's' descriptive norm, perceived behaviour control, perceived convenience, instrumental knowledge, trust in the system and subjective norm could all be improved as less than 50% of the respondents score positively on these factors. The businesses of Athens appear to sort their waste more frequently (56.3% of them indicated they do so more than half of the time). Less than 50% of businesses display a positive descriptive norm, subjective norm, attitude, perceived convenience, system trust and perceived personal responsibility.
    - Valencia presents a disparate distribution in terms of the frequency of selective biowaste sorting, with 46.1% indicating that they sort their biowaste less than half of the time and 41.2% indicated sorting it more frequently than half of the time. Interestingly, it is also the only city where more than 50% of the respondents indicated not being aware of the concept of CE. Less than 50% display a positive instrumental knowledge, subjective norm, descriptive norm and system trust. Likewise, the businesses of Valencia do not display a trend in terms of selective biowaste sorting: 23.1% do so less than half the time, 30.7% do so half the time and 46.2% do so more than half the time. All other investigated elements scored positively, but the descriptive norm could be increased.
- In the **exchange** section, the nature of the behaviour in terms of costs and benefit is discussed and the concept characterised as of a "perfect moral storm" is introduced. To counter the perception of high barriers and low (individual) benefits, several strategies are presented (1) decrease the perception of the barriers (through easy-to-understand information on how to sort their biowaste, location of points and time of collection; decrease feeling of inconvenience; examples of the behaviour so that individuals will perceive it as easier to undertake), (2) increase the perception of the benefits (emphasize relevance of the behaviour in terms of collective and individual outcomes compared to the competing behaviour, provision of incentives).
- In the **competition**, the competing behaviours are detailed: disposing of its biowaste into the residual waste bag or in a public street bin. To face these competing behaviours, the intervention should aim to gain the attention of the participants during their habitual competing behaviours, e.g. by changing contextual factors on the sorting location and/or highlighting the consequences of the competing behaviour.
- The **segmentation** section described the profile of the citizens of the pilot city. As biowaste sorting is considered as a pro-environmental behaviour, it was chosen to segment the population through the use of the SASSY questionnaire. We observed that most **(95%) of the population of each pilot city is considered as "high involvement**

– high attitude", indicating that they are convinced of the reality of climate change although some are still looking for scientific proof of the reality of global warming.

- Finally, in the **methods mix**, the product, price, place and promotion of the intervention are reviewed. Within the behaviour change intervention of WaysTUP!, the "core product" would be a 'convenient way to participate in the recycling scheme of biowaste'; the "actual product" would be the 'biowaste bag or bin', while a possible "augmented product" would be the tools of the behaviour change toolkit. The price strategy will focus on non-monetary (dis)incentives such as commitment and badges and warning sticker on the public 'common' bins and residual bins. In regard to the 'place' components of the method mix, and although it is not a goal of the WaysTUP! behaviour change strategy to modify the network of biowaste bins within the pilot cities, the strategy could focus on the perception of inconvenience associated with the bins by providing information on the location of the bins and providing tips on how to better transfer the biowaste from home to bins. All in all, this finally leads to the **promotion** components of the method mix, which refers to the **messages** to be communicated; how these messages will be communicated (**creative strategy**); the **messengers** that will deliver them and where and when they will be communicated (**communication channels**). These last aspects consist of the behaviour change toolkit, and are detailed in Chapter 3.

Lastly, **Chapter 3** details the behaviour change toolkit. More specifically, the toolkit encompasses the messages and the creative strategy of the "promotion" aspect, while the messengers and communication channels to be used will be defined in D4.3 "Local engagement plans". The tools have as common aim to increase the **trust in the local authorities, the perception of descriptive norm, the perception of convenience** and **the instrumental knowledge** of citizens and businesses; and will do so through an information-based campaign. Rather than only relying on the "education" intervention functions the information based campaign will make use of various functions such as "environmental restructuring" in the form of stickers and posters, "persuasion" such as norm-based messages on social media, "modelling" through the use of video-clips, "incentivization" through the use of badges and "enablement" through the provision of specific bins and/or bags. Finally, elements can be combined in "Join the loop" events that can take place in person in the format of workshops, or online in the format of a webinar.

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6. Annexes

6.1 Annex 1: Community assessment online survey: questionnaire

In this section, the online community assessment survey is reported. The questionnaire was created in two versions: one for the citizens and one for the businesses. The citizen's version can be found below. The businesses' version was similar to the citizens' but included a change in wording (e.g. "to what extent *do you* actually dispose of the item in the separate and dedicated bag or bin for this specific recycling scheme?" was transformed into "to what extent *does your business* actually dispose of the item in the separate and dedicated bag or bin for this specific recycling scheme?") and included questions related to the type of business and the position of the respondent in the business.

Dear participant,

Thank you for your interest! This survey is part of the WaysTUP! project. This specific research study focuses on waste sorting, and more particularly urban **biowaste sorting** (or '**food waste**', '**biodegradable waste**' or '**organic waste**'). The goal is to understand your perception of biowaste, the bioeconomy and the Circular Economy.

For this reason, we would like to understand your **habits regarding waste sorting** and **biowaste discard**.
Answering the survey should take you no longer than **10 min**.
Thank you very much for your time!

The WaysTUP! team
imec (research coordinator)
SAV (Valencia community coordinator)
AMB (Barcelona community coordinator)
SUST (Athens community support)

Before going further, please read the 'Informed Consent form' to have more information on the study and on how the collected data will be handled:
Informed Consent form.

Data handling is fully compliant with GDPR Regulations and is performed exclusively for the purposes of WaysTUP! project.

☐ I have read the "Informed Consent form"

☐ I agree to participate in the study as stated in the Informed Consent form

☐ I agree with the processing of my personal data as stated in the Informed Consent form

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Before we start we would like to know from which WaysTUP! community you come from. Currently, you live in ...

○ Valencia

○ Barcelona

○ Athens

○ Other: _____

What is your ZIP code? ____

This is the start of the survey. Please answer spontaneously. Your personal experience is what matters to us, therefore there are no right or wrong answers.

How important is the issue of global warming to you personally?

- ○ Extremely important
- ○ Very important
- ○ Somewhat important
- ○ Not too important
- ○ Not at all important

How worried are you about global warming?

- ○ Very worried
- ○ Somewhat worried
- ○ Not very worried
- ○ Not at all worried

How much do you think global warming will harm you personally?

- ○ A great deal
- ○ A moderate amount
- ○ Only a little
- ○ Not at all
- ○ I don't know

How much do you think global warming will harm future generations of people?

- ○ A great deal
- ○ A moderate amount
- ○ Only a little
- ○ Not at all
- ○ I don't know

Let's talk about the Circular Economy.
Please indicate to which extent you agree with the following statements from strongly disagree to strongly agree (5-point Likert scale)

I have heard of the concept of the Circular Economy before

In general terms, I know what the Circular Economy refers to

I could explain what the Circular Economy is about

I personally believe that as citizens, we should be able to take part in the Circular Economy

I understand how, as citizens, we can contribute to the Circular Economy

As a citizen, I want to play a role in the Circular Economy

Let's talk about waste.
Please indicate to which extent you sort your waste (place it in a different bag or bin for a separate and dedicated waste collection).
Example: When you have to discard an item that can be identified as being part of a specific recycling scheme (paper, plastic, organic, glass or garden waste) ***to what extent do you actually dispose of the item in the separate and dedicated bag or bin for this specific recycling scheme****? From "never" (you do not participate in the recycling scheme of this*

specific waste at all) to "all the time" (you always sort items of this specific waste in the separate and dedicate bag or bin)

	Never	Rarely	Sometimes	About half the time	Often	Most of the time	All the time
Paper waste	○	○	○	○	○	○	○
Plastic waste	○	○	○	○	○	○	○
Organic waste	○	○	○	○	○	○	○
Glass	○	○	○	○	○	○	○
Garden waste	○	○	○	○	○	○	○

Let's now talk about organic waste. If there are times you do not selectively sort your organic waste, you ...

	Never	Rarely	Sometimes	About half the time	Often	Most of the time	All the time
Put it with the normal/residual waste	○	○	○	○	○	○	○
Flush it down the toilet	○	○	○	○	○	○	○
Put it in a compost	○	○	○	○	○	○	○
Throw it in a public bin	○	○	○	○	○	○	○
Throw it in the nature	○	○	○	○	○	○	○
Other (please specify):	○	○	○	○	○	○	○

Let's play a game!

Where would you discard ... **tea leaves**? Please pick the bin where you would throw it away!
Where would you discard ... **unwanted cooked food**?
Where would you discard ... **tissues**?
Where would you discard ... **bones**?
Where would you discard ... **dead leafs**?
Where would you discard ... **expired food**?
Where would you discard ... a **pizza box**?

- ☐ Residual waste
- ☐ Organic waste
- ☐ Glass
- ☐ Paper waste
- ☐ Plastic waste

In the following section, we talk about your habits regarding organic waste sorting.
I think that sorting my **organic waste** in a specific bag/bin is ...

	1	2	3	4	5	
Useful	○	○	○	○	○	Useless
Necessary	○	○	○	○	○	Unnecessary
Beneficial	○	○	○	○	○	Harmful
Negative	○	○	○	○	○	Positive
Convenient	○	○	○	○	○	Inconvenient
Unhygienic	○	○	○	○	○	Hygienic
Pleasant	○	○	○	○	○	Unpleasant
Difficult	○	○	○	○	○	Easy
Clean	○	○	○	○	○	Dirty

Please indicate to which extent you agree with the following statements from strongly disagree to strongly agree (5-point Likert scale)

Most people that I care about think that I should sort my organic waste

People who are important to me are expecting me to sort my organic waste

I think I should sort my organic waste

If I don't sort my organic waste, I feel guilty

People around me sort their organic waste

It is common to sort for someone to sort his organic waste

Everything is in my power to sort my organic waste

I have everything I need to sort my organic waste

I feel personally capable to sort my organic waste correctly

I feel personally confident in my capacity to sort my organic waste correctly

I believe I have enough information to sort my organic waste

Organic waste sorting takes a lot of place in a home

Organic waste sorting can bring unpleasant odors

I have the time to sort my organic waste

I have the energy to sort my organic waste

I think that I have the adequate bin to sort my organic waste

I find my local schedule for organic waste pick up convenient

I find the current location for organic pick up convenient

I have confidence that if I do sort my organic waste, it will effectively be recycled

I trust my local recycling facilities to effectively recycle the organic waste that I would selectively sort

I feel jointly responsible for the organic waste that ends up in the landfill

I feel partly responsible for the methane that is emitted into the atmosphere by the non-sorted organic waste

I feel jointly responsible for the contamination of soil and water by the non-sorted organic waste

Here are some statements regarding organic waste. To which degree are you certain they are true? From "I am certain this is false" to "I am certain this is true"

If not sorted, organic waste releases greenhouse gases into the atmosphere

If not sorted, organic waste can lead to local water and soil contamination

If not sorted, organic waste ends up in the landfill

Organic waste contains valuable nutrients

Organic waste can be turned into energy

Organic waste can be recycled into valuable products

Organic waste could replace fossil resources

Start of Block: Demographics

What is your gender:

- ○ Male
- ○ Female
- ○ Other
- ○ I would rather not say

In which year were you born:

▼ 1920 ... I would rather not say

Are you employed?

- ○ Yes, full time
- ○ Yes, part time
- ○ I am a stay-at-home parent
- ○ I am looking for a job
- ○ I am retired
- ○ I am a student
- ○ I would rather not say

What is your highest degree of education?

- ○ No formal education
- ○ Primary school
- ○ Middle school / lower secondary school
- ○ High school / higher secondary school
- ○ Bachelor's degree or equivalent
- ○ Master's degree or equivalent and above
- ○ Other degree
- ○ I would rather not say

What is the total income of your household (net per year)?

▼ Less than €10,000 ... I would rather not say

You are living (if multiple apply, select the most frequent situation) ...

- ○ Alone
- ○ Alone with my child(ren)
- ○ With my partner
- ○ With my partner and my child(ren)
- ○ With my parents
- ○ With my parents and my children
- ○ In a shared housing
- ○ In a shared housing and with my child(ren)
- ○ Other (please specify): _____
- ○ I would rather not say

Start of Block: Community leader

Urban biowaste is an abundant source for the production of alternative biobased products, such as bioplastic and bio-oil, but is largely unexploited. Approximately 75% of this material is landfilled while only 25% is recycled into products, mainly compost and biogas.

The EU-funded project WaysTUP! has the goal to address the different **economical, technical and social issues linked to the bioeconomy** (the Circular Economy for biowaste). The goal of this specific study is to **understand the role you as a citizen can play in the bioeconomy and how you can be empowered to take a more active role** in this circular economy process.

The project is taking place in cities all over Europe: Alicante, Valencia, Prague, Barcelona, Chania, London, Terni and Athens.
By taking part in the project, you add your contribution to a much bigger initiative and contribute to the creation of **circular communities**!

I'd like to take part in future activities of the project!

- ○ Yes
- ○ No

I'd like to receive information and support regarding food waste sorting.

- ○ Yes
- ○ No

I'd like to be active in my community regarding the project (convince my neighbours, distribute flyers at some locations, post on social media, etc.)

- ○ Yes
- ○ No

You can contact me at the following email address:

- ○ I consent to the use of my email address by imec (research partner of the WaysTUP! project) and the associated community partners (SAV, SUST and AMB) for communication purposes in the framework of the WaysTUP! project's activities.

This question enables us to identify your contribution and link it to other contributions you might complete for this project (other survey, interview, etc.). By answering the following questions, you will produce a unique identification code, whilst remaining anonymous (you do not have to remember this code, the same questions will be asked to you if you take part in other activities).

- ○ First two letters of your mother's first name (if none use xx)
- ○ First two letters of your father's first name (if none use xx)
- ○ Numbers (2) of the month you were born
- ○ First two letters of your middle name (if none use xx)

6.2 Annex 2: Community assessment online survey: analysis

In the following sections, we analyse the results of the community assessment online survey. In the first section, we detail the reliability analysis that were conducted on the scales constituting the different concepts investigated. For more information on the concepts, please refer to "D4.1: Setting the scope of the behavioural change campaign: a behavioural mapping exercise". The second section details the descriptive results for each pilot city individually.

6.2.1 Reliability analysis of constructed scales

Awareness of Circular Economy

The scale was constituted of the following items and was measure on a five-point scale Likert scale ranging from strongly disagree to strongly agree:

- I have heard of the concept of Circular Economy before
- In general terms, I know what the Circular Economy refers to
- I could explain what the Circular Economy is about

Cronbach's alpha is very good for both the citizens survey (α = .935) and business survey (α = .958), we can conclude that the three items do measure the same construct, which can be named "awareness of Circular economy".

Role of citizens/businesses in the Circular Economy

The scale was constituted of the following items and was measure on a five-point scale Likert scale ranging from strongly disagree to strongly agree:

- I believe that we, as citizens/businesses, should take part on the Circular Economy
- I understand how, as citizens/businesses, we can contribute to the Circular Economy
- As citizens/business, I would like us to have a role to play in the Circular Economy

Cronbach's alpha is very good for both the citizens survey (α = .902) and business survey (α = .958), we can conclude that the three items do measure the same construct, which can be named "role in the Circular economy".

Awareness of consequences

The scale was constituted of the following items and was measure on a five-point scale Likert scale ranging from strongly disagree to strongly agree:

- If not sorted, organic waste releases greenhouse gases into the atmosphere
- If not sorted, organic waste can lead to local water and soil contamination
- If not sorted, organic waste ends up in the landfill
- Organic waste contains valuable nutrients
- Organic waste can be turned into energy
- Organic waste can be recycled into valuable products
- Organic waste could replace fossil resources

Cronbach's alpha is very good for both the citizens survey (α = .769) and business survey (α = .874), we can conclude that the seven items do measure the same construct, which can be named "awareness of consequences of biowaste sorting".

Attitude regarding biowaste sorting

The scale was constituted of the following items and was measure on a 5-point bipolar scale. Items that ranged from positive to negative were recoded prior to the analysis so that all items would range from negative to positive:

- Useless – useful
- Unnecessary – necessary
- Harmful – beneficial
- Negative – positive
- Inconvenient – convenient
- Unhygienic – hygienic
- Unpleasant – pleasant
- Difficult – easy
- Dirty – clean

Cronbach's alpha is very good for both the citizens survey (α = .844) and business survey (α = .775), we can conclude that the nine items do measure the same construct, which can be named "attitude regarding biowaste".

Subjective norm

The scale was constituted of the following items and was measure on a five-point scale Likert scale ranging from strongly disagree to strongly agree:

- Most people that I care about think that I should sort my organic waste / Most clients think that we should sort our business' organic waste
- People who are important to me are expecting me to sort my organic waste / My employees/colleagues are expecting our business to sort its organic waste

Cronbach's alpha is very good for both the citizens survey (α = .882) and business survey (α = .729), we can conclude that the two items do measure the same construct, which can be named "subjective norm".

Moral norm

The scale was constituted of the following items and was measure on a five-point scale Likert scale ranging from strongly disagree to strongly agree:

- I think I should sort my organic waste / I think we should sort our business' organic waste
- If I don't sort my organic waste, I feel guilty / If we don't sort our business' organic waste, I feel guilty

Cronbach's alpha for the citizens survey is not satisfactory (α = .590). Both items should be taken into consideration individually. The first item could be renamed "personal norm" while the second could be renamed "moral guilt".

Cronbach's alpha for the business survey (α = .817) is very good, we can conclude that the two items do measure the same construct, which can be named "subjective norm".

Descriptive norm

The scale was constituted of the following items and was measure on a five-point scale Likert scale ranging from strongly disagree to strongly agree:

- People/businesses around me sort their organic waste
- It is common for someone/ a business to sort its organic waste

Cronbach's alpha is very good for both the citizens survey (α = .812) and business survey (α = .879), we can conclude that the two items do measure the same construct, which can be named "subjective norm".

Perceived behavioural control

The scale was constituted of the following items and was measure on a five-point scale Likert scale ranging from strongly disagree to strongly agree:

- Everything is in my power to sort my/our business' organic waste
- I have everything I need to sort my/our business' organic waste

Cronbach's alpha is very good for both the citizens survey (α = .845) and business survey (α = .777), we can conclude that the two items do measure the same construct, which can be named "Perceived behavioural control (PBC)".

Self-efficacy

The scale was constituted of the following items and was measure on a five-point scale Likert scale ranging from strongly disagree to strongly agree:

- I feel personally capable to sort my organic waste correctly / I feel that we, as a business, are capable to sort our organic waste correctly
- I feel personally confident in my capacity to sort my organic waste correctly / I feel confident that it is in our business' capacity to sort our organic waste correctly

Cronbach's alpha is very good for both the citizens survey (α = .887) and business survey (α = .894), we can conclude that the two items do measure the same construct, which can be named "self-efficacy".

Personal responsibility

The scale was constituted of the following items and was measure on a five-point scale Likert scale ranging from strongly disagree to strongly agree:

- I feel jointly responsible for the organic waste that ends up in the landfill / I think that our business is jointly responsible for the organic waste that ends up in the landfill
- I feel partly responsible for the methane that is emitted into the atmosphere by the non-sorted organic waste / I think that our business is partly responsible for the methane that is emitted into the atmosphere by the non-sorted organic waste
- I feel jointly responsible for the contamination of soil and water by the non-sorted organic waste / I think that our business is jointly responsible for the contamination of soil and water by the non-sorted organic waste

Cronbach's alpha is very good for both the citizens survey (α = .916) and business survey (α = .869), we can conclude that the two items do measure the same construct, which can be named "self-efficacy".

Convenience

The scale was constituted of the following items and was measure on a five-point scale Likert scale ranging from strongly disagree to strongly agree:

- Organic waste sorting takes a lot of place in a home/ in our business
- Organic waste sorting can bring unpleasant odors
- I think that I / we have the adequate bin to our my / our business' organic waste
- I find the local schedule for organic waste pick up convenient
- I find the current location for organic waste pick up convenient

Cronbach's alpha is not satisfactory (α = .555) for the citizens survey when taking into account all items of the scale, it was decided to drop the first item "Organic waste sorting takes a lot of place in a home" to increase the alpha to .639. The scale is therefore composed of four items and can be named "perceived convenience".

Cronbach's alpha is very good for both the business survey (α = .762), we can conclude that the five items do measure the same construct, which can be named "perceived convenience".

System trust

The scale was constituted of the following items and was measure on a five-point scale Likert scale ranging from strongly disagree to strongly agree:

- I have confidence that if I do sort my organic waste, it will effectively be recycled / I have confidence that if we do sort our business' organic waste, it will effectively be recycled
- I trust my local recycling facilities to effectively recycle the organic waste that I would selectively sort / I trust my local recycling facilities to effectively recycle the organic waste that we would selectively sort as a business

Cronbach's alpha is very good for both the citizens survey (α = .891) and business survey (α = .775), we can conclude that the two items do measure the same construct, which can be named "self-system trust".

6.2.2 Descriptive statistics – citizens

Demographics

In the following graphs, the demographics distribution of the respondents for each pilot city can be found. The gender, age, education, employment status and income and reported for Athens, Barcelona and Valencia.

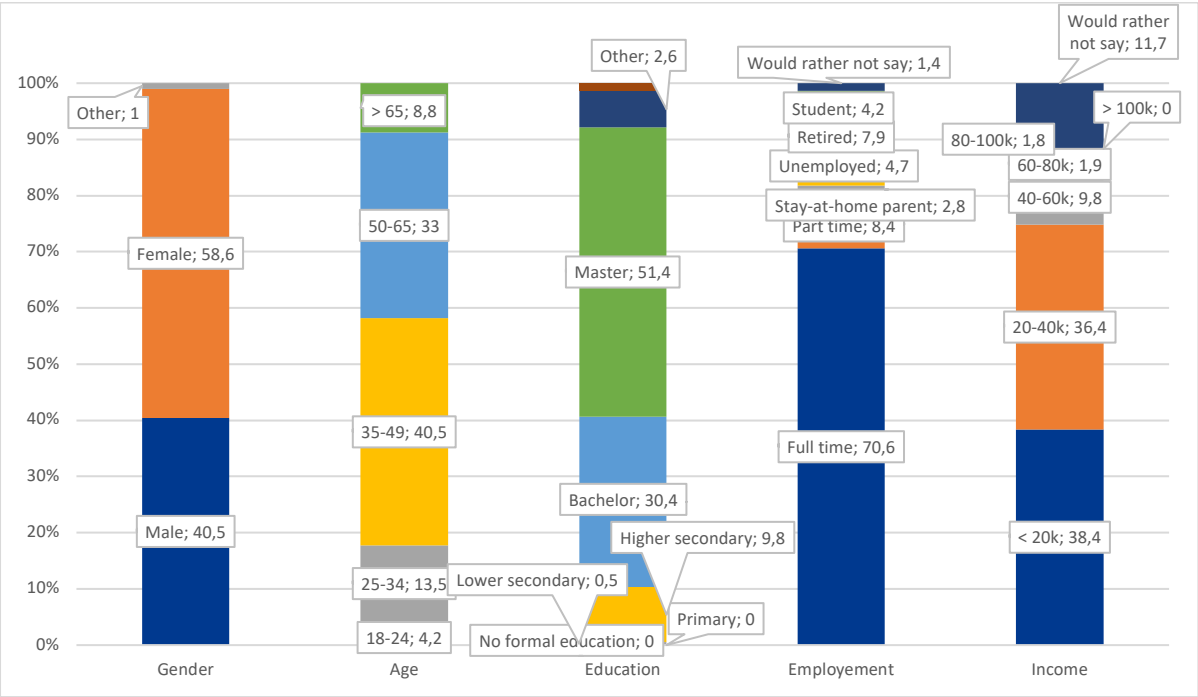


Figure 17: Demographic information for Athens (N=215). The respective categories are indicated before the semicolon. The values indicated after the semicolon are indicated in percentages. Income indicated is net per year per household.

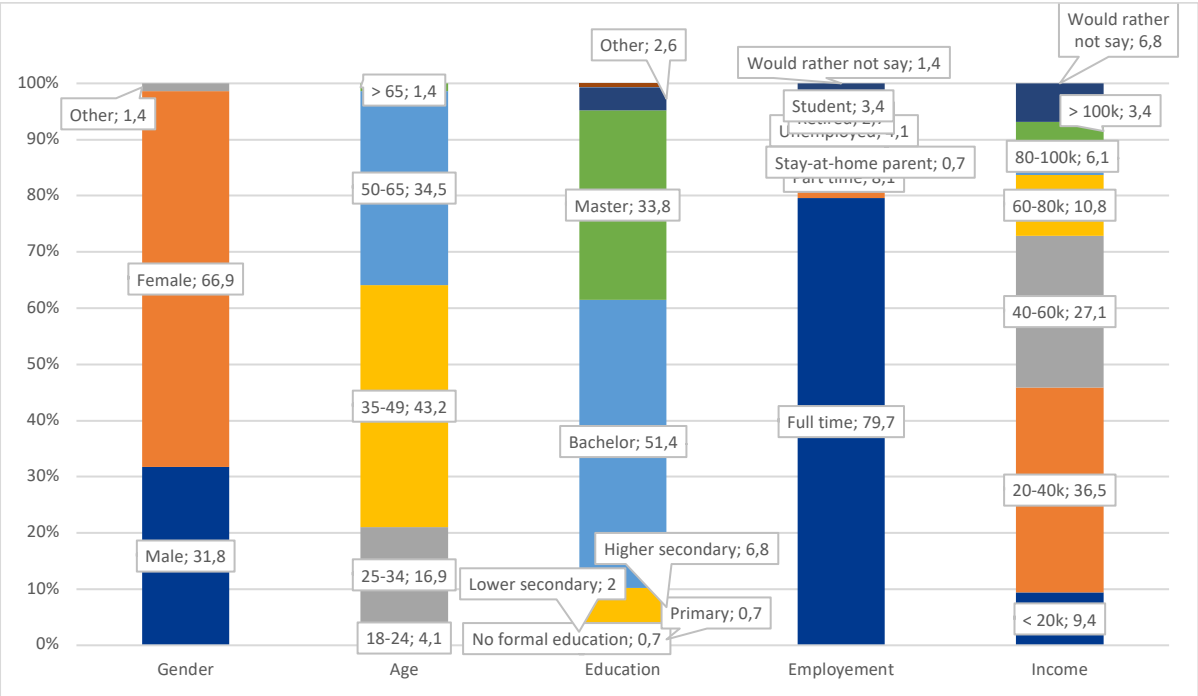


Figure 18: Demographic information for Barcelona (N=148). The respective categories are indicated before the semicolon. The values indicated after the semicolon are indicated in percentages. Income indicated is net per year per household.

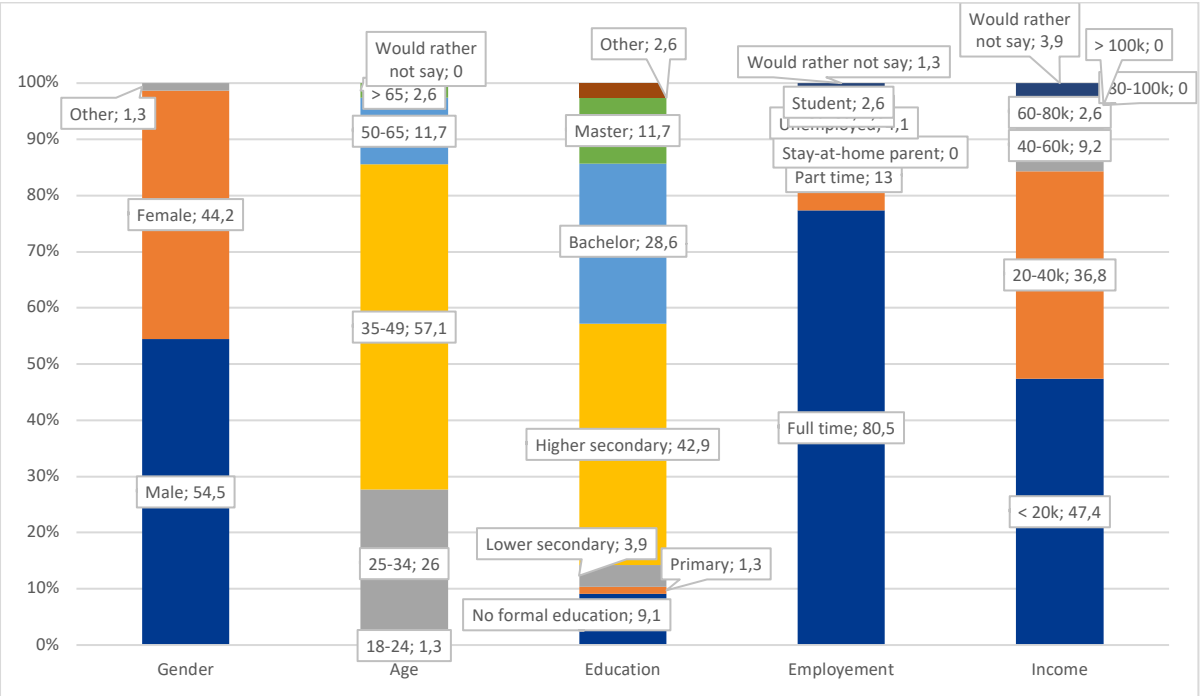


Figure 19: Demographic information for Valencia (N=76). The respective categories are indicated before the semicolon. The values indicated after the semicolon are indicated in percentages. Income indicated is net per year per household.

Sorting behaviour

First and foremost, the frequency to which citizens in each pilot city selectively sort their waste was assessed. As can be observed from Figure 20, this frequency varies greatly between pilot city. **Athens appears to have the lowest frequency**, with the majority of respondents indicating that they selective sort their waste 'rarely' to 'never', which is also translated in their low mean score (x= 2.97). On the contrary, **Barcelona demonstrates the highest frequency**, with almost 65% of the respondents indicating that they sort their biowaste 'all the time', which is also translated in their high mean score (x= 5.87). **Valencia appears to be in a middle ground**, with a mean neutral score of approx. 4.

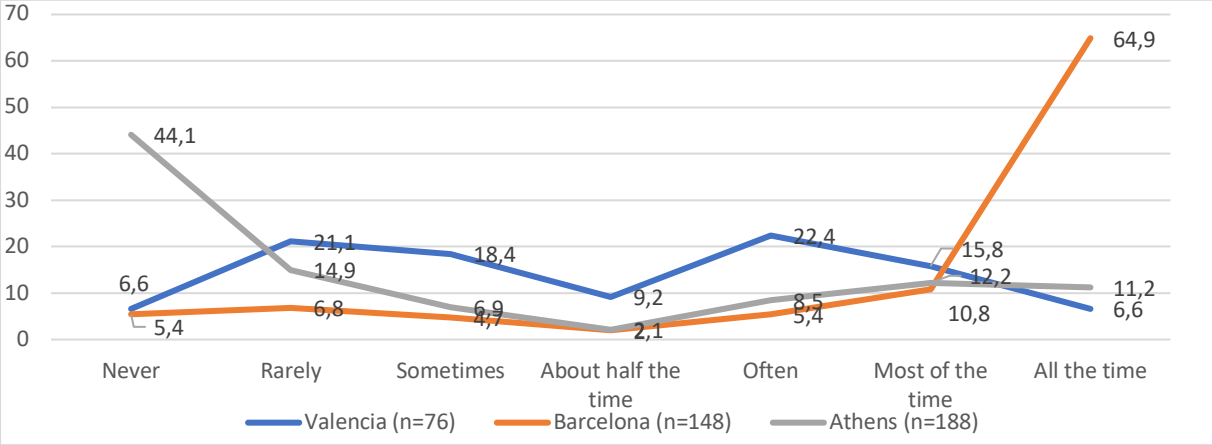


Figure 20: Frequency (represented in % of respondents) of selective biowaste sorting per pilot (for municipalities with a collection scheme in place)

In regards to the **selective biowaste sorting behaviour**, it is important to make the analysis taking into account that some municipalities currently don't have a collection scheme. From our respondents, 25 of them were residing in a municipality without a collection scheme in place (all from Athens). It is interesting to note that in Valencia, all participants had access to a 'community bin' type of scheme (n=76), same in Athens for those who lived in a municipality that collects biowaste (n=188), while in Barcelona some had access to a 'community bin' (n=122) and other had access to a door-to-door model (n=26).

Second, the **competing behaviours** to selective biowaste sorting were assessed, to better understand what would need to be "fought against" in the intervention. It appears that for all pilot cities, the most frequently undertaken alternatives to selective biowaste sorting are throwing biowaste in the **residual waste bins** (most frequent alternative in all pilot cities), followed by throwing biowaste into a **public bin**.

Table 7: Descriptive statistics regarding the frequency of undertaken competing behaviour of selective biowaste sorting measured on a 7-point Likert scale (never, rarely, sometimes, about half the times, often, most of the time, all the time).

City	Competing behaviour	N	Mean	Std. deviation
Valencia	Residual waste	77	5,23	1.605
	Toilet	77	1,29	1.122

	Compost	77	1,18	0,579
	Public bin	77	3,53	1.635
	Nature	77	1,68	0,715
Barcelona	Residual waste	148	3,8	2.471
	Toilet	148	1,36	0,927
	Compost	148	1,65	1.350
	Public bin	148	2,04	1.661
	Nature	148	1,29	0,827
Athens	Residual waste	214	5,76	1.615
	Toilet	214	1,43	1.036
	Compost	214	1,44	1.246
	Public bin	214	4,8	2.313
	Nature	214	1,71	1.168

Circular economy awareness and role

Third, the awareness towards the concept of circular economy as well as the perception of the roles of citizens in the circular economy were assessed for each pilot, in order to assess these components, but also to observe if the use of such concept in future communication would make sense, or if some educational material were needed. As can be observed from **Error! Reference source not found.**, the scores regarding these two concepts are positives is all pilot cities, translating a good awareness of the concept of CE as well as a positive perception of the role of citizen within the CE. Most specifically, respondents believe quite strongly that citizens have a role to play in the circular economy (scores all above 4), although they are less sure of what circular economy actually means (scores between 3 and 4). We do observe some significant differences between cities: Athenians are significantly more aware of the concept of CE than Valencians ($t_{(287)}$= 5.449, p<.001), same for Barcelonans who display a higher awareness scores than Valencians as well ($t_{(222)}$= 4.173, p<.001). Further, respondents perceived more strongly the role of citizens in the CE in Athens than in Valencia ($t_{(287)}$= 3.192, p=.002) or Barcelona ($t_{(359)}$= 2.277, p=.024).

Table 8: Descriptive statistics regarding CE awareness and the role of citizen in the CE for each pilot, measured on a 5-point Likert scale (from strongly disagree to strongly agree). Mid-point is value '3'.

Concept	City	N	% of positive (> 4/5)	Mean	Std. deviation
CE awareness	Athens	213	66.5%	4.02	1.09

	Barcelona	148	72.3%	3.94	1.27
	Valencia	76	38.2%	3.21	1.19
CE citizen role	Athens	213	83.1%	4.45	0.72
	Barcelona	148	76.4%	4.22	1.07
	Valencia	76	68.4%	4.12	0.84

Influencers of selective biowaste sorting

Finally, the factors related to the selective biowaste sorting behaviour in the previously conducted literature review were investigated (see D4.1 for more information and definitions of the concepts).

We observe that the city of **Athens** displayed a variety of scores. Most specifically, participants reported of very low **descriptive norm**, meaning they do not perceive at all that other citizens are sorting their biowaste (this is not such a surprising finding considering that only 31.9% reported sorting their waste more often than half of the time) – only 8.4% of them do. The level of **perceived behaviour control** – the extent to which participant believe that they have everything in their power to sort their waste – as well as the **perceived convenience** of sorting also scored negatively (below the mid-point value of 3) with respectively 18.7% and 7% reporting a positive score. Likewise, participant's **instrumental knowledge**[2] scores just below the mid-point, with only 38.6% of the participants obtaining a positive score, indicating that only a low number of participants actually know how to sort. It appears that the items that are most commonly missorted are 'pizza box' (missorted by 95.3% of respondents) and 'paper tissues' (missorted by 88.4%) followed by 'bones' (missorted by 42.3%), 'expired food' (missorted by 36.3%) and 'unwanted cooked food' (missorted by 31.2%).

The **trust in the system** scores just above the mid-point but only 34.7% report a positive trust, which implies a rather low level of trust regarding authorities on the subject of biowaste. Although positive, the **subjective norm** and **perceived responsibility** in regards to the harmful consequences of non-sorted biowaste could be further increased, with respectively 49.5% and 58.7% of participants reporting a positive score.

On the other hand, the attitude regarding biowaste, personal norm, moral guilt, self-efficacy perceived personal responsibility and the awareness of consequences all score positively. Therefore, the intervention for the pilot of Athens should put a great deal of effort on increasing the perceived behavioural control, the perceived convenience and descriptive norm,

[2] Instrumental knowledge was measured by computing a score from the "Let's play a game" question that assessed whether respondents were putting the waste in the appropriate bin for tea leaves, unwanted cooked food, paper tissues, bones, dead leaves, expired food, and a pizza box. All answers for these items was "organic waste", based on existing local guidelines. One point was allocated per good answer and none in case of wrong answer. The score on a scale from 1 to 7 was converted on a 5-point scale and is reported in the table.

as well as on the trust in the authorities, the perceived personal responsibility, the subjective norm and the instrumental knowledge[3].

Table 9: Descriptive statistics regarding influencing factors – Athens pilot measured on a 5-point Likert scale (from strongly disagree to strongly agree). Mid-point is the value '3'.

City	Concept	N	% of positive (> 4/5)	Mean	Std. deviation
Athens	Attitude	214	68.2%	4,18	.732
	Subjective norm	214	49.5%	3,67	1,122
	Personal norm	214	93,9%	4,64	.696
	Moral guilt	213	51,6%	3,51	1,168
	Descriptive norm	214	8.4%	1,98	1,018
	Perceived behavioural control	214	18.7%	2,34	1,300
	Self-efficacy	214	78%	4,20	.993
	Perceived personal responsibility	213	58.7%	3,78	1,035
	Awareness of consequences	213	69.5%	4,18	.527
	Perceived convenience	213	7%	2,43	.851
	System trust	213	34.7%	3,07	1,294
	Instrumental knowledge	215	38.6%	2,66	1,124

Likewise, all factors are scoring positively for the city of **Barcelona**. For this pilot, it appears that the lowest-scoring factors are the **descriptive norm**, **perceived personal responsibility** and **perceived convenience** with less than 50% of the respondents scoring positively on them. In this sense, participants have a mild perception that other are also selectively sorting their biowaste (which is surprising in regards to our results, where almost 65% of the respondents indicated always sorting their biowaste) and only weakly perceive that they have a personal responsibility regarding the harmful consequences of not sorting biowaste.

The **subjective norm** and **system trust** score more positively with just over 50% indicating that they believe others think they should sort and that they trust their local authorities on the matter of biowaste recycling.

On the other hand, the attitude regarding biowaste, the personal norm, moral guilt, perceived behavioural control, self-efficacy, awareness of consequences and instrumental knowledge (knowledge regarding 'paper tissues' and 'pizza box' could however be increased as there are missorted respectively by 66.4% and 96.6% of the respondents) of the participants all score

[3] It has to be noted that comparison analysis were conducted between the participants living in a municipality with a collection scheme in place and those without, and that no significant differences were found between the two groups.

highly positively. Therefore, the intervention strategy for Barcelona could rather focus on elements of descriptive norm, subjective norm, perceived personal responsibility, perceived convenience and system trust.

Table 10: Descriptive statistics regarding influencing factors – Barcelona pilot measured on a 5-point Likert scale (from strongly disagree to strongly agree). Mid-point is the value '3'.

City	Concept	N	% of positive (> 4/5)	Mean	Std. deviation
Barcelona	Attitude	148	81.1%	4,44	.668
	Subjective norm	148	58.1%	3,68	1,166
	Personal norm	148	91,9%	4,61	1,034
	Moral guilt	148	78,4%	4,05	1,142
	Descriptive norm	148	41.9%	3,33	1,004
	Perceived behavioural control	148	72.3%	4,24	1,012
	Self-efficacy	148	85.1%	4,37	1,040
	Perceived personal responsibility	148	42.6%	3,32	1,306
	Awareness of consequences	148	76.4%	4,26	.603
	Perceived convenience	148	48.6%	3,70	.759
	System trust	148	62.2%	3,77	1,233
	Instrumental knowledge	149	75.8%	3,55	.721

Finally, for the pilot of **Valencia**, all factors score positively (mean score above the mid-value of '3') except for the **instrumental knowledge** where only 28.6% of the participants score positively. We observe that the items which appear the most confusing to the respondents are 'paper tissues' (missorted by 92.2%), 'pizza box' (missorted by 87.0%), 'leaves' (missorted by 61.0%) and 'tea leaves' (missorted by 55.5%).

Although the **subjective** and **descriptive norm** in regards to biowaste sorting, as well as the **system trust,** score positively, less than 50% of the respondent display a positive score. This means that less than half of the participants perceive that people around them are sorting their biowaste and that there is a positive social pressure for them to sort their biowaste. Further, participants only have a mild trust towards their authorities in regards to biowaste, implying that there is room for improvement there. Likewise, the **perceived convenience** scores positively, but only 55.8% of the respondents believe that biowaste sorting is convenient.

All other scores are highly positive: attitude, personal norm, perceived behavioural control, self-efficacy, perceived personal responsibility and awareness of consequences. For Valencia,

the intervention strategy could therefore focus on increasing citizen's descriptive and subjective norm, perceived convenience and system trust.

Table 11: Descriptive statistics regarding influencing factors – Valencia pilot measured on a 5-point Likert scale (from strongly disagree to strongly agree). Mid-point is the value '3'.

City	Concept	N	% of positive (> 4/5)	Mean	Std. deviation
Valencia	Attitude	77	64.9%	4,18	.544
	Subjective norm	77	42.9%	3,43	.833
	Personal norm	77	94.8%	4.45	.787
	Moral guilt	77	62.3%	3,60	1,290
	Descriptive norm	77	36.4%	3,34	.795
	Perceived behavioural control	77	79.2%	4,34	.808
	Self-efficacy	77	81.8%	4,39	.879
	Perceived personal responsibility	77	81.8%	4,20	1,012
	Awareness of consequences	77	79.2%	4,29	.644
	Perceived convenience	77	55.8%	3,79	.758
	System trust	77	48.1%	3,66	.990
	Instrumental knowledge	77	28.6%	2.67	.992

6.2.3 Descriptive statistics – business

Demographics

In the following graphs, the demographics distribution of the respondents for the business survey for each pilot city can be found. The gender, age, education, sector position at the company and size of the company are reported for Athens, Barcelona and Valencia.

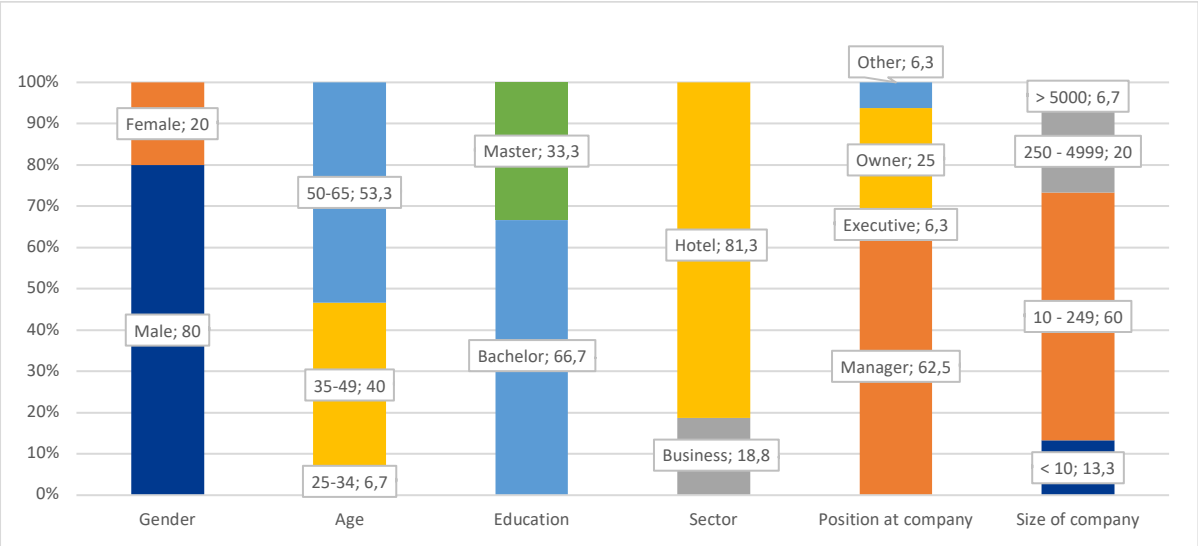


Figure 21: Demographic information for Athens (N=16). The respective categories are indicated before the semicolon. The values indicated after the semicolon are indicated in percentages. Size of company is indicated in numbers of employees.

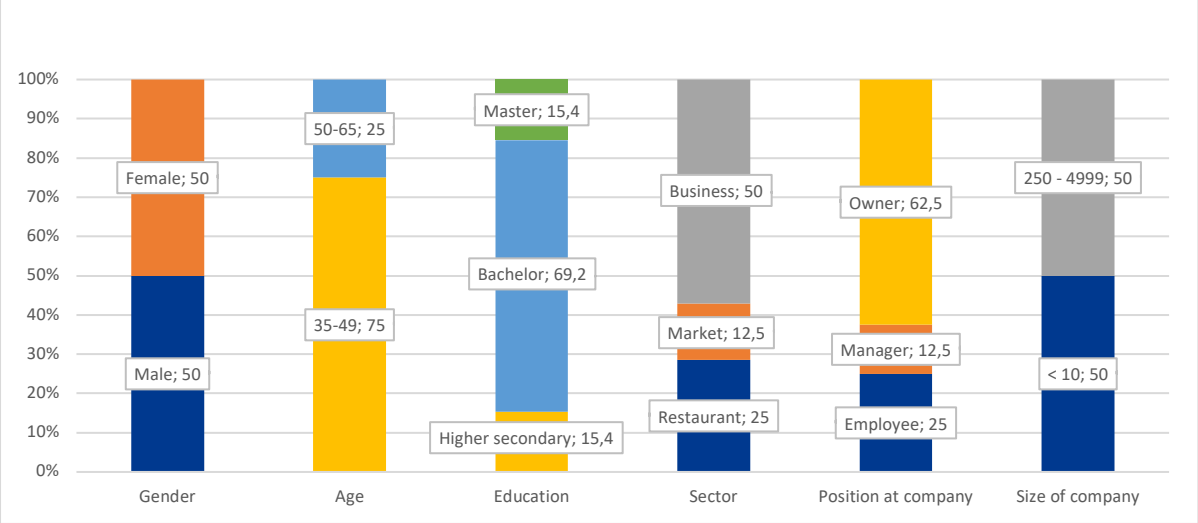


Figure 22: Demographic information for Barcelona (N=8). The respective categories are indicated before the semicolon. The values indicated after the semicolon are indicated in percentages. Size of company is indicated in numbers of employees.

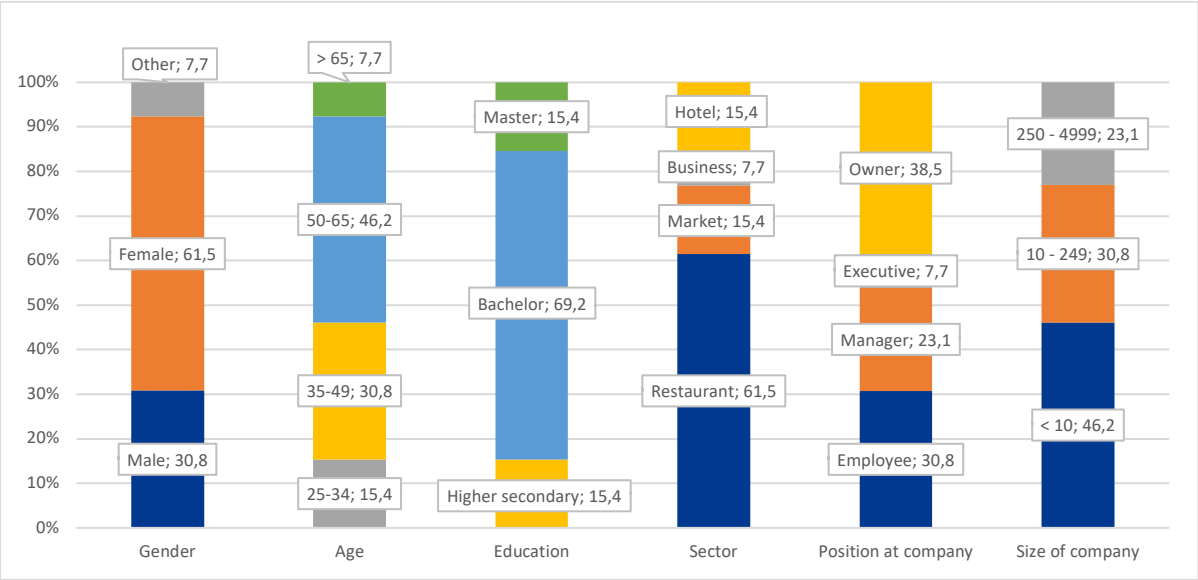


Figure 23: Demographic information for Valencia (N=13). The respective categories are indicated before the semicolon. The values indicated after the semicolon are indicated in percentages. Size of company is indicated in numbers of employees.

Sorting behaviour

First and foremost, the frequency to which businesses in each pilot city selectively sort their waste was assessed. As can be observed from Figure 24, this frequency varies greatly between pilot city. Overall there is no one tendency that can be observed per city, with answers being quite disparate. In **Athens** businesses either never sort their biowaste, or do so all the time. Likewise, in **Barcelona** businesses either sort their waste rarely or all the time. Finally, in **Valencia** businesses sort their waste about half the time, although some do it all the time.

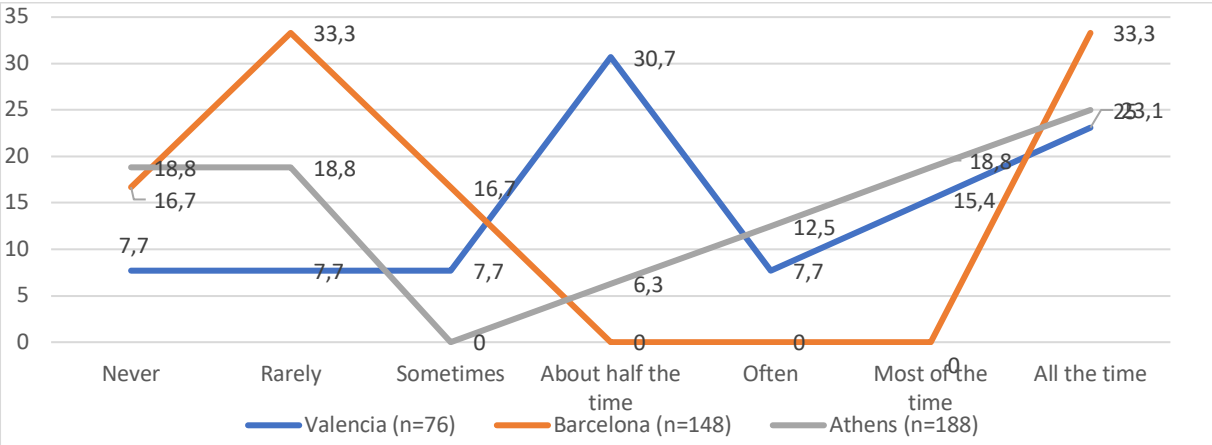


Figure 24: Frequency (represented in % of respondents) of selective biowaste sorting per pilot

Second, the **competing behaviours** to selective biowaste sorting were assessed, to better understand what would need to be "fought against" in the intervention. It appears that for all pilot cities, the most frequently undertaken alternatives to selective biowaste sorting for businesses are throwing biowaste in the **residual waste bins** (most frequent alternative in all pilot cities), followed by throwing biowaste into a **public bin**.

Table 12: Descriptive statistics regarding the frequency of undertaken competing behaviour of selective biowaste sorting measured on a 7-point Likert scale (never, rarely, sometimes, about half the time, often, most of the time, all the time).

City	Competing behaviour	N	Mean	Std. deviation
Valencia	Residual waste	13	5,38	1.387
	Toilet	13	1,46	1.664
	Compost	13	2,08	1.935
	Public bin	13	2,77	2.204
	Nature	13	1,77	1.922
Barcelona	Residual waste	6	5,5	1.643
	Toilet	6	1,5	1.225
	Compost	6	3	2.449
	Public bin	6	3,33	2.422
	Nature	6	1,67	1.211
Athens	Residual waste	16	4,44	2.308
	Toilet	16	3,63	2.825
	Compost	16	3,19	2.401
	Public bin	16	4,31	2.549
	Nature	16	3,13	2.604

Circular economy awareness and role

Third, the awareness towards the concept of circular economy as well as the perception of the roles of citizens in the circular economy were assessed for each pilot, in order to assess these components, but also to observe if the use of such concept in future communication would make sense, or if some educational material were needed. As can be observed from **Error! Reference source not found.**, the scores regarding these two concepts are positives is all pilot cities, translating a good awareness of the concept of CE as well as a positive perception of the role of businesses within the CE.

Table 13: Descriptive statistics regarding CE awareness and the role of citizen in the CE for each pilot, measured on a 5-point Likert scale (from strongly disagree to strongly agree). Mid-point is value '3'.

Concept	City	N	% of positive (> 4/5)	Mean	Std. deviation

CE awareness	Athens	213	62.5%	3.66	1.371
	Barcelona	148	71.4%	4.19	0.878
	Valencia	76	53.8%	3.30	1.109
CE businesses role	Athens	213	56.3%	3.87	1.039
	Barcelona	148	57.1%	3.76	1.100
	Valencia	76	61.5%	3.61	0.767

Influencers of selective biowaste sorting

Finally, the factors related to the selective biowaste sorting behaviour in the previously conducted literature review were investigated (see D4.1 for more information and definitions of the concepts).

We observe that the city of **Athens** pilot displayed a variety of scores. Most specifically, participants reported a negative **descriptive norm**, meaning they do not have the perception at all that other businesses are sorting their biowaste (only a third thought so). All other components score positively, but we observe some components that do not perform very well such as the attitude, where only 37.5% display a positive **attitude** towards biowaste sorting, as well as the **perceived convenience** and **trust in the system**, where only 1/3 of businesses were positive. In the same vein, only 40% of businesses perceive a social pressure to sort their biowaste, only 40% feel responsible for the negative effect of non-sorting, only 53.3% appear aware of the consequences of non-sorting and only 53.3% have a satisfying level of instrumental knowledge regarding biowaste sorting. **Therefore, the intervention for the pilot of Athens should put a great deal of effort on increasing the attitude, the subjective norm, the descriptive norm, the perceived responsibility, the awareness of consequences, the perceived convenience, the instrumental knowledge, as well as on the trust in the authorities.**

Table 14: Descriptive statistics regarding influencing factors – Athens pilot measured on a 5-point Likert scale (from strongly disagree to strongly agree). Mid-point is the value '3'.

City	Concept	N	% of positive (> 4/5)	Mean	Std. deviation
Athens	Attitude	15	37.5%	3,77	0,875
	Subjective norm	15	40%	3,50	0,124
	Moral norm	15	66.7%	3,87	0,133
	Descriptive norm	15	33.3%	2,93	0,158
	Perceived behavioural control	15	73.3%	3,83	0,136
	Self-efficacy	15	73.3%	3,93	0,135
	Perceived personal responsibility	15	40%	3,40	0,144

	Awareness of consequences	15	53.3%	3,99	0,100
	Perceived convenience	15	33.3%	3,27	0,134
	System trust	15	33.3%	3,07	0,164
	Instrumental knowledge	15	53.3%	3,99	1.00

For the pilot of Barcelona, it appears that the lowest-scoring factors are the **descriptive norm,** with **none of the respondents believing that other businesses selectively sort their biowaste**. Further businesses in Barcelona seem to have very little **trust** in their recycling facilities with only 25% indicated that they do. Further, only half of the respondents appear aware of the consequences of non-sorting, only half perceive biowaste sorting as **convenient**, and only half have a satisfying level of instrumental knowledge regarding biowaste sorting. **Therefore, the intervention strategy for Barcelona could focus on elements of descriptive norm, awareness of consequences, perceived convenience, system trust and knowledge**.

Table 15: Descriptive statistics regarding influencing factors – Barcelona pilot measured on a 5-point Likert scale (from strongly disagree to strongly agree). Mid-point is the value '3'.

City	Concept	N	% of positive (> 4/5)	Mean	Std. deviation
Barcelona	Attitude	5	80%	4,24	0,535
	Subjective norm	5	80%	4,30	0,671
	Moral norm	5	60%	3,90	0,114
	Descriptive norm	5	0%	2,70	0,104
	Perceived behavioural control	5	100%	4,60	0,418
	Self-efficacy	5	100%	4,60	0,548
	Perceived personal responsibility	4	61.5%	3,42	0,129
	Awareness of consequences	4	50%	4,18	0,472
	Perceived convenience	4	50%	3,60	0,864
	System trust	4	25%	3,38	0,750
	Instrumental knowledge	4	50%	4,18	0,472

Finally, for the city of **Valencia**, all factors score positively (mean score above the mid-value of '3'). The lowest scoring components are the **descriptive norm** in regards to biowaste sorting, followed by **moral norm** and **perceived responsibility**. We observe that for the component of descriptive norm, only 53.8% of respondents indicated that they agree or strongly agree with the fact that other businesses are selectively sorting their biowaste. This means that participants do perceived that business around them are sorting their biowaste, but that this

perception is quite mild and could be increased. **For Valencia, the intervention strategy could therefore focus on increasing businesses' descriptive norm, moral norm and perceived personal responsibility**.

Table 16: Descriptive statistics regarding influencing factors – Valencia pilot measured on a 5-point Likert scale (from strongly disagree to strongly agree). Mid-point is the value '3'.

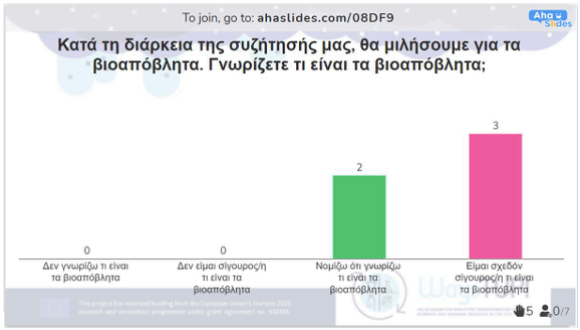
City	Concept	N	% of positive (> 4/5)	Mean	Std. deviation
Valencia	Attitude	13	84.6%	4,41	0,522
	Subjective norm	13	69.2%	4,04	0,749
	Moral norm	13	61.5%	4,23	0,753
	Descriptive norm	13	53.8%	3,81	0,123
	Perceived behavioural control	13	84.6%	4,12	0,116
	Self-efficacy	13	92.3%	4,54	0,111
	Perceived personal responsibility	13	61.5%	3,85	0,765
	Awareness of consequences	13	84.6%	4,42	0,558
	Perceived convenience	13	69.2%	3,97	0,626
	System trust	13	69.2%	3,85	0,801
	Instrumental knowledge	13	84.6%	4,42	0,558

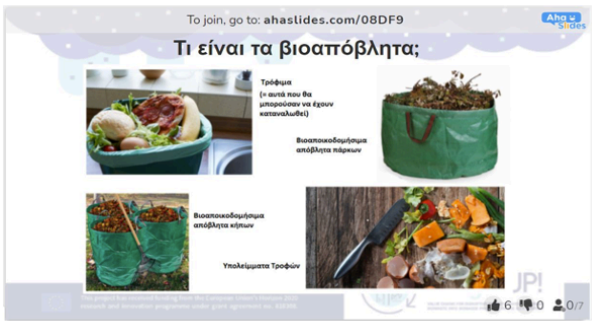
6.3 Annex 3: co-creation workshops

Co-creation workshops were organised in Athens (by SUST) and in Valencia (by SAV). The following section reports the slides presented on the "aha slide" platform, and details the analysis of the notes from the workshops. Based on the current activities in Barcelona, the community coordinator AMB decided that organising co-creation workshops was no longer relevant. More information on this can be found in the technical report (reporting period I).

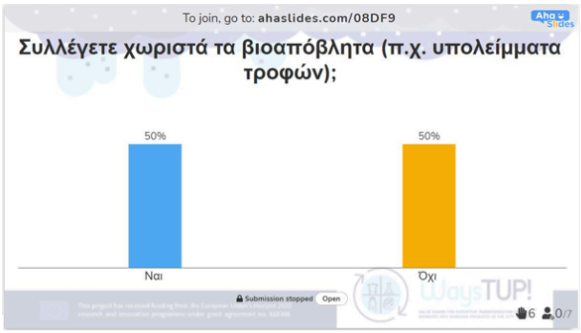
6.3.1 Slides on the "AHA slide" online platform

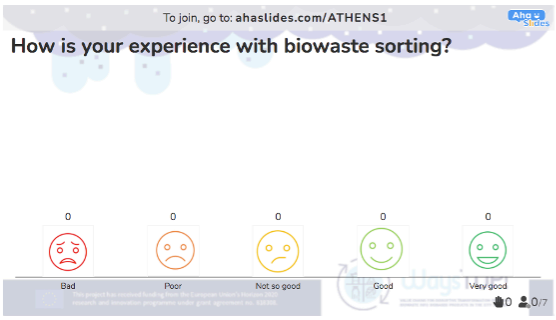
On the left, the English version of the slides can be found, on the right, a completed version of the Greek version of the slide can be found.

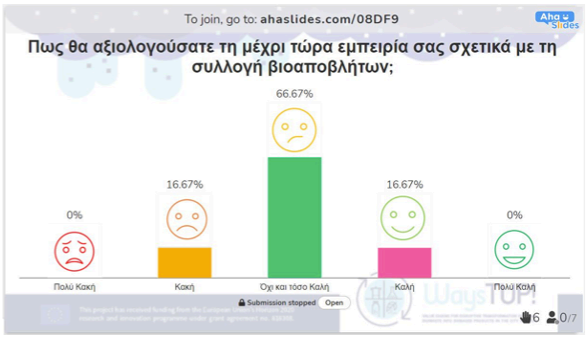


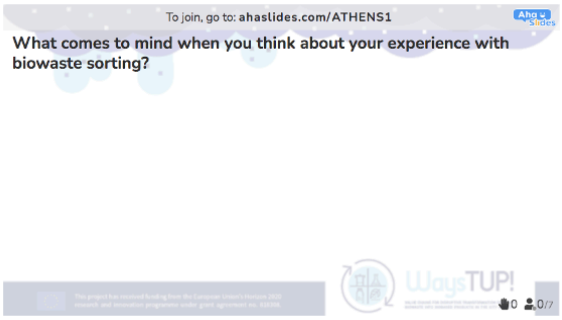



To join, go to: ahaslides.com/ATHENS1
Do you selectively sort your biowaste (e.g. food and kitchen waste)?
0%
Yes, I do
0%
No, I do not
0
0/7

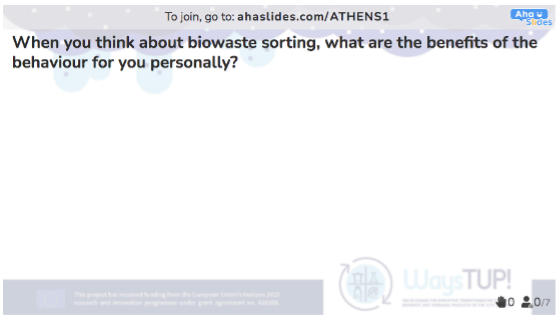

To join, go to: ahaslides.com/08DF9
Συλλέγετε χωριστά τα βιοαπόβλητα (π.χ. υπολείμματα τροφών);
50%
Ναι
50%
Όχι
Submission stopped
Open
6
0/7


To join, go to: ahaslides.com/ATHENS1
How is your experience with biowaste sorting?
0
Bad
0
Poor
0
Not so good
0
Good
0
Very good
0
0/7

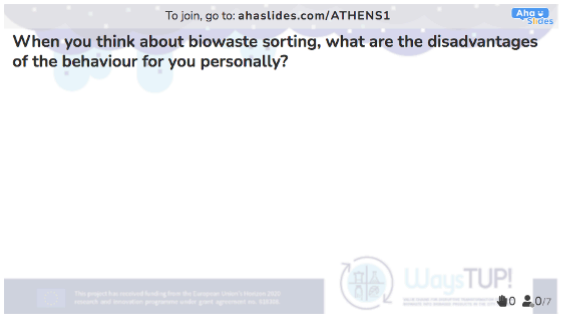

To join, go to: ahaslides.com/08DF9
Πως θα αξιολογούσατε τη μέχρι τώρα εμπειρία σας σχετικά με τη συλλογή βιοαποβλήτων;
0%
Πολύ Κακή
16.67%
Κακή
66.67%
Όχι και τόσο Καλή
16.67%
Καλή
0%
Πολύ Καλή
Submission stopped
Open
6
0/7


To join, go to: ahaslides.com/ATHENS1
What comes to mind when you think about your experience with biowaste sorting?
0
0/7

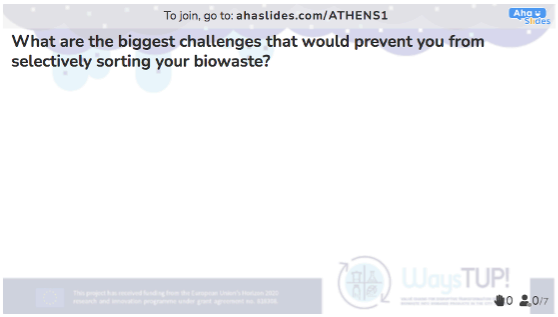

To join, go to: ahaslides.com/08DF9
Τι σας έρχεται στο μυαλό όταν σκέφτεστε την εμπειρία σας σχετικά με τη συλλογή βιοαποβλήτων;
κομπόστ
οικονομία
χρονοβόρα
δυσκολία λόγω χρόνου
ανακύκλωση
βιωσιμη αναπτυξη
σωστή
διαλογη
βιοκαύσιμα
ειδικοι καδοι
προστασια περιβαλλοντος
λίπασμα
δυσκολία επειδή δεν ξέρω
ακριβώς ποια απόβλητα
δύσκολη
δυσκολία συλλογής
22
0/7

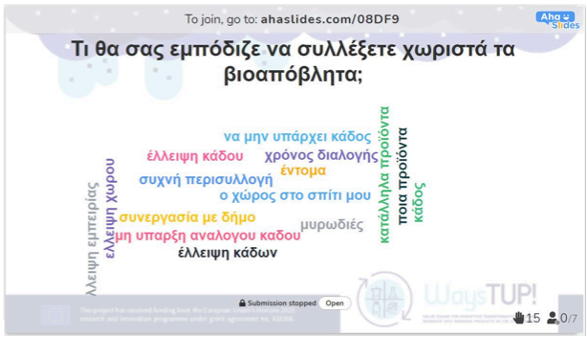

To join, go to: ahaslides.com/ATHENS1
When you think about biowaste sorting, what are the benefits of the behaviour for you personally?
0
0/7

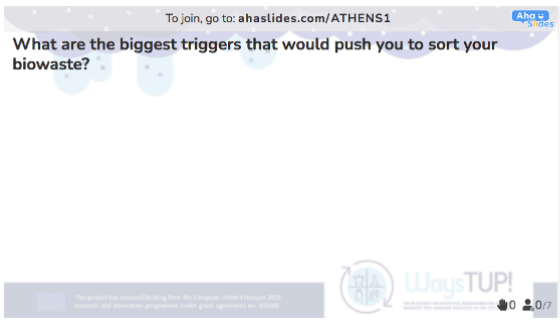

To join, go to: ahaslides.com/08DF9
Ποια είναι τα προσωπικά οφέλη που σας έρχονται στο μυαλό, όταν σκέφτεστε τη χωριστή συλλογή βιοαποβλήτων;
η αίσθηση του να βοηθάμε
προστασία περιβάλλοντος
καθαριότητα
καλό για το περιβάλλον
καλύτερο μέλλον
τα απορριματα δεν μυριζου
προστατευω το περιβαλλον
δεν μαζευω υπολειματα
καθαριοτητα
οικολογική συνείδηση
στην βελτίωση της ζωής
19
0/7

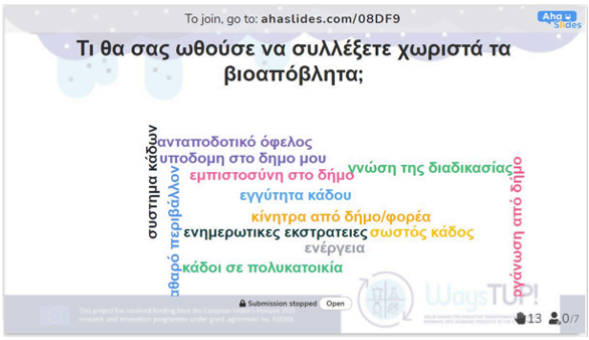

To join, go to: ahaslides.com/ATHENS1
When you think about biowaste sorting, what are the disadvantages of the behaviour for you personally?

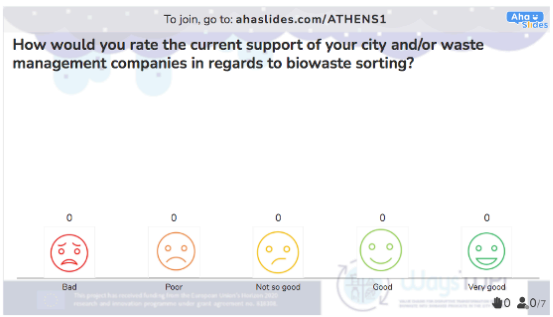

To join, go to: ahaslides.com/08DF9
Ποια είναι τα αρνητικά που σας έρχονται στο μυαλό, όταν σκέφτεστε τη χωριστή συλλογή βιοαποβλήτων;
μη ύπαρξη κάδων
μπέρδεμα με κρέας κόκαλα
ποντίκια
ειδική κάδοι
έντομα
κανενα
κάδος στη περιοχη
και πού θα πρέπει να
παραδώσω τα βιοαπόβλητα
μυρωδιές
δεν γνωρίζω ακριβώς πώς
σακούλες ειδικές
χρονοβόρα διαδικασία
Λειτουργεί
υγρά
χρόνος
έλλειψη γνώσης
δυσκολία συλλογής


To join, go to: ahaslides.com/ATHENS1
What are the biggest challenges that would prevent you from selectively sorting your biowaste?


To join, go to: ahaslides.com/08DF9
Τι θα σας εμπόδιζε να συλλέξετε χωριστά τα βιοαπόβλητα;
να μην υπάρχει κάδος
έλλειψη κάδου
χρόνος διαλογής
έντομα
συχνή περισυλλογή
ο χώρος στο σπίτι μου
συνεργασία με δήμο
μυρωδιές
μη υπαρξη αναλογου καδου
έλλειψη κάδων
έλλειψη εμπειρίας
έλλειψη χωρου
κατάλληλα προϊόντα
ποια προϊόντα
κάδος

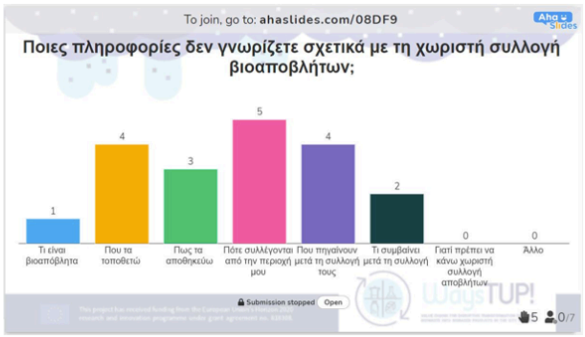

To join, go to: ahaslides.com/ATHENS1
What are the biggest triggers that would push you to sort your biowaste?

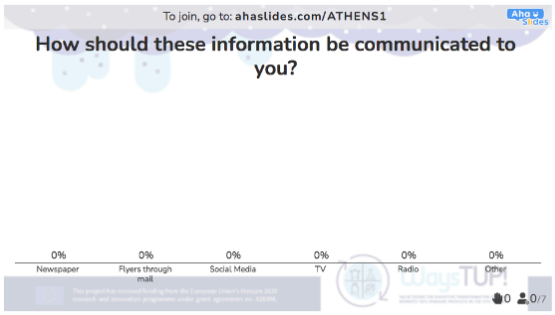

To join, go to: ahaslides.com/08DF9
Τι θα σας ωθούσε να συλλέξετε χωριστά τα βιοαπόβλητα;
ανταποδοτικό όφελος
υποδομη στο δημο μου
γνώση της διαδικασίας
εμπιστοσύνη στο δήμο
εγγύτητα κάδου
κίνητρα από δήμο/φορέα
ενημερωτικες εκστρατειες
σωστός κάδος
ενέργεια
κάδοι σε πολυκατοικία
σύστημα κάδων
άθαρό περιβάλλον
οργάνωση από δήμο

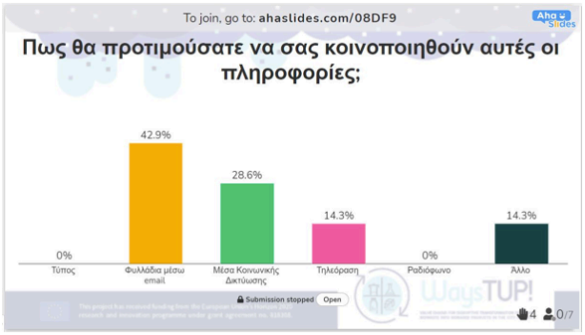

To join, go to: ahaslides.com/ATHENS1
How would you rate the current support of your city and/or waste management companies in regards to biowaste sorting?
0
0
0
0
0
Bad
Poor
Not so good
Good
Very good

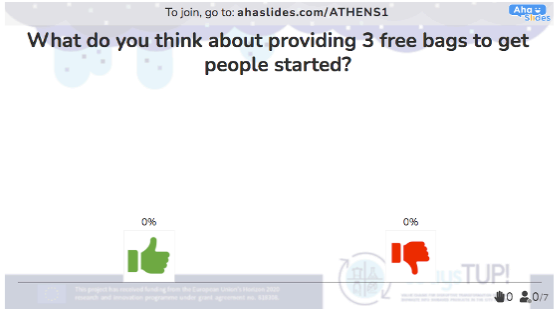

To join, go to: ahaslides.com/08DF9
Πως θα βαθμολογούσατε την υποστήριξη του Δήμου σας, αναφορικά με τη χωριστή συλλογή βιοαποβλήτων;
0
2
3
0
1
Πολύ Κακή
Κακή
Όχι και τόσο Καλή
Καλή
Πολύ Καλή

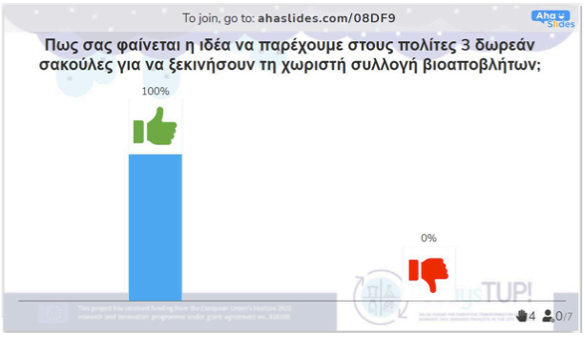

To join, go to: ahaslides.com/ATHENS1
What type of information are you missing on biowaste?
What is considered biowaste
Where do I put my biowaste
How do I store my biowaste
When is biowaste being collected in my street?
Where is biowaste being collected?
What happens with my biowaste after pick-up?
Why should I sort my biowaste?
Other

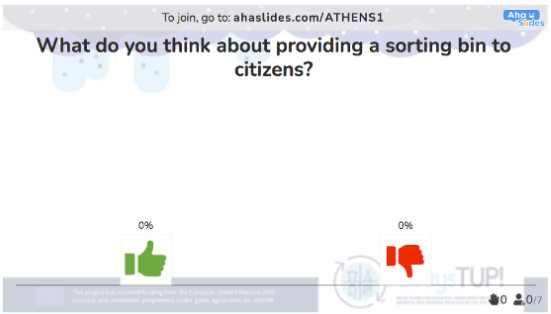

To join, go to: ahaslides.com/08DF9
Ποιες πληροφορίες δεν γνωρίζετε σχετικά με τη χωριστή συλλογή βιοαποβλήτων;
Τι είναι βιοαπόβλητα
Που τα τοποθετώ
Πως τα αποθηκεύω
Πότε συλλέγονται από την περιοχή μου
Που πηγαίνουν μετά τη συλλογή τους
Τι συμβαίνει μετά τη συλλογή
Γιατί πρέπει να κάνω χωριστή συλλογή αποβλήτων
Άλλο


To join, go to: ahaslides.com/ATHENS1
How should these information be communicated to you?
Newspaper
Flyers through mail
Social Media
TV
Radio
Other

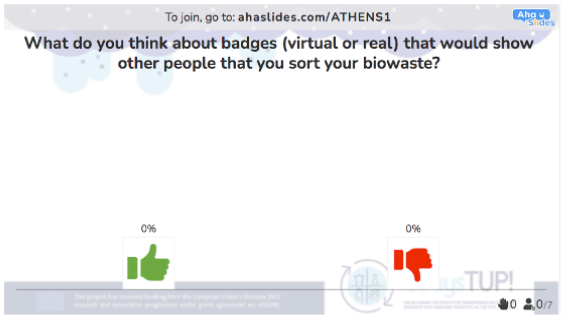

To join, go to: ahaslides.com/08DF9
Πως θα προτιμούσατε να σας κοινοποιηθούν αυτές οι πληροφορίες;
Τύπος
Φυλλάδια μέσω email
Μέσα Κοινωνικής Δικτύωσης
Τηλεόραση
Ραδιόφωνο
Άλλο

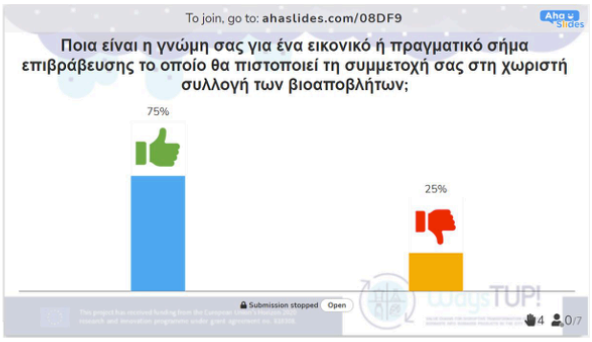

To join, go to: ahaslides.com/ATHENS1
What do you think about providing 3 free bags to get people started?

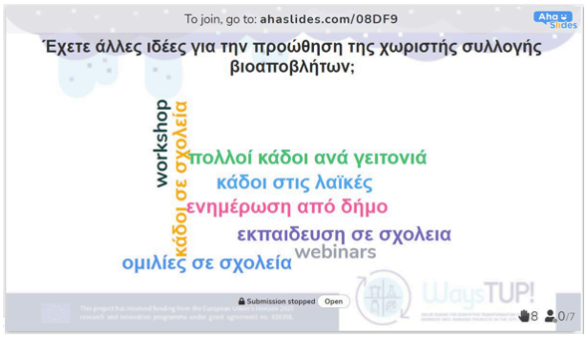

To join, go to: ahaslides.com/08DF9
Πως σας φαίνεται η ιδέα να παρέχουμε στους πολίτες 3 δωρεάν σακούλες για να ξεκινήσουν τη χωριστή συλλογή βιοαποβλήτων;


To join, go to: ahaslides.com/ATHENS1
What do you think about providing a sorting bin to citizens?


To join, go to: ahaslides.com/08DF9
Πως σας φαίνεται η ιδέα να παρέχουμε στους πολίτες 1 κάδο χωριστής συλλογής βιοαποβλήτων;







6.3.2 Results Athens

Analysis – citizens (two workshops)

Participants associate biowaste sorting with three main categories of elements (1) difficulties associated with it (odours, lack of bins, time consuming, tiring, difficult, lack of knowledge, difficult procedure); (2) the environment (environmental protection, sustainable development, return to earth, soil fertility) and (3) possible outcomes (compost, fertilizer, biofuels).

The main advantages that they see associated with selective biowaste sorting are in regards to environmental protection (clean environment, beneficial for the environment, environmental awareness, no rubbish in nature, zero waste, cleanliness), moral gratification (conscientiousness, responsibility, sense of helping) as well as well-being, a better future and education. On the other hand, the main disadvantages of selective biowaste sorting regards practical elements of the behaviours such as a lack of bins, bags, the fact that it is time consuming, the lack of practical knowledge as to how to sort and what to sort, as well as rats, insects, odours and liquid. As we can see for these two elements – advantages and

disadvantages – we can observe that there is a conflict in their locus: while most of the perceived advantages are external to the individual, the disadvantages are all internal to the individual. **The balance between the costs and the benefits of the behaviour is therefore challenged**.

More specifically participants mentioned that the biggest challenges to biowaste sorting was the **lack of available bins close by**, with bins being only available in certain regions or points of the municipality and therefore the fact that it was **time consuming** to effectively sort their biowaste. **In this sense, it appears that it is not the act of sorting that require the most efforts from citizens but rather the act of taking their bags to a point of collection (the brown bins)**. They mention that to transfer their bags, they have to walk a relatively long distance on foot (300-500m) or to bring the bag via car. It can therefore happen that even though citizens have effectively selectively sorted their biowaste at home, they finally put their bags in the wrong bins, by lack of convenience. Further, they stated that sorting was time and space-consuming and that it brought rats, insects, odours and liquid leaks. In the same line, the biggest trigger for participant to sort their waste would be the correct and dense placement of bins near their homes. They also mentioned incentives and knowledge in the procedure (valorisation of the biowaste) as potential triggers. Citizens declared themselves that they are aware and environmentally conscious, and that they are willing to sort biowastes, however, they do not receive information from the Municipality on the brown bin network. The also stated missing information on: where to put their biowaste, how to store their biowaste, when and where was biowaste being collected.

Citizens in the workshops also wanted to be assured that the biowaste was going to be treated correctly by their municipalities and that their effort would indeed have a positive outcome, as they were suspicious of what was being done with it. They would like to know what kind of products can be produced as a result of their treatment and the reason why this is significant. Citizens doubt about the management scheme of biowastes either because the Municipality has not informed them adequately about this issue or because they do not trust the Municipality Authorities in general.

In regard to communication, citizen indicated that they preferred being contacted by emails and flyers as this was seen as the most professional type of contact with them. They also mentioned the idea of being contacted by a message mobile application such as WhatsApp or Viber. Social media was also positively evaluated but was seen as less effective in reaching out citizens.

All participant were positive in regards to the idea of providing three free biowaste bags to citizens to get them started, and likewise for the sorting bin. Badges were seen as positive, but rather for a younger audience such as children. The idea of an informational sticker to put on their bin was also positively received and perceived as very useful. In regards to additional activities, participants mentioned that workshops and webinars could be organized, as well as educational activities within schools.

6.3.3 Results Valencia

Analysis – citizens (one workshop)

Attitude of the participants vis-à-vis biowaste sorting is quite negative. **They see it as a waste of time, complicated due to the diversity of bins, and are not even sure if it is useful to do**. One participant mentions that, in any case, it is the same garbage truck that collects all the different

waste. The most frequently mentioned disadvantages are the **time** it takes, the distance to the containers and the smell. Participants mention that smaller bag would be better to avoid odors, but that on the other ends, it would also imply more trip to the container.

The **advantages associated with it are again all external** and in relation to the environment. One respondent mentions the possibility that something useful can be made out of it, such as compost. Another mentions that rather than having a personal benefit, this is a personal responsibility.

Respondents mentioned that **what would they motivate to sort their biowaste would be knowing it is relevant to do so and that it does make a difference**. Some also requested to have **more information** on the type of items that can be sorted in the biowaste bags. Participants mentioned that if their local authority was communicating on the matter, the message didn't reach them. They suggested to have poster and easily-accessible point of information.

The favorite option for communication channels appeared to depend on their age group, with younger participants mentioning social media and influencers, and middle-aged participants mentioning more traditional form of communication such as TV, newspaper and radio.

Respondents were not sure about the relevance of providing free bags. They said they would rather use any other type of bags. The idea of bins was more popular. Badges were also positively perceived, although they weren't sure how it would work. The middle-aged participants were of the opinion that to promote selective biowaste sorting, the authorities should rather implement an obligation or a fee to comply.

Analysis – businesses (one workshop)

Most of the attendant mentioned that they do not currently sort their biowaste, due to time, space and hygiene restrictions. One participants also mentioned that they are not even sure the waste is treated adequately once collected. Participants were all unsure about the concept of recycling in itself.

Businesses suggested to have a monetary incentive to motivate them to participate, notably on the model of Ireland, where businesses pay a fee based on the weight of the residual waste, sorting becoming then the most economical way to function. The idea of a tax-return is also mentioned.

In regards to the disadvantages of the biowaste sorting, businesses mentioned that it would take more space and be more tiresome for employees as this type of waste is heavier to carry out to the container. **Space** appeared as the number one inconvenience for them.

Businesses mentioned that having a label that would act as a certification that they participate in selective biowaste sorting would be a good incentive for them. They also mention promotional items to help them in the process and help in terms of space logistic.

Businesses also requested an informational sheet with sorting instruction and colour code, and were favourable to the idea of a sticker to put on the bin. The also thought that the authorities should provide more general information and legislate to make it mandatory. Social media was seen as a good tool to provide information and one participant even mention the use of big brands such as Zara to disseminate the information.

The idea of providing three bags to businesses was seen as too weak to get them started, where the bin was seen as more beneficial although it should have specific elements such as a closing lid.