WaysTUP!

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

D4.1: Setting the scope of the behavioural change campaign: a behavioural mapping exercise

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

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Lexicon

Concept	Definition	Source
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), with the aim to accomplish sustainable development, which implies creating environmental quality, economic prosperity and social equity, to the benefit of current and future generations.	Kirchherr et al. (2018)
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)
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)
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)
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)
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)

Executive summary

This deliverable is the first 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 biowaste derived products with citizens and communities. This Work Package will be structured according to the MBAA model with the following steps: (1) Scoping; (2) Understanding; (3) Intervention; (4) Define deviations; (5) Value; (6) Evaluation, that are explained in *Chapter 1*. This deliverable focuses on **defining the scope of the behavioural change campaign** (Step 1: Scoping) and do so by (a) defining the purpose and focus of the campaign, (b) identifying the social issue and finally, (c) identifying the target audiences.

In *Chapter 2*, we first define the **purpose and focus** of the campaign by laying down the broader issue the project and the specific behavioural change campaign are facing and trying to solve. After a brief introduction to the Circular Economy (CE) and bioeconomy concepts, we highlight the **lack of focus the social component of these models has received** over the years. This has led to an **insufficient and inadequate representation of the citizens** and the role they hold within the loop of CE. To counteract this shortcoming, we propose to look at the citizen and communities' position in the CE loop and focus on their role, and this more precisely in the context of the WaysTUP! project. Here we highlight that citizens and communities take part in the loop via two different behaviours: (1) the **biowaste sorting** behaviour and (2) the **consumption** (or acceptance) **of bio-based products** behaviour.

In *Chapter 3*, we investigate these two behaviours in more details. Through a thorough literature review, we first propose a clear **definition** for each behaviour, followed by the current elicited **determinants** for each. In the aim, in order to be as exhaustive as possible, we also compare the identified determinants to the broader behaviours of waste sorting (compared to biowaste sorting) and acceptance of sustainable products (compared to the acceptance of bio-based products), where we highlight overlap and gaps in the literature. We then propose a **framework** of determinants that will inform the design of the behaviour change intervention. Furthermore, we reference interesting and **related projects** with whom potential synergies could be found.

Finally, *Chapter 4* focuses on the **identification of the campaign's target audience** for each of the pilot studies that is part of WP4 (Pilots 1, 5, and 6). Convenience samples of each population were identified in terms of pre-existing communities in the urban environments where Pilots would take place. The selection of the target populations and the identification of communities was conducted in close collaboration with the partners through a common process: (1) identify the target audiences; (2) gain insights into the target communities and define the desired behavioural objectives; (3) evaluate the target communities in terms of their expected reaction to the behavioural change intervention. Information was obtained from the Pilot partners with the use of survey and semi-structured interviews. The questions addressed in each of the steps and the resulting outcomes are presented in Chapter 4. Target audiences are diversified (from citizens to fishermen cooperatives and food markets) and communication medium are often not yet in place. Although Pilot partner indicates that citizens have all already taken part in waste sorting before, their participation could be improved. Information regarding the acceptance of bio-based products however is completely missing and will therefore require extra effort in the following steps.

Introduction

This deliverable is the first 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". The goal of this work package is to investigate the motivations and barriers related to the separate collection of urban biowaste of citizens and communities, as well as the customer acceptance of biowaste derived products. Therefore, a behaviour change campaign is designed and executed in close collaboration with the pilots (pilot 1, 5 and 6 – WP3), with the aim to achieve the following objectives:

- to improve the current **perception** of citizens and local communities on urban biowaste as a local resource – target goal: improved perception > 80%
- to enhance the **active participation** of citizens in the **separate collection** of urban biowaste – target goal: enhanced participation > 60%
- 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 behaviour change study through the Modular Behavioural Analysis Approach (**MBAA**). The MBAA entails several steps: from the initial scoping of the study, the design of the behaviour change interventions towards 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 Chapter 1.

This deliverable reports the results of the first phase of the MBAA, which sets the scope of the behavioural change study in the three pilots. The scoping phase includes: the identification of target audiences who will participate in the behaviour change study, the formulation of specific behavioural objectives and target goals, and a first exploration of determinants of change for urban biowaste recycling and acceptance of biowaste derived products.

The structure of this document is as following:

- **Chapter 1 – A Modular Behaviour Analysis Approach (MBAA): Behaviour change towards a circular economy:** this chapter includes detailed information about the behaviour change model and the principles of community-based social marketing.

- **Chapter 2 – Purpose and focus of the behaviour change study: the need for a (circular) bioeconomy**: this chapter explains the basic concepts of the circular economy and looks at the relevance of the social dimension within the circular economy.
- **Chapter 3 – Identification of the social issue – The key determinants of the consumption and sorting behaviour in a bioeconomy context:** this chapter presents a first framework of determinants that need to be taken into account for the adoption of biowaste recycling behaviour and consumer acceptance of biowaste derived products.
- **Chapter 4 – Identification of target audience and behaviour objectives – Pilot cases:** This chapter presents the results of the scoping phase for pilot 1, 5 and 6. The target audiences are identified and the target goals and objectives are discussed.

1. A Modular Behavioural Analysis Approach (MBAA): Behaviour change towards a circular economy

This chapter explains the different phases of the MBAA which will be applied to set up the behaviour change studies in the WaysTUP! project.

The MBAA was developed by imec in order to support and implement the design of behavioural change interventions in the context of (digital) social innovation, and this for small-scale to large-scale studies in real-life field settings. The iterative approach of the MBAA makes it possible to identify which interventions are efficient to promote change, and which ones should be redefined. The model was already tested and applied within the context the hackAIR project (promotion of pro-environmental behaviours for cleaner air), the City of Things project (design of policy interventions for smart cities) and Health at work (promoting healthy behaviours at work). If necessary, the imec team will make the necessary adjustments to the different phases and its subsequent activities to fit it with the context of the pilot studies in WaysTUP!

The MBAA will act as a framework for WP4, meaning that the various phases are connected to specific tasks and deliverables of this work package:
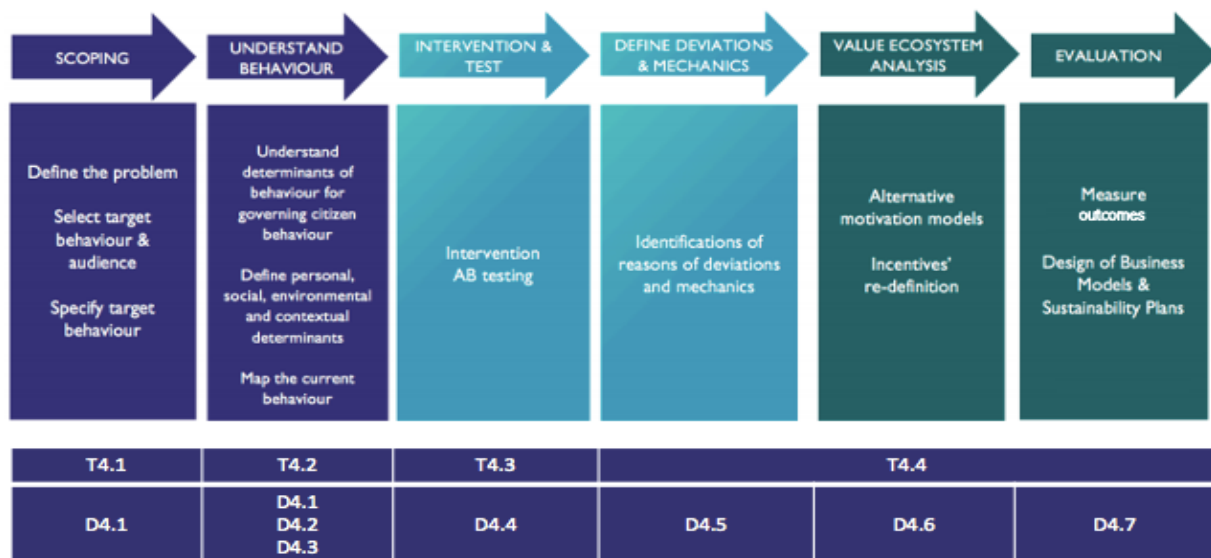
Figure 1: Modular Behavioural Analysis Approach (MBAA)

This deliverable reports about the **scoping phase (phase 1),** and identifies the main target audiences for the pilots, defines the specific objectives and target goals of the behavioural change campaign and presents a first exploration of barriers and motivators for the desired behaviours.

A further exploration of the main determinants (personal, economic, environmental and contextual) will be done in the **second phase (understand behaviour)**. In this second stage, the necessary preparations are also taken to launch the pilot studies with the design of specific behaviour change interventions through various engagement tools. This will result into a toolkit

with specific interventions to improve the perception and acceptance of consumers of bio-waste derived products (D4.2) and concrete engagement plans for the pilots (D4.3).

In the **third and the fourth phase** (**intervention and test**), the behaviour change interventions are implemented, and a specific methodology is defined to measure the change (D4.4).

Finally, the in the **fifth and the sixth phase** (**evaluate and monitor**), the outcomes are analysed and the effectiveness of certain interventions are evaluated (D4.6, D4.7). The various tools and activities that were set up for engagement purposes are specifically reported in D4.5

It should be noted that the design of the business models and sustainability plans are not part of WP 4 (cfr. phase 6 of the MBAA). These tasks are allocated in work package 6, and for which the outputs of this work package will serve as a starting point.

In the following subchapters, each phase is further explained through its encompassing sub activities. The activities of the various phases are relying on the principles of community-based social marketing (Lee and Kotler 2013) and on experiences and validation of previous research (van der Graaf, Hoelck, and McCrory 2017; Veeckman and Temmerman 2018).

1.1　Phase I: Scoping

The first phase of the MBAA has the objective to define the scope of the behavioural change analysis. It consists of the following sub-activities:

- **Sub activity 1 – Purpose and focus:** Define the purpose and scope of the behavioural change campaign
- **Sub activity 2 – Define the social issue**: Describe the background of the issue, and perform a situational analysis with also a review of previous good practices
- **Sub activity 3 – Identification of target audiences**: Make a list of the prioritized target audiences and provide a description
- **Sub activity 4 - Define objectives and target goals:** Defining the behaviour, knowledge and belief objectives, and defining the target goals as specific, measurable, attainable, relevant and time sensitive.

Sub activity 1 – Purpose and focus

This sub activity focuses on presenting information and facts about the specific issue that are addressed in the behaviour change study. What is the problem? How bad is it? What is contributing to the problem? The information presented helps to understand the purpose and focus of the behaviour change study. The purpose is the ultimate impact that will be realized if your target audience performs the desired behaviour, while the focus narrows down the scope of the plan and selects a specific option that contributes to the realization of the overall purpose.

For the WaysTUP! project, the purpose and its focus are determined by the project objectives, and will be further explained in **Chapter 2**.

Purpose	The purpose of the behavioural change study is the establishment of new value chains for urban biowaste utilisation through a multi-stakeholder approach in line with circular economy. Through these new value chains, resources are kept in use as long as possible, maximum value from them is extracted and recovered for regenerating new products.
	As such, the behaviour change study contributes to a sustainable economic system whereby we aim to reduce the consumption footprint (annual waste generation is projected to increase by 70% by 2050[1]) and increase the circular material use rate.
Focus	The specific focus of the behaviour change study is on the collection and separation of urban bio waste of households and organisations in the pilot studies 1, 5 and 6. Further, the intervention will also focus on improving citizen's acceptance and willingness to buy biowaste derived products.

Sub activity 2 - Define the social issue

This sub activity focuses on the collection of information and facts about the social issue. A situational analysis and a literature review can be performed to identity currents strengths, weaknesses, opportunities and threats related to the problem statement. During this phase, a first exploration (conceptual inquiry) can be performed about potential barriers and enablers that can evoke behaviour change, but also discourage it. For instance, several barriers on the macro level can play a significant role, such as: cultural forces (e.g.: trends related to certain lifestyles and values), political forces (e.g. potential news laws that can affect the campaign), natural forces (e.g. droughts, pandemic viruses, etc.). These aspects however, are reported in D1.4 "Report on barriers for urban biowaste valorisation for biobased products" led by Draxis. This deliverable (D4.1) will rather focus on barriers and drivers at the individual level.

Further, it is good to identify similar campaigns or projects that have looked into the social issue. Here, a review can take place of the type of behaviours which were selected, the type of interventions and lessons learned.

In **Chapter 3** a literature review is presented that explores the social dimension of the circular economy, and a review is presented of behaviour change studies in similar projects.

Sub activity 3 – Identification of target groups

This sub activity focuses on the identification and description of the target groups. The target group refers to a group of people that is selected for the purpose of the behaviour change campaign, and which will be involved in the co-creation and engagement activities of the project. The selection of the target group can be made on several criteria, such as the size (number of households, or organisations), the ability to reach each identified segment and how receptive they might be to the idea of the project. Other criteria can be the problem incidence (how many people or organisations do not perform the desired behaviour) and the incremental costs (how do estimated costs reach and influence the target group).

If multiple target groups are selected, then it is also likely that a different set of tools and methods are necessary for the upcoming stages of the MBAA.

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[1] World Bank (2018), What a Waste 2.0: A Global Snapshot of Solid Waste Management to 2050.

For each target group, information is collected to understand the profile and to make potential segmentations (e.g. demographic characteristics, current levels of awareness, behaviours, knowledge, etc.). An often-used model to segment target groups is via the "Stages of Change model" developed by Prochaska et al. (1985). This model describes six stages that people go through when they change their behaviour (precontemplation, contemplation, preparation, action, maintenance and termination).

More information about this sub activity is presented in **Chapter 4**.

Sub activity 4 – Define the specific objectives and target goals

As a final sub activity in the first phase, the behaviour objectives and target goals are defined. The overall campaign's objectives are defined on three levels: (i) behavioural objectives: what you want your target group to do, (ii) knowledge objectives: what you want your audience to know and (iii) belief objectives: what you want your audience to believe or feel. The formulation of the behaviour objectives should be simple, doable behaviours and explained in clear terms. After the formulation of the objectives, the target goals are defined. These are expressed in numbers, according to the SMART principle (specific, measurable, attainable, relevant and time sensitive). It is advised that these objectives are revised by the target audience to see if they are realistic and appropriate to them.

A first body of information about this sub activity is presented in **Chapter 4** and will be further completed in D4.2.

1.2 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, by creating a mapping of the targeted behaviour. To deepen the understanding about the target audiences, research is set up to discuss the current knowledge, beliefs, attitudes and practices. In this stage, a first contact is 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 your target groups are preferring instead, other behaviours which are routines, or other behaviours that are opposed to the desired behaviour
- **Influential others**: individuals or organisations to which your target groups listen, watch, or look up to

In this phase, specific theories of behaviour that fit with the context of the project are reviewed and selected to explain (i) the dynamics of the separate collection of urban bio waste and (i) the consumer behaviour of bio-waste derived products.

1.3   Phase III: Intervention and test

Based on the conceptual inquiry and the first empirical inquiry, behaviour change interventions are designed and implemented among the target groups. Within WaysTUP! the interventions will mainly be based on the principles of community-based social marketing, and other techniques (e.g. 7E-model). Social marketing is defined as the "application of commercial marketing principles and tools in social change interventions where the primary goal is the public good" (N. R. Lee & Kotler, 2015). The social change interventions involved in social marketing generally focus on influencing behaviours in one of the following ways: (a) accept a new, desirable behaviour, (b) reject a potentially undesirable behaviour, (c) modify a current behaviour, (d) abandon an old, undesirable behaviour.

Therefore, in each of the pilot studies, a behavioural change intervention inspired by the social marketing approach, will be designed and implemented aiming at enhancing (1) current perception of citizens on urban biowaste as a resource and its related behaviours ; (2) active participation of citizens in the separate collection of urban biowaste; (3) customer acceptance of urban biowaste derived products. These interventions will specifically focus on reducing barriers to these behaviours but also on increasing change-promoting benefits that matter to the target communities, reflecting the unique value proposition of the social marketing approach in promoting societal good. These interventions are set up in strong collaboration with the coordinators of the WaysTUP! communities (AMB, VAL, HSPN, SUST) and dissemination partner (CREVIS).

Potential behaviour change interventions can include: information campaigns, education material, awareness raising videos, ambassador techniques, community fairs, etc. These interventions can link with ongoing activities and programs on the national and European level, such as for instance the International Compost Awareness Week (support by the European Compost Network)[2].

During this phase, a specific evaluation plan and methodology is also defined to decide how the actual behaviour change will be monitored and evaluated. This can be done through a combination of qualitative and quantitative methods. Further, randomized controlled trials are specifically interesting to test the effectiveness of certain interventions by comparing results with a control group that does not receive the intervention.

1.4   Phase IV: Define deviations and mechanics

During this stage, the actual behaviour change interventions are put in place and the communities are engaged through various tools and techniques. The evaluation plan, which was defined in the previous stage, helps to monitor any deviations from the targeted behavioural change direction. Therefore, it is recommended to perform a mid-term evaluation to ensure that "actual" change is happening, what the underlying mechanics are, and if any deviations from the initial plan need to be made. Through closely monitoring the target groups and following up certain statistics, such as the number of attendees at events, online logging statistics of social media, waste collection numbers, and self-perceived scores related to waste management, it is possible to determine whether the goals are likely to be met. If the mid-term evaluation shows that deviations are occurring and that alternative solutions are needed, then the MBAA proceeds to phase 5. If no

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[2] https://www.compostfoundation.org/ICAW/ICAW-Home - The International Compost Awareness Week takes place from May 2 – May 8 2022.

deviations are occurring and target goals are likely to be met, then one can proceed to the final evaluation phase.

1.5   Phase V: Value ecosystem analysis

As described above, if deviations are occurring during the implementation of the behaviour change interventions, such as low attendance rates at events, low participation rates online, or low amounts of collected bio waste for specific target groups, then phase V helps to redesign the behaviour change study. During this phase, a solution should be sought by the various stakeholders in the ecosystem to redesign the behaviour change interventions. Alternative motivations models can be explored, as well as a redefinition of the incentive strategy. This phase is optional. If it seems from the intermediary results, that good progress is being made towards the initial stated objectives, then no deviations mechanisms should be defined.

1.6   Phase VI: Evaluation

The final phase of the MBAA is the evaluation whereby outcomes and impacts are summarized. The changes in behaviour, measured and stated in terms of change in percentages regarding the above-mentioned target goals, are described. During this phase, various variables can be explored, such as:

- Behavioural intention: what is the intention of certain household and organisations, and what are the actual behaviours that took place? In which stage of change are most of the households or organisations? (cfr. Stages of change model)
- Changes in knowledge
- Changes in beliefs or attitudes
- Participation and responses towards specific engagement tools and methods
- Level of awareness related to the topic
- Partnerships and contributions from external organisations
- Policy changes
- Etc.

During this phase, a business model and a sustainability plan can also be drafted. These plans look towards how the different processes, value chains and behaviours can be made sustainable. These actions are not within the scope of WP 4. Therefore, the outcomes collected during the behaviour change study will be served as input for WP 6.

2. Purpose and focus of the behaviour change study: the need for a (circular) bioeconomy

In this section, we present the specific scope and purpose of the behaviour change study of WaysTUP!. Namely, we lay down the issue WaysTUP! and its specific behavioural change campaign is facing and why it needs to be addressed. We therefore explain why the establishment of new value chains for urban biowaste through a multi-stakeholder approach in line with the circular economy is necessary, and explain the role of the citizens within the circular economy loop.

2.1   The (lack of) social focus in the Circular Economy

The global population is rising which causes a rapid depletion of many resources, such as food and feed, and which in turn lead to increasing environmental pressure on our planet. Indeed, growing prosperity leads to the extraction and use of more resources: the world's population currently consumes the equivalent of 1.6 planets, and it is forecasted to demand two planets by 2030 (Howard, 2015). As Lacy & Rutqvist (2015) have said "**business as usual is heading for trouble**" (p.xvi). By "business as usual", the authors refer to the paradigm of the "linear economy" based on the principle of "take the resources you need, make the goods to be sold and make profit, dispose of everything you don't need" (Sariatli, 2017, p. 32). This paradigm poses a problem as it postulates the idea of an ever-growing economy based on earth's limited resources. Over the years, the linear model has led to issues such as biodiversity loss, soil, water and air pollution and overall resource depletion (Geissdoerfer et al., 2017), while the colossal amount of waste produced by this system is being overlooked . These issues have gradually emphasised the need for another economical model.

As a solution, the concept of "**Circular Economy**"(CE) has progressively received more and more attention from academia, policymakers and companies (Geissdoerfer et al., 2017), conceptualising a closed-loop system with no effect on the environment (Murray et al., 2017). This economic system would maintain the value of the products, materials and resources in the economy for as long as possible, therefore minimizing the generation of waste (European Commission, 2015) and its environmental impacts. In this fashion, materials such as minerals, fossil carbons, metals and biomass are remanufactured into products, traded, used and further enter the waste hierarchy by being reused and recycled.

The waste hierarchy, or the "R framework", is considered as a core principle of the CE. While several R frameworks exist, mainly 3R, 4R, 6R and 9Rs (see Potting et al., 2017 for more information), they all share the principle of a **hierarchy** starting with the idea of preventing the production of waste through smarter product use and manufacture (**Refuse**, **Rethink**, **Reduce**), following with the prolongation of products lifespan (**Reuse**, **Repair**, **Refurbish**, **Remanufacture**, **Repurpose**) and ending with mitigation techniques (**Recycle**, **Recover**), indicating the preferential order in which these options should be pursued (Kirchherr et al., 2017).

A short introduction to the concept of Circular Economy (CE)

According to Blomsma & Brennan (2017), the emergence of the concept of Circular Economy (CE) can be traced back to 1960 when two developments took place: (1) a renewed interest for the idea of the responsible management of natural resources and (2) progress in the academics field of biology, ecology, physics and management and business sciences. According to these authors, waste and resource management practices such as recycling were reframed and became a permanent industry on their own. Waste became a positive element, being considered both as a resource and a source of value. In the following years, the concept gained momentum due to growing environmental concerns and the related focus on sustainable development (Sariatli, 2017).

The origin of the term "circular economy" in itself is often discussed and there is no consensus regarding its original author (Winans et al., 2017). The concept has been developed and refined by several schools of thoughts such as the "Regenerative Design" (1970) by John Lyle, "Performance Economy" (1976) by Walter Stahel, "Cradle to Cradle" (1990) by Michael Braugnart, as well as the approaches of "Industrial Ecology", "Blue Economy" by Gunter Pauli, "Biomimicry" by Janine Benyus and "Permaculture" by Bill Mollison and David Holmgren (Ellen MacArthur Foundation, 2013). These different influences and perspectives on the subject have led to a certain lack of consensus around the concept within the literature. In an effort to foster transparency, Kirchherr and colleagues (2017) have proposed the following definition based on an analysis of 14 different definitions:

> "*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), with the aim to accomplish sustainable development, which implies creating environmental quality, economic prosperity and social equity, to the benefit of current and future generations*" (p. 224-225).

The 'system' aspect in the definition of the circular economy highlights the need for "a fundamental shift instead of an incremental twisting of the current system" (Kirchherr et al., 2017, p. 224). This shift, as explained by the definition, needs to happen on three levels: the macro-systems (industry and economy level), the meso-systems (eco-industrial parks as systems) and the micro-systems (products, individual enterprises and consumers). However, as pointed out by Merli and colleagues (2018) in their systematic review on CE, while the concept of CE has been investigated in different fields, scholars have mainly put their focus on the operationalisation and implementation of circular economy solutions such as waste management, with a major focus on the technical and business aspects, i.e. the macro and meso levels, leaving out the micro level out of the discussion.

Indeed, a quick key term search based on the term "Circular Economy" on the database Web of Science leads to 5172 results (in March 2020) and help to visualise this lack of focus. As can be observed from Figure 1, the most used key terms of these articles mainly focus on three aspects: (1) economic aspects ("economic development", "resource productivity", etc. – in blue); (2) business innovation aspects ("business", "eco innovation", "product lifetime", etc. – in red) and (3) technical aspects ("treatment", "property", "recovery", "enzyme", etc. – in green, yellow, purple and cyan).

Figure 1: VOS map of the key term search "circular economy"

While CE's relation to the economic and environmental aspect of sustainability seems to be straightforward, **the relationship to the social aspect of sustainability appears to be unclear**. This lack of focus from academia on the social component of the CE has been pointed out by several authors (e.g. Ezzat, 2016; Homrich et al., 2018; Merli et al., 2018; Murray et al., 2017): CE, being seen as a way to reach sustainability should address the **triple bottom line** associated with it, namely the three pillars of sustainability: (1) economic, (2) environmental and (3) social (for more information see Purvis et al., 2019). However, as can be observed from Figure 1, the social aspect and its implications have only been given marginal consideration. When considered, the social aspect appears to be represented by the notion of "**consumer**" which is conceptualised from a business and consumption perspective (Hobson & Lynch, 2016). **This lack of representation of the social dimension can cause major challenges for the transition from a linear to a circular economy** (Ezzat, 2016), **as it translates an inadequate and insufficient representation of the role citizens hold in this new system** (Hobson & Lynch, 2016). Indeed, it has been shown that the general public has very limited awareness and understanding of the concept of CE and does not have sufficient information regarding their role in the loop (Y. Liu & Huang, 2014). **This is a crucial element, as a lack of public awareness and involvement in CE initiatives leads to issues in the implementation of the said initiatives** (Q. Liu et al., 2009). The lack of understanding regarding the social component of CE could therefore affect the implementation of the whole circular loop foreseen in CE initiatives, such as in WaysTUP!.

To mitigate the risk of low public engagement, the following sections will focus on reporting the **citizens' role** (or "user[3]") in the circular loop, the **related behaviours** as well as their **determinants**, in order to inform the behaviour change strategy.

2.2   The bioeconomy of WaysTUP! and the user's role

The WaysTUP! project is based on the concept of the bioeconomy. The bioeconomy is a key element of the Europe Strategy 2020 for a smart and green growth in Europe. The concept is described as having the potential to create economic growth in rural, costal and industrial areas, reduce fossil fuel dependence and improve the economic and environmental sustainability of primary production (European Commission, 2012b). To do so, the **bioeconomy** encompasses the "*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, 2012b, p. 3).

Although biowaste recycling is located at the top of the waste management hierarchy, representing therefore the least favourable option to be pursued (see previous section), some biodegradable materials cannot be "refused" nor "reused" due to their nature such as green waste from garden, food spoilage and inedible scraps among others, and must therefore be discarded (Pearson & Perera, 2018). **Turning biowaste into a resource is therefore a major key to a circular economy**. However, while biowaste is an abundant source for the production of alternative bio-based products, it is still **largely unexploited**. Biowaste is estimated to represent 40% of the municipal solid waste (MSW) in Europe (European Union, 2008), but other studies have found even higher percentage (Benis et al., 2019; Elimelech et al., 2019). In practice, we see that in Europe many countries are not yet capturing the full potential of bio-waste sorting and that implementing separate biowaste collection schemes is lengthy and complex (European Environment Agency, 2020). Approximately 75% of this material is landfilled, representing an astonishing amount of 1.3 billion of global food waste annually (Hao et al., 2015), while only 25 % is recycled into products - mainly compost and biogas. This missed opportunity is not only a loss at the level of the raw material, but has also repercussions in terms of economic losses, nutritional losses and environmental impacts. This fact is mostly related to the complexity, heterogeneity and variability of the urban biowaste as well as to the level of purity needed from this raw material.

To overcome this, there is a need to focus on the full value chain of biowaste and understand its functioning. To do so, it is interesting to investigate the loop that illustrates the continuous flow of the goods. The WaysTUP! loop will focus on biodegradable materials and bio-based products and will comprise of the steps presented in Figure 2.

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[3] We voluntarily choose to refer to citizens as "users" instead of "consumers" to highlight the fact that their role in the CE loop is not only to consume goods but to use it from start to finish not as passive agents it but as active agents having an effective role to play in the loop.
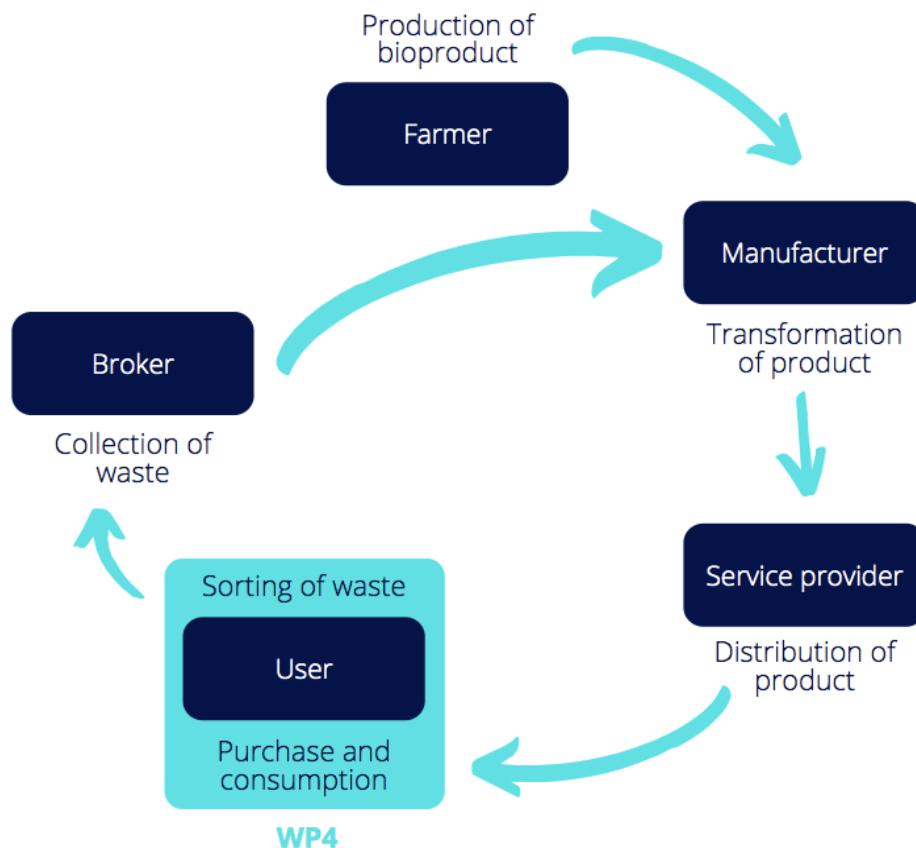
Figure 2: WaysTUP! loop

As was highlighted in the previous section, it is more than necessary to understand the role of the user in this loop. Indeed, user have their respective role to play in the loop, and without their participation, the whole project could be jeopardised. Providing good information, organising awareness-raising campaigns and activities are seen as crucial factors to help motivate people to separate and manage their bio-waste. Awareness-raising should be combined with creating a positive image by the waste management authority or organisation, this is of particular importance when a new separate collection system is introduced (BIPRO et al., 2015).

From Figure 2, it can be observed that the user accomplishes two different type of behaviours within the loop: a consumption behaviour and a waste sorting behaviour. Within WaysTUP!, these behaviours will specifically refer to the **consumption of biowaste-derived product** (or "bio-based products") and to the **selective sorting of biowaste**. Therefore, the behaviour change campaign must focus on these two types of behaviours to enhance citizens and communities' participation, and this to ensure the good development of new value chains for urban biowaste.

The behavioural change study will contribute to a **sustainable economic system** whereby the aim is to **reduce the consumption footprint** and **increase the circular material use rate**. The specific focus of the behaviour change study is on the **sorting of urban biowaste** of households and organisations in the pilot studies 1, 5 and 6. Further, the intervention will also focus on improving citizen's **acceptance of biowaste derived products**.

Therefore, the behavioural change study that will be implemented within WaysTUP! aims to:

- Improve the current **perception** of citizens and local communities on urban biowaste as a local resource.
- Enhance the **active participation** of citizens in the separate collection of urban biowaste.
- Improve **customer acceptance** of urban biowaste derived products, including food and feed ingredients.

3. Identification of the social issue – The key determinants of the consumption and sorting behaviour in a bioeconomy context

To better understand the targeted behaviours of the behaviour change strategy of WaysTUP!, a first literature review was conducted in order to:

(1) Provide a clear definition of the waste sorting behaviour and consumption behaviour
(2) Identify the key determinants (conceptual inquiry)

3.1 Biowaste sorting

The first step of this literature review was to construct a representative dataset of scientific publications on the "sorting behaviour" in the context of biowaste. To construct this dataset, we first selected representative key words for the phenomenon to be investigated. The selection of these terms was done through a back and forth between the literature and the successive searches. In this sense, the key terms represent our first result of this systematic literature review as we believe we have successfully highlighted the terms related to the action of the behaviour (sorting, separating, segregating and recycling) and the object of the behaviour (biowaste, food waste, kitchen waste, biodegradable waste and organic waste). In an effort to be the most inclusive as possible, different key terms were used in this key term search. The search was conducted on the Web of Science database with the following terms:

(sort* OR separat* OR segregat* OR recycl*) AND behavio* AND (biowaste OR food waste OR kitchen waste OR biodegradable waste OR organic waste)

We considered all publications, for the period 1990 – 2020, for which these terms were used in the search fields of the title, abstract and author keywords. This first search gave **1323 results.** Downloaded records were imported in the Zotero library where they were screened for relevance. The selection of relevant publications was done in four steps. First, after having excluded conference papers, webpages, book section and theses, technical articles were deleted based on
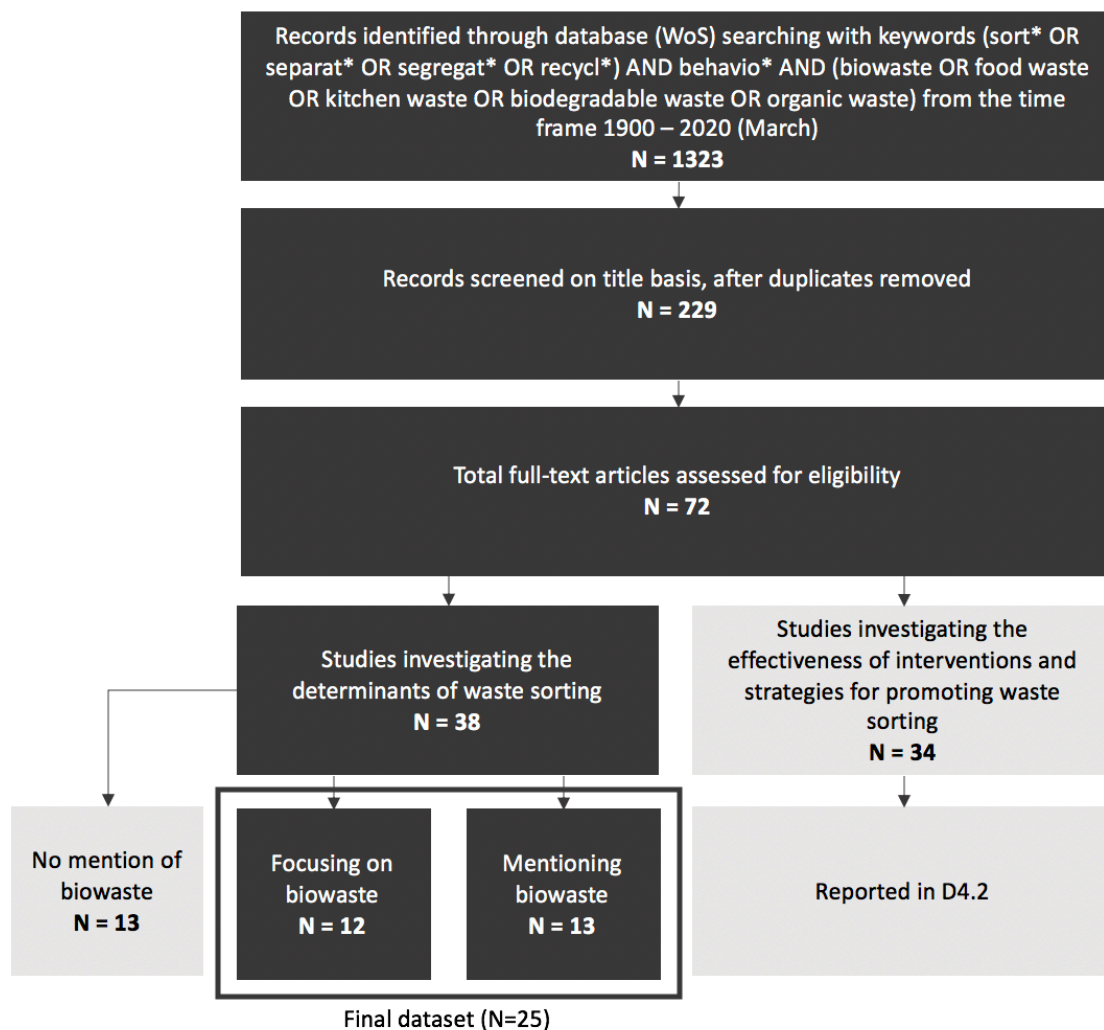
```
┌──────────────────────────────────────────────────────────────────┐
│ Records identified through database (WoS) searching with keywords  │
│ (sort* OR separat* OR segregat* OR recycl*) AND behavio* AND       │
│ (biowaste OR food waste OR kitchen waste OR biodegradable waste    │
│ OR organic waste) from the time frame 1900 – 2020 (March)          │
│ N = 1323                                                           │
└──────────────────────────────────────────────────────────────────┘
                               ↓
┌──────────────────────────────────────────────────────────────────┐
│ Records screened on title basis, after duplicates removed          │
│ N = 229                                                            │
└──────────────────────────────────────────────────────────────────┘
                               ↓
┌──────────────────────────────────────────────────────────────────┐
│ Total full-text articles assessed for eligibility                  │
│ N = 72                                                             │
└──────────────────────────────────────────────────────────────────┘
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Studies investigating the determinants of waste sorting
N = 38

Studies investigating the effectiveness of interventions and strategies for promoting waste sorting
N = 34

No mention of biowaste
N = 13

Focusing on biowaste
N = 12

Mentioning biowaste
N = 13

Reported in D4.2

Final dataset (N=25)

Figure 3: Steps undertaken in the literature search process

a first screening of their title, resulting in a remaining dataset of **229 articles**. Second, articles focusing specifically on the waste sorting behaviour were selected, resulting in a pool of 72 articles. Third, these articles were divided into two categories: (i) articles focusing on investigating the determinants of the behaviour (N=38) and (ii) articles focusing on evaluating the effectiveness of intervention and strategies for promoting waste sorting (N=34). The first category was retained for this deliverable, while the second category will be used in the framework of D4.2 "Toolkit: Interventions for change". Finally, the last step of the dataset selection was done through content reading were solely articles focusing specifically (N=12) or taking into account (N=13) biowaste[4] in their investigation were retained, leading to a **final dataset of 25 articles**.

3.1.1   Definition

Waste sorting, or also called "waste separation" (e.g. Chen et al., 2017; Pedersen & Manhice, 2020), "waste segregation" (e.g. in Basri et al., 2017; Bees & Williams, 2017; Dai et al., 2016) or even "waste recycling" (e.g. in Aprile & Fiorillo, 2019; Bernstad et al., 2013; Bruvoll et al., 2002; Huang et al., 2018; Kalsher et al., 1993), is defined as the "process by which waste is separated into different

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[4] Either referring to kitchen waste, food waste, biodegradable waste or organic waste.

elements operated manually at the household or through curbside collection schemes" (Xu et al., 2017, p. 2). Biowaste on the other hand designates, according to the European Parliament (2008), all "biodegradable garden and park waste, food and kitchen waste from households, restaurants, caterers and retail premises and comparable waste from food processing plants". Therefore, we will define **biowaste sorting** as the **process by which biodegradable garden, park waste, food and kitchen waste is separated from other type of waste and placed in a specific repository**.

It can be considered that biowaste sorting is therefore inseparable from the more generic act of sorting waste as separating biowaste is always separated *from* another material (i.e. separating biowaste from residual waste). Therefore, the phenomenon is rarely investigated by itself (N=11/23 articles). However, a focus on biowaste appears to be necessary as its specific inclusion in the waste management process can represent a burden on individuals. It can be foreseen that an additional sorting system could annoy users due to the supplementary effort, the space and time it would require, but also create some annoyance due to the nature of the biowaste itself, causing potential odors and perception of hygiene risks (Bernad-Beltran et al., 2014). Therefore, the following sections will report (1) the currently known determinants (barriers and drivers) for citizens to engage with biowaste sorting and (2) confront them with the currently know determinants of the broader waste sorting behaviour to highlight possible gaps in its investigation.

3.1.2   Determinants of biowaste sorting

Awareness regarding waste sorting, the waste issue and its consequences

Zeng et al. (2016) have reported in their study a lack of awareness among citizens as an elicited cause for low involvement in waste sorting. According to the participants, a poor announcement and insufficient amount of education materials provided by the municipality, as well as a general lack of knowledge regarding the reason they should participate in waste sorting are the reason for their low participation. In these results we can observe that the concept of awareness and knowledge about sorting are confounded.

> The lack of **awareness** regarding waste sorting, its possibilities and the reasons citizens should participate has been identified as a main barrier for citizens to engage with the behaviour.

Knowledge

A lack of knowledge or information provision is often pointed as an explanation for low engagement in waste sorting. For example, this element was highlighted by participants in Bees and Williams' study (2017). However, the authors note that this could have been an excuse used by participant to justify their behaviour as they also reported high awareness. In this regard, the results of W. Zhang et al. (2012) are interesting in the sense that respondents themselves indicates that they are aware that waste should be sorted but that they are confused as to which waste belongs to which category, emphasising a lack of practical knowledge instead of a lack of awareness.

Results indeed seem to give reasons to respondents' explanation as Dhokhikah et al. (2015) reported that citizens with a higher level of knowledge were two times more likely to engage in a

waste sorting behaviour. These results were corroborated by H. Zhang et al. (2017) who found that citizens who were engaging in stricter waste sorting behaviour (sorting three kind of waste instead of two or one) were significantly more familiar with waste separation standards and concepts. However, it has to be pointed out that less than half of the "strict sorters" indicated being familiar with the sorting classification (H. Zhang et al., 2017), highlighting the gap of publicity around waste sorting and the potential for a better emphasis on waste classification. Granting all this, accuracy rates regarding the classification of different type of waste (tea leaves, fruit resides and food leftovers) into the category of "food waste" were the highest in comparison with hazardous waste and recyclables (H. Zhang et al., 2017), indicating a good level of knowledge regarding biowaste classification.

> **Knowledge** about waste sorting has been found to positively influence citizen's biowaste sorting behaviour. It has to be noted that although knowledge levels regarding general waste sorting are low, individuals have shown a good understanding of what constitutes food waste.

Attitude towards the behaviour

The attitude towards the behaviour constitutes one of the three predictors of behavioural intention in the Theory of Planned Behaviour (TPB)[5]. The concept is defined by Ajzen as "the degree to which a person has a favourable or unfavourable evaluation or appraisal of the behavior in question" (1991a, p. 188). It is also one of the most investigated variables in the context of biowaste sorting.

Although some authors could not report a significant influence of this construct on the intention (Xu et al., 2017) nor on the actual sorting behaviour (Tran et al., 2019), positive attitude towards the behaviour has generally been found to have a significant positive influence on the intention to perform waste sorting (Liao et al., 2018; M. Reid et al., 2018a; Tran et al., 2019) as well as on the self-reported waste sorting behaviour (Loan et al., 2017; H. Zhang et al., 2017). Furthermore, when the three components of the TPB (attitude, subjective norm and perceived behavioural control) are investigated together, attitude is often found to be the strongest predictor of the intention to engage in biowaste sorting (Ghani et al., 2013).

> According to the literature, citizens who have a positive **attitude** towards biowaste sorting, meaning they hold a favourable evaluation regarding the behaviour, are more likely to engage in biowaste sorting.

Perceived behavioural control

The perceived behavioural control (PBC) is the one of the three predictors of behavioural intention in the TPB. The concept is defined by Ajzen as "the perceived ease or difficulty of performing the behavior" (1991a, p. 188).

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[5] The Theory of Planned Behaviour (TPB) is a model developed by Azjen and Fishbein in the 70'. The TPB postulates that the intention to undertake a behaviour is the main antecedent of the actual behaviour, and that the intention is influenced by (1) the attitude towards the behaviour, (2) the subjective norm and the (3) the perceived behavioural control (Ajzen, 1991).

Several authors have found that perceived behavioural control has a statistically significant influence on the intention to perform biowaste sorting (Liao et al., 2018; L. Reid et al., 2010).

> It has been found that the more citizens perceived waste sorting as an easy to perform activity (**perceived behavioural control**), the more likely they are to participate in waste sorting.

Norms

Norms are beliefs individuals hold regarding the way they think they should act, enforced by the sanctions or rewards. Norms are differentiated according to their degree of internalisation. In this sense, Thogersen (2006) proposes to differentiate between (ranging from the most external to the most internal level) descriptive norm, subjective norm, introjected norms and integrated norms. Therefore descriptive norms and subjective norms refers to what the individual think she/he should do or what others think she/he should do, whilst introjected norm and integrated norms refers to what the individual her/himself think she/he should do, leading to a feeling of moral obligation.

Descriptive norm

Descriptive norms are a form of external norm that refers to what an individual believes other people are doing (Thogersen, 2006). The concept has been found to have a significant positive relationship with self-reported waste sorting (Thogersen, 2006; H. Zhang et al., 2017). Respondents themselves have stated that they would be more likely to engage in a waste sorting behaviour if their friends were doing the same (H. Zhang et al., 2017), and that a low neighbourhood participation was the reason for their non-participation in waste sorting as separating the waste by themselves would be useless (W. Zhang et al., 2012).

Subjective norm

The subjective norm is one of the three predictors of behavioural intention in the Theory of Planned Behaviour. The concept is defined by Ajzen as "the perceived social pressure to perform or not to perform the behaviour" (1991a, p. 188). While it is still considered as being an external norm, it has a more internalized form compared to the descriptive norm (Thogersen, 2006).

Results regarding the subjective norms are mixed. Some authors have reported a positive influence on the intention to perform the behaviour (Liao et al., 2018; L. Reid et al., 2010) or on the self-reported behaviour of waste sorting (Thogersen, 2006; Xu et al., 2017). However, other studies have found no direct link to the intention to perform the behaviour (Liao et al., 2018).

Moral norm

Moral norms are a form of internalised norms that leads the individual to feel a **moral obligation** to undertake a behaviour. Compared to the descriptive and subjective norm, the moral norm will lead the individual to undertake a behaviour not due to external pressure, but rather due to internal pressure (Thogersen, 2006).

Several authors have reported the role of moral obligation in the context of waste sorting. Some authors have reported its role as an elicited motivation to perform biowaste sorting (Bees & Williams, 2017), while others have reported its effect as a direct influencer of the self-reported biowaste sorting behaviour (Loan et al., 2017). In the same fashion, Tran et al. (2019) found a

positive influence of the perceived responsibility on the intention to separate food leftovers. This shows the influence of internalized norms.

On the other hand, Xu et al. (2017) and Loan et al. (2017) have found that it positively and significantly influences the attitude regarding waste sorting. Interestingly, Loan et al. (2017) also found an influence of the moral norm on the evaluation of the situational factors: individuals that hold stringer morals norms evaluate situation factors significantly less difficult to overcome.

> The norms individuals hold regarding waste sorting have been found to have an influence on citizen's probability of engaging with waste sorting: the more they believe that other people are waste sorting (**descriptive norm**); that other people think they should be sorting waste (**subjective norm**); and the more individuals think they should be sorting waste themselves (**moral norm**), the more likely they are to engage with waste sorting

Pro-environmental tendencies

Environmental awareness

Although, respondents often indicate their environmental awareness as their motivation to sort their waste, this variable has been shown to be a poor predictor of citizen's sorting behaviour (H. Chen et al., 2017). Chen et al. (2017) put forward the idea that this inconsistency might be due to a lack of knowledge: while their environmental awareness is pushing participants to sort their waste, they simply lack the practical knowledge to do so.

Environmental concern

In their study, Aprile and Fiorillo (2019) found all three components of environmental concern[6] to be associated with waste sorting behaviour. The authors noted that the marginal effects of these variables decrease as the number of separate collection increase, this effect being possibly explained by the subsequent increase of inconvenience costs (e.g. cost of transport, cost of time, etc.). Bees and William (2017) found the general environmental concern to be a motivation to sort waste, as well as Ekere et al. (2009) who found the relationship statistically significant. In their studies, Liao et al. (2018) found the effect of environmental concern on the intention to engage in waste sorting was partially mediated by all three components of the TBP (attitude subjective norm and perceived behavioural control). Furthermore, identifying environmental problems as being a main issue leads to higher (self-reported) sorting activities (Fiorillo, 2013).

> **Environment concern** has been found to have an impact on waste sorting behaviour, with its effect being partially mediated by attitude towards waste sorting, subjective norm and perceive behavioral control. On the other hand, **environmental awareness** has **not** been found to have a direct influence on sorting behaviour. This could be explained by a general lack of knowledge regarding waste sorting.

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[6] Environmental concern is defined by Schultz as "the interest associated with environmental problems" (2005, p. 458). The concept of environmental concern was later divided by Stern into three components: altruistic, egoistic and biospheric (1993). While egoistic concerns are located at the personal level, altruistic concerns refer to concerns towards all people and biospheric refers to concerns regarding all living species (Schultz, 2001).

Past behaviour

Past behaviour is said to be a strong predictor of future behaviours. In this context, this would mean that previous waste sorting behaviour could predict individuals. Probability to engage with biowaste sorting. This assumption appears to be true in the context of waste sorting as authors have found a significant influence of past behaviour on the intention to sort waste in the future (Reid et al., 2018; Xu et al., 2017) as well as on the self-reported behaviour (Xu et al., 2017).

> It has been found that individuals who have already displayed a biowaste sorting behaviour (**past behaviour**) are more likely to engage in biowaste sorting in the future.

Situational factors and the related inconvenience cost

A number of barriers have been identified within the literature. The perception and individual evaluation of these situational factors can also be referred to as **inconvenience costs** which can be defined as "the monetary representation of the inconvenience experienced by a consumer when performing a given action" (M. Lee et al., 2017, p. 59). The impact of these elements is important to take into account because, as Metcalfe et al. (2012) indicates, even those with pro-environmental attitudes may be put off if using the bin appears to them as too inconvenient.

Among these factors, the **bin size**, a **lack of bins** and a **lack of facilities** are the most popular elicited barriers to sort biowaste (Bees & Williams, 2017; Fiorillo, 2013; Metcalfe et al., 2012; Zeng et al., 2016; W. Zhang et al., 2012), with participants stating that a separate and more frequent collection of food waste (Ghani et al., 2013), as well as the provision of waste bins by the municipality would encourage them to engage in a biowaste sorting behaviour (Bernad-Beltran et al., 2014; Ghani et al., 2013). Regarding the bin size, Lehmann (2015) postulates that larger containers may lead to reduced sorting of food waste as they are too large for participants to use within the required time frame. However, results are mixed: while Liao et al. (2018) found a positive significant influence of the satisfaction with the facilities on the intention to perform the behaviour while Zhang et al. (2017) found no influence of the satisfaction with the infrastructure on the self-reported behaviours of students. The distance from the containers to the dwellings (**physical proximity**) is also reported as an important element by the respondents where the willingness to walk a longer distance to the bin has been found to be a significant predictor of self-reported waste sorting (H. Zhang et al., 2017).

Furthermore, a **lack of space** in the dwelling is often reported as a barrier to participation in biowaste sorting by the respondents (Bees & Williams, 2017; Bernad-Beltran et al., 2014; Refsgaard & Magnussen, 2009; Xiao & Siu, 2018), as well as a **lack of time** (Dhokhikah et al., 2015; Liao et al., 2018; Refsgaard & Magnussen, 2009). Indeed, Loan et al. (2017) did find a significant influence of the evaluation of situational factors with organic waste sorting: respondents facing several difficulties such as a lack of time, a lack of space, a lack of cooperation among family members and a confusion regarding waste sorting are significantly less likely to sort their organic waste.

Tran et al. (2019) did find a negative influence of the "**evaluation of trouble**" that engaging in waste sorting would cause on the intention to engage and on the leftover food separation behaviours. Overall, "inconvenience" has been highlighted as a main barrier to engage in waste sorting (Zeng et al., 2016).

Furthermore, as biowaste is putrescible, it comes with its own set of specific inconveniences. In their qualitative study, Metcalfe et al. (2012) highlight for example that biowaste bins are

associated with the idea that it is dirty and smells, which lead respondents to voice their concern regarding **hygiene** issues that would appear with biowaste storage within their home (Xiao & Siu, 2018). This element is corroborated by Lee at al. (2017) who found that the inconvenience cost associated with the hygiene of the disposal is even higher than the cost associated with the act of sorting. Similarly, Pedersen & Manhice (2020) have identified perceptions of disgust (also found in Refsgaard & Magnussen, 2009), potential extra cleaning and interim storage as barriers to biowaste sorting, which they referred to as respondents wanting to preserve the "**household order**".

Associated with this inconvenience cost is the **trust** that citizens hold **towards the system**. Indeed, the extra effort invested by citizens in the sorting activity call for a new need to evaluate the whole waste collection system (Pedersen & Manhice, 2020). In their study, Pedersen & Manhice (2020) reported **mistrust levels towards the system** (30% of recyclers), which could be due to a lack of knowledge regarding the whole recycling process. These results are in alignment with those of Refsgaard & Magnussen (2009), where participants indicated that they want assurance that the waste collected is actually being recycled, along with indicating that they would like information about practical matters such as further treatment and the consequences of waste. Confirming these elements, Loan et al. (2017) found that trust towards the system had a significant positive influence on the self-reported organic waste sorting behaviour: respondents that trusted their local authority to have the ability to treat the sorted waste, to strictly implement punishment methods for non-participation and that trusted that the organic sorting program enhanced recycling benefits overall were more likely so sort their organic waste.

Interestingly, Loan et al. (2017) have found that the attitude is a mediator of both (1) the relationship between the evaluation of the situational factors on the waste sorting behaviour and (2) the relationship between the trust in the system and the waste sorting behaviour. Indeed, if individuals hold a negative evaluation of the situational factors, their attitude towards the behaviour is weakened, and they are therefore less likely to take part in organic waste sorting. On the other hand, individuals who trust the waste management system will hold a stronger attitude towards the behaviour and are therefore more likely to engage with organic waste sorting.

> Situational factors and the associated "inconvenience cost" appear to play an important role in whether individuals choose to engage with biowaste sorting or not. Among the most influential elements, aspects related to the **sorting facilities** (lack of facilities, distance from dwellings, collection time), **bins themselves** (lack of bin, size of bin, lack of space in-house), the "**household order**" (possible smell, dirtiness, and extra cleaning required), the **lack of time** to perform the behaviour, and the **trust in the system** have been found to negatively impact the sorting of biowaste.

Socio-demographics

Several authors have reported the influence of socio-economic variables such as age, gender, marital status, education, employment status and income on waste sorting. A possible explanation for this differential influence is advanced by Ghani et al. (2013) who found that respondents from different gender, age, employment and education had different views of situational factors related to waste sorting, which could in turn influence their behaviour.

As such, married women are more likely to display a waste sorting behaviour (Aprile & Fiorillo, 2019), or **women** in general (Ekere et al., 2009; Fiorillo, 2013; H. Zhang et al., 2017). A higher **age** was also found to be related to a higher probability of sorting waste (Aprile & Fiorillo, 2019;

Dhokhikah et al., 2015). Further, the **education** level was found to have a positive influence, with higher education households being more likely to engage in sorting behaviour (Aprile & Fiorillo, 2019), although this was specifically not found to be true for waste sorting and Fiorillo's study (2013). **Employment** status was also found to be a relevant variable, as unemployment was linked to lower participation in waste sorting (Aprile & Fiorillo, 2019) and food waste sorting (Fiorillo, 2013). Ghani et al. (2013) found in their study that employed and unemployed respondents hold different beliefs regarding the subjective norms, which could therefore impact their behaviour, as stated by the Theory of Planned Behaviour. Furthermore, the household's **income** has been found to have a positive influence on the waste sorting behaviour of its constituents (Aprile & Fiorillo, 2019), although this relationship was not validated for food waste in Fiorillo's study (2013).

Other authors have not reported a link between the sorting behaviour and socio-demographic variables (Bernad-Beltran et al., 2014).

Although these relationships were not always verified, studies that did find significant relationships reported that, "waste sorters" are generally citizens who are **female**, of a **higher age**, **higher education**, **employed** and with a **higher income**.

3.1.3 Comparison with the key determinants of waste sorting

In order to identify the overlap and gaps between the identified determinants of **biowaste sorting** with the **broader behaviour of waste sorting**, we conducted a brief review of meta-analysis and review articles regarding waste sorting, based on the following articles:

- "*A meta-analysis of factors related to recycling*" (Geiger et al., 2019)
- "*Recycling Behaviour Among Householders: Synthesizing Determinants Via a Meta-analysis*" (Miafodzyeva & Brandt, 2013)
- "*Social factors influencing household waste separation: A literature review on good practices to improve the recycling performance of urban areas*" (Knickmeyer, 2020)

Table 2: Determinants confrontation (waste vs biowaste sorting)

	Determinants	Influence on waste sorting	Influence on biowaste sorting
Socio-psychological	Anticipated affect[7]	Yes, medium effect	No
	Attitudes	Yes, strong effect	Yes
	Environmental attitude/awareness	Yes, medium	Yes
	Descriptive / social norms	Yes, strong	Yes
	Self-identity[8]	Yes, strong	No
	Injunctive / subjective norm	Yes, strong	Yes
	Knowledge	Yes, strong	Yes

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[7] Anticipated affect is defined as "the extent to which individuals anticipate recycling will elicit different feelings" (Geiger et al., 2019, p. 79)
[8] Self-identity reflects "the way individuals describe themselves" (Geiger et al., 2019, p. 79)

	Past behaviour	Yes, strong	Yes
	Perceived behavioral control	Yes, strong	Yes
	Personal / moral norm / moral obligation	Yes, very strong	Yes
	Environmental concern	Yes, not consistent	Yes
	Values[9]	Yes, strong	No
	System trust	No	Yes
	Perceived inconvenience (personal effort included)	Yes, strong	Yes
Situational	Possession of bin	Yes, medium	Yes
	Distance	Yes, small	Yes
	Facilities / access to curbside	Yes, consistent	Yes
	Storage space	Yes (not specified)	Yes
	Legal norm	Yes, inconsistent	No
Socio-demographi	Age	Yes, inconsistent	Yes
	Gender	Yes, inconsistent	Yes
	Income	Yes, but not constant	Yes
	Education	Ambiguous	Yes

Anticipated affect has been linked to several pro-environmental behaviours and was found to significantly impact waste sorting. The more individuals anticipate positive feelings associated with waste sorting, the more likely they are to engage with the behaviour, whilst negative feelings discourage such behaviour. It would be interesting to see if this relationship is also found on the context of biowaste sorting.

Self-identity has been found to be a very strong predictor of waste sorting, both the recycling self-identity (the measure in which an individual perceives him/herself as someone who sorts his/her waste) and the general environmental self-identity (the measure in which an individual perceives him/herself as someone who is environmental friendly in general). Therefore, the inclusion of this variable in the investigation of biowaste sorting could be beneficial.

Values, and more specifically, **biospheric values** have been found to be positively related to waste sorting. However, few studies have tested the Value-Belief-Norm Theory on environmentalism[10] from Stern (2000), and it might be interesting to do so in the context of biowaste sorting seen the reported impact of norm on biowaste sorting.

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[9] Values are "desirable trans-situational goals that reflect what people find important in life in general" (Geiger et al., 2019, p. 80)
[10] The Value-Belief-Norm Theory on environmentalism link five variables through a causal chain where values are conceptualized as impacting the NEP (acceptance of the New Ecological Paradigm), which impact the awareness of consequences then the ascription of responsibility and finally personal norms for pro-environmental actions, activating a sense of moral obligations creating a predisposition to act (P. C. Stern et al., 1999).

Finally, **legal norms** have been rarely investigated, even in the context of general waste sorting, but positive correlations have been found. It might be interesting to study this variable in the context of biowaste sorting.

Overall, based on Table 2, it can be observed that most of the determinants of waste sorting have been investigated in the context of biowaste sorting, with the exception of: anticipated affect, self-identity, values and legal norm. Seen the medium to strong influence these factors have on waste sorting, it would be interesting to include them in future research on biowaste sorting.

3.2   Consumer acceptance of biowaste derived products

The second behaviour, referring to the consumer acceptance of bio-based products, is one of the key targeted behaviours of the behavioural change approach within WaysTUP! A consumer's acceptance of a product can be translated as it's behavioural intention regarding the product (Garces et al., 2016). Therefore, within the WaysTUP! behavioural change approach, consumer acceptance will be approached with the use of multiple, proxy terms, including **intention (or willingness) to: adopt, pay, purchase and use**. Consumption practices (i.e. *how* a product is being consumed) are not addressed as target behaviours in the current approach as it doesn't fall under the scope of the WaysTUP! project.

Understanding the determinants of acceptance plays a key role in improving acceptance itself and, ultimately, the success of biowaste derived products and the sustainability of the closed-loop in the circular economy (Russo et al., 2019). To this end, a systematic review of peer-reviewed academic literature of determinants of urban biowaste-derived products is conducted. Given the lack of information about the origin of bio-based product materials across several studies (derived from urban bio-waste or not) as well as the limited number of studies that explicitly mention the waste-origin of the examined bio-based products, the present literature review has included articles that target bio-based products but still lack the identification of their material origin. This selection was deemed necessary in order to enrich the insights into possible determinants of consumer acceptance which may be applicable across a wide range of bio-based products, including urban bio-waste derived products. The outcomes of this review serve to inform the design of the behavioural change intervention targeting consumer acceptance of urban biowaste derived products. The definition of the target behaviour, the review method followed to identify its determinants, and the outcomes of this review are presented below.

The Web of Science database was selected for the search of relevant peer-reviewed articles. The search keywords used were:

(("bio based") OR ("bio waste")) AND (product* or material*) AND (adopt* OR acceptance OR willingness OR pay OR purchase OR use OR consum* OR behavi*)

We considered all publications, for the period 1990 – 2020, for which these terms were used in the search fields of the title, abstract and author keywords. This first search gave **4601 results**. Seen the large amount of literature (including high number of articles not relevant for the scope of this research), it was decided to force the search on title only. This second search led to **55** articles. Downloaded records were imported in the Zotero library where they were screened for relevance. The selection of relevant publications was done in four steps. First, after having excluded conference papers, webpages, book section and thesis, technical articles were deleted

based on a first screening of their title, resulting in a remaining dataset of 8 articles. Second, articles focusing specifically on the acceptance of bio-based product were selected, leading to **only five articles.**

Regarding the very low numbers of articles arising from this systematic search, it was decided to opt for an exploratory research on the databases JStor, ProQuest, PubPsych, ScienceDirect, Scopus, Web of Science, and Wiley Online, and proceed with a "snowball" technique[11] to identify relevant literature. The initial search results were scanned, throughout the text, with the aim of identifying whether they included measures of consumer acceptance (as described above) of urban biowaste derived products or not. The resulting articles were, subsequently, scanned, throughout the text, with the aim of identifying whether determinants of consumer acceptance (as approached in each article) were explored. Only the articles focusing on and reporting determinants of consumer acceptance were retained for consideration in the current literature review. Furthermore, the reference lists of the retained articles were searched with the aim of obtaining additional relevant literature. The relevant articles found via the reference list search were similarly scanned using the same keyword criteria. A synthesis of this review results is presented below. Determinants of consumer acceptance of urban biowaste derived products are categorised in themes, according to their content. Determinants whose influence on consumer acceptance was accompanied by mixed results in certain studies, were included in this review outcome synthesis, taking into account possible methodological limitations in the studies, as reported by the authors.

3.2.1 Definition

One of the focus points and target goals of the behavioural change approach is to improve the consumer (or customer) acceptance of urban biowaste derived products. Acceptance of urban biowaste derived products (i.e. products wholly or partly derived from biowaste found in municipal solid waste) such as bio-based materials and food and feed ingredients play a key role in their market success.

As mentioned above, and in the context of the current project, consumer acceptance is approached through the concepts of intention (or willingness) to: adopt, pay, purchase and use. Bio-based products are products that are derived (produced through the process of bioconversion) from biowaste (Russo et al., 2019). Therefore, in the framework of the WaysTUP! project, the **consumer acceptance of bio-based products** will be defined as "**consumers intention/willingness to adopt, pay, purchase and use/consume a product that is made partly or entirely from recycled biowaste**".

By their nature, bio-based products are part of what is more generally referenced as "sustainable", "green" or "eco-friendly" products. Therefore, the following sections will report (1) the currently known determinants of the acceptance of bio-based products and (2) confront them with the currently know determinants of the broader acceptance of sustainable products to highlight possible gaps in its investigation.

3.2.2 Determinants

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[11] The snowball technique refers to the act of selecting articles through the references of others articles, therefore *accumulating* relevant literature on a subject.

The outcomes of the current literature review on the acceptance of urban biowaste derived products has yielded a number of consumer acceptance determinants. The overall results are categorized in distinct themes and presented accordingly.

Attitudes towards biowaste derived products

As explained previously, the more favourable a person's evaluation of the behaviour in question, the greater the person's intention to display the behaviour is expected to be. In the case of bio-waste derived products, a favourable customer evaluation of the bio-waste derived product translates to the customer's greater intention to accept the product. Similarly, positive attitudes towards issues directly associated with the product may also exert a positive influence on its acceptance by consumers. For example, a favourable customer evaluation of environmental sustainability can also translate to greater intention to accept the product. In this section, we address *product-specific environmental attitudes*, as those attitudes held by consumers towards a particular bio-waste derived product.

Empirical evidence has supported the effect of **attitudes towards bio-based products** on their acceptance of them. Holding a positive attitude towards bioenergy – a potential product derived from urban biowaste – has been found to positively impact consumers' intention to use bioenergy in the future (Qu et al., 2019). Consumer acceptance of other products derived from urban biowaste, such as bio-based packaging, has also been shown to be affected by attitudes. Another example of empirical support in favour of the effect of product-specific attitudes on consumer acceptance of urban bio-waste derived products comes from a study conducted by Russo and colleagues on bio-waste derived PHA material (Russo et al., 2019). The findings of this study showed a positive impact of consumers' attitude towards the bio-waste derived product on their willingness to pay for it, their intention to switch to it (from other, non-bio-based products) and their intention to purchase it.

Perceived value is defined as a set of attributes related to the consumer's perceptions of a product's value (Ashton et al., 2010), with value itself defined or as a set of trade-offs between benefits and costs in a customer's interaction with a product (Payne & Holt, 2001). Perceived value is known as a driver of pro-environmental behaviour, such as the adoption of green products (Chen, 2013; Gonçalves et al., 2016; Tseng & Hung, 2013). In the case of bio-based consumer acceptance, perceived value of bio-based products, such as bioplastics, has been shown to affect the intention to purchase bio-based products as well as the intention to switch to them from non-bio-based products (Confente et al., 2019).

According to the literature, individuals who have a positive **attitude towards biowaste derived product**s and who **perceive more positively the value of biowaste derived products** are more likely to have the intention to purchase and use biowaste derived product as well as display a higher willingness to pay for these products.

Knowledge

The effect of **knowledge about bio-based products** on consumer acceptance has received mixed support. In particular, drivers' knowledge and awareness of biofuels was associated with low willingness to pay for them (Lanzini et al., 2016). This effect has been assumed to be due to the increase in negative messages about biofuels in advertising and to 'experts' tendency to underestimate the costs of the innovative technologies needed for the production of bio-fuels

(Lanzini et al., 2016)). On the other hand, consumers' knowledge about renewable energy sources has also been associated with increased willingness to pay for bio-fuels (Mamadzhanov et al., 2019). In a similar vein, lack of knowledge about the bio-fuel industry amongst the public has been linked with low acceptance of bio-fuels by consumers (Delshad & Raymond, 2013; Mariasiu, 2013).

> The role of **knowledge** on the acceptance of biowaste derived products has received mixed support.

Pro-environmental tendencies

Environmental attitudes, which can be defined as attitudes towards the environment in general and towards environmentally-relevant actions, and include (but are not limited to) *environmental awareness* (interpreted as being aware of the consequences of one's behaviour on the environment), *environmental concern* (interpreted as "an attitude towards facts, one's behaviour or others' behaviour with consequences for the environment" (Fransson & Gärling, 1999, p. 370), and *environmental friendliness* (interpreted as displaying environmentally-friendly behaviours).

Such generic attitudes have been shown to play an important role in consumer acceptance of bio-based products. When being introduced to the concept of bio-economy in general (defined as "the 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, 2012a), consumers tend to associate it with the concept of environmental awareness more than with any other concept (Stern et al., 2018). Consumers who report strong **environmental awareness** are also more willing to pay a premium price for bio-based products, compared to those with weaker environmental awareness (Kainz, 2016; Kurka & Menrad, 2009; Stern et al., 2018). A similar finding has been obtained about willingness to pay for bio-based products and intention to purchase them by consumers who score high on **environmental friendliness** (Herbes et al., 2018; Mamadzhanov et al., 2019). Intention to purchase a bio-based product, such as a renewable energy contract - also including energy produced by biofuels - is also reported to be stronger for consumers who express high levels of environmental concern (Hartmann & Apaolaza-Ibáñez, 2012).

Referring to an individual's overall perceived identification with the typical green consumer, **green self-identity** is a well-recognized antecedent of pro-environmental behaviour (Oliver & Rosen, 2010). In the same study on bio-waste derived PHA material previously discussed, consumer acceptance of the product -in terms of willingness to pay, intention to switch to it from non-bio-based products and intention to purchase it - was found to be affected by 'green' self-identity as well. Moreover, green self-identity played an additional role in consumer acceptance, as it mediated the effect of attitudes on the latter. Put differently, holding positive attitudes towards a bio-waste derived product could influence consumer acceptance partially by strengthening consumers' green self-identity (Russo et al., 2019).

> Citizens displaying pro-environmental tendencies are more likely to accept biowaste derived product: **environmental attitude** (environmental awareness, concern and friendliness) and **green self-identity** has been shown to have a positive impact of consumer's willingness to pay and intention to purchase biowaste derived products.

Values

Consumer research has shown that consumer preferences and judgements of products can be substantially affected by their endorsed values (Holbrook, 1999; Zailani et al., 2019). Values have been found to affect pro-environmental behaviour (Kilbourne & Pickett, 2008). Regarding consumer behaviour, a typology of values known as "**consumption values**" (Sheth et al., 1991): among the five known consumption values (functional, social, emotional, conditional, and epistemic), four of them have been found to determine willingness to pay for bio-fuels (Zailani et al., 2019). More specifically, *functional value* (i.e. "the perceived utility of a product or service to attain utilitarian or physical performances that results from attributes, such as durability, reliability and price"), *emotional value* (i.e. "the perceived utility that results from a product or service that provokes feelings or affective states"), *conditional value* (i.e. "the perceived utility acquired by an alternative as the result of the specific situation or set of circumstances facing the choice maker"), and *epistemic value* (i.e. "the perceived utility acquired from an alternative 's capacity to arouse curiosity, provide novelty and/or satisfy a desire for knowledge), have all had a positive effect on drivers' willingness to pay a premium for biofuels (Zailani et al., 2019).

Green consumer values, defined as consumers' consciousness of the effects of their behaviour on the environment (Haws et al., 2014), are also considered important determinants of consumer acceptance of urban bio-waste derived products. For example, consumers with strong green consumer values expresses greater willingness to pay for bio-based products as well as stronger intention to purchase them (Kainz, 2016; Klein et al., 2019). Strong, green consumer values are also one of the profile characteristics of ecologically concerned consumers and consumers who are concerned about product material origin - two types of consumers who hold favourable preferences towards bio-based products (Scherer et al., 2017).

Psychological characteristics reflecting consumers' pro-social attitudes were also found to impact their acceptance of bio-based products. **Altruism**, defined as the importance attached to helping others, and emotional performance, defined as the feeling that the consumer is doing something good by purchasing the bio-based product (Carus et al., 2014) were both found to affect consumer intention to purchase and their willingness to pay a premium price for them (Carus et al., 2014; Klein et al., 2019).

> Citizen's values such as **consumption values** (functional, emotional, conditional and epistemic), **green consumer values** and **altruism** have been found to impact consumer's willingness to pay and intention to purchase biowaste derived products.

Past behaviour

Amongst other determinants of drivers' acceptance of biofuels, past purchase of green products has been to exert a strong influence on willingness to pay for biofuels (Klein et al., 2019; Lanzini et al., 2016; Scaringelli et al., 2017). Past consumption behaviour of eco-friendly products has also been shown to positively influence willingness to pay for, switch to, and purchase bio-waste derived products, such as PHA-based bioplastics (Confente et al., 2019; Russo et al., 2019).

> The past behaviours of citizens, in this context, **previous so-called "eco-friendly purchase"** appears to have a positive influence on their willingness to pay and purchase biowaste-derived product.

Consumer characteristics

Consumers' willingness to obtain information about biowaste derived products has been found to be a predictor of consumer acceptance. Empirical support for this effect has been obtained for consumer intention to purchase bio-based products (Klein et al., 2019).

Apart from consumers' willingness to obtain information about bio-based products, their **perception of themselves as communicating and influencing others** with regards to the use and benefits of a bio-based product -or, put differently, the perception of themselves as opinion leaders - is an additional determinants of intention to purchase a bio-based product (Klein et al., 2019).

Another consumer characteristic that can determine consumer acceptance of bio-based products, as revealed by the current literature review, is **perceived consumer effectiveness**. Defined as the consumers' belief that they can influence the outcome of the environmental appeals of products (Roberts, 1996; Straughan & Roberts, 1999), perceived consumer effectiveness has also been identified as an important characteristic of consumers who favour bio-based products (Scherer et al., 2017).

A final consumer characteristic that has also been shown to positively affect consumer acceptance of bio-based products, when assessed as intention to purchase such product, is the propensity of consumers to adopt and try new products - a characteristic known as **consumer innovativeness** (Klein et al., 2019; Tellis et al., 2009).

Consumer's characteristics, meaning the characteristics of individuals when placed in their role of consumers have proven to influence the acceptance of biowaste derived products. Indeed, **interest in information** regarding biowaste derived product, consumer's **perceived influential communication behaviour**, **perceived effectiveness** and **innovativeness** have all been found to positively influence the intention to purchase biowaste derived products.

Perceived behavioural control

Research has provided mixed support for the effect of perceived behavioural control on consumers' intention to use bio-energy (Halder et al., 2016; Qu et al., 2019). More specifically, whereas perceived behavioural control was found to exert a positive influence on consumer intention to use bio-energy in the future for Finnish consumers, the same effect appeared to be insignificant and, even negative, in the case of Indian and Chinese consumers. Such mixed findings point to the potential influence of external factors that need to be taken into account when estimating the consumer acceptance of bio-based products based on certain determinants. For example, and as pointed out by Qu and colleagues (2019), the future use of bio-energy may not be perceived as a choice under the consumer's behavioural control and, therefore, external enablers or barriers need to be taken into account.

The role of the **perceived behavioural control** on the acceptance of biowaste derived product has not been clearly demonstrated. An explanation for the mixed results could lie in the fact that citizens do not perceived the purchase of biowaste derived product as a free choice.

Subjective norm

Subjective norm. Describing an individual's "perceptions of the extent to which significant others would endorse a given behaviour and personal motivations to comply with this social pressure" (Abrahamse & Steg, 2011), subjective norm has been addressed as a potential determinant of behavioural intention both by the Theory of Planned Behaviour and its precedent, the Theory of Reasoned Action. In the case of intention to use bio-based products, subjective norm has been indeed found to have a positive impact on it (Halder et al., 2016; Klein et al., 2019; Radics et al., 2016). Similar to perceived behavioural control, the anticipated impact of subjective norm on consumers' intention to use a bio-based product, such as bio-energy, bio-plastics or bio-fuels, may also be affected by external factors, such as the consumers' cultural context.

> **Subjective norm**, referring to perceptions of the extent to which others would endorse a behaviour and the individual's motivation to comply with this type of social pressure, has been found to positively influence consumer acceptance of bio-based products.

Product features

Given the focus of the current literature review of consumer acceptance determinants that can inform the design of a behavioural change intervention and be sustainably exploited in the long run, **economic determinants** of bio-based product acceptance have not been deemed relevant for this purpose - as altering the economic aspects of bio-based products is *beyond* the scope and possibilities of a behaviour change intervention approach. Nevertheless, the influence of two important economic determinants on consumer acceptance is briefly mentioned below with the aim of acknowledging their potential interplay with any behaviour change intervention parameters. These two economic aspects of bio-based products include: (1) *product price*: examined mainly in the context of consumer acceptance of bio-fuels, product price has been found to exert a major influence on consumers' willingness to choose a bio-based product over a non-bio-based product (Radics et al., 2016); (2) *tax benefits*: the provision of tax benefits to consumers who are willing to opt for bio-fuels, over gasoline, has been reported as a factor that can facilitate consumers' choice of bio-fuels (Radics et al., 2016).

Similarly relevant mainly in the case of bio-based fuels, the **availability** of the products, and the resulting **feeling of convenience** with which consumers can refuel their vehicles with bio-fuels, has also been reported as a factor that impact willingness to choose biofuels over non-bio-based alternatives (Radics et al., 2016; Vliet et al., 2010).

A final product characteristic, also relevant mainly for bio-based fuel products, is the consumers' **perceived safety** from product use. For example, in the case of bio-fuels, Browne and colleagues (2012) have found that perceived risks of flammability and explosion have the potential to affect consumer choice of the product.

Communication features

A set of different communication design features have been revealed as potential determinants of consumer acceptance of bio-based products. These features include:

Displaying information about the contribution of the bio-based product to environmental sustainability (such as its package being made from biodegradable material and designed to maximize the optimal use of materials and resources) have been found to affect consumers' acceptance of such products (Jerzyk, 2016). When compared with other products of similar price

and effectiveness, **communicating the environmental benefits** of bio-based products has been shown to increase consumers' willingness to purchase the latter (Delshad & Raymond, 2013; Hartmann & Apaolaza-Ibáñez, 2012; Walter, 2011). Enriching potential consumers' knowledge about the environmental benefits of bio-based products, such as the benefits of biomass usage, has been shown to enhance their perception of the product which, in turn, has been shown to have a positive impact on consumers' intention to use the product in the future (Van Dael et al., 2017). Communicating information about the pro-environmental impact of bio-based products has also been linked to higher willingness to pay for them, as in the case of bio-ethanol (Mamadzhanov et al., 2019). Especially for environmentally-concerned consumers, influencing their opinion about the use of bio-based products, such as bio-fuels, depends primarily on communicating to them information about the pro-environmental benefits of such products (Velde et al., 2009).

Products presented as composed of higher percentage of bio-based material elicit stronger purchase intentions on behalf of the consumer, compared to products with lower percentage of similar material or no bio-based material at all (Grimmer & Bingham, 2013; Reinders et al., 2017). Interestingly, this effect of product composition on purchase intention appeared to hold for private brands but not for global ones. Put differently, **communicating a higher percentage of bio-based material composition** is associated with stronger intention to purchase the product (as compared to moderate or zero percentage of similar material composition) only in the case of private brand products - the same effect disappears in the case of global brands (Reinders et al., 2017). Next to purchase intention, the product's bio-based material composition was also found to affect other aspects of consumer acceptance, such as attitude towards the product brand as well as the emotions elicited by the brand (Reinders et al., 2017). That is, products with higher percentage of bio-based material composition are associated with more positive attitudes towards the product brand and more positive emotions towards the brand (Reinders et al., 2017). Related to the communication of information about the product's bio-based material composition, Sijtsema and colleagues (2016) have found that consumers may express scepticism, concern and **distrust** about a product company's marketing tactics when being presented with products partially made from bio-based materials. As explained in their study, consumers tend to associate bio-based products with the concept of 'naturalness' and expect them to be developed primarily as a pro-environmental solution. Any information that may elicit perceived 'inconsistencies' between these consumer expectations about the product and the product itself (such as the product being partially made from bio-based materials and partially from non-bio-based materials) may have a negative impact on consumers' acceptance of the product (Sijtsema et al., 2016).

Whereas communicating the pro-environmental friendly benefits of bio-based products can have a positive impact on consumer acceptance, **communicating additional benefits** (such as convenience for the consumer, appealing product looks and price) for the consumer can also enhance consumer acceptance. For example, communicating benefits such as convenience offered to the consumer by the product use, attractive product looks, appealing product price, enabling a healthy lifestyle, feeling close to nature and feeling good thanks to the product usage can also have a positive influence on consumers' acceptance of the product (Hartmann & Apaolaza-Ibáñez, 2012; Sijtsema et al., 2016). The value of communicating the personal benefits to be gained from bio-based product adoption is in line with research findings suggesting that consumer acceptance of new technological products depends less on the general assessment of the product and more on the assessment of the personal benefits it brings to the consumer (Aerni et al., 2011; Phillips & Corkindale, 2002). Given the novelty of many of the bio-waste derived

products, the communication of personal benefits to consumers appears to be relevant for enhancing their acceptance by consumers.

The mode of **information display** (visual versus text-based) is an important factor determining the perception and persuasiveness of communication efforts. In the case of marketing communication for bio-based products, the results in one study have shown that providing information about the bio-based material composition of a product via a visual label was associated with stronger willingness to pay for the product, compared to providing the same information via text (Kainz, 2016).

> Communication around biowaste derived products have a positive influence on consumer's acceptance of the products: **communicating environmental benefits** and **additional benefits** (non-environmental) of the products and **giving information on the product's composition** has a positive influence on the willingness to pay and to purchase such products, although inconsistencies in these communications may have a negative impact. The way the information is displayed also seem to have its importance as **visual labels** leads to stronger willingness to pay than a text.

Socio-demographic characteristics

The reviewed studies have provided mixed results about the role of **age** in consumer acceptance of bio-based products. Koutsimanis and colleagues (2012), for example, have shown a positive effect of age on preference for bio-based packaging - in other words, older consumers showed a stronger preference for bio-based packaging compared to younger consumers. On the other hand, research has demonstrated an absence of the age effect on consumer acceptance for bio-based products. For instance, Lanzini and colleagues (2016) showed a non-significant effect of age on consumers' willingness to pay for bio-fuels.

Mixed findings have been observed regarding the effect of **gender** on consumer acceptance of bio-based products. Whereas willingness to pay for a bio-based product was found, in two studies, to be stronger for female consumers (Kainz, 2016; Mamadzhanov et al., 2019), other studies have shown non-significant gender effects (Lanzini et al., 2016).

Among the reviewed studies, one study examined the potential impact of **household type** on willingness to pay for bio-based products. The results of this analysis showed that willingness to pay for bio-based products was higher for households with children living in them, compared to other household types (Kainz, 2016).

Mixed findings have also been observed for the effect of **income** on consumer acceptance and, in particular, willingness to pay for bio-based products. While the effect of income was found to be negative, albeit small, or non-significant in the study by Kainz (2016), Mamadzhanov and colleagues (2019) showed a positive effect of it on willingness to pay for bio-fuels. The presence of mixed results in the first case may indicate, as the author suggests, the moderating role of other factors, such as product category, in the relationship between income and willingness to pay (Kainz, 2016).

Similarly, mixed findings have been obtained with respect to the effect of **education** on consumer acceptance of bio-based products. In a study with U.S. consumers, those with high-school and college diploma education were found to show stronger preference for bio-based products,

compared to those with graduate education degrees (Koutsimanis et al., 2012). The authors attribute this finding to the possibility that consumers with lower education may not be equipped with the necessary knowledge to criticise the pro-environmental displayed benefits of bio-based product marketing communication. In a different study, education was not found to exert a significant influence on consumers' willingness to pay for bio-fuels (Lanzini et al., 2016).

> The socio-demographics characteristics of citizens have been found to have some impact on the acceptance of biowaste derived products. There are mixed results regarding the impact of age, gender, education and income. It has been found that **households that still include children** are more likely to display positive intention to pay for biowaste derived products.

3.2.3 Comparison with the key determinants of the acceptance of sustainable consumption

In order to identify the overlap and gaps between the identified determinants of the acceptance of bio-based products with the **broader behaviour** of "**sustainable consumption**", we conducted a brief review of meta-analysis and review articles regarding sustainable consumption and sustainable products acceptance, based on the following articles:

- "*Models for Predicting Sustainable Durable Products Consumption Behaviour: A Review Article*" (Ghose & Chandra, 2020)
- "*Determinants of sustainable/green consumption: a review*" (Tripathi & Singh, 2016)

We report in Table 3 the most important elicited determinants (i.e. that have been investigated by more than one study).

Table 3: Determinants comparison (sustainable products vs bio-based products)

Determinants		Influence on the acceptance of sustainable products	Influence on the acceptance of bio-based products
Socio-psychological	Attitudes	Yes on intention – "gap" with behaviour	Yes
	Environmental attitude (awareness, concern, friendliness, emotion)	Yes	Yes
	(Green) Self-identity[12]	Yes	Yes
	Injunctive / subjective norm	Yes	Yes
	Knowledge	Yes	Yes
	Environmental knowledge[13]	Yes	No
	Past behaviour	Yes	Yes

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[12] Self-identity reflects "the way individuals describe themselves" (Geiger et al., 2019, p. 79)
[13] Environmental knowledge refers to "the knowledge of relevant environmental concepts, environmental problems, and action strategies that may be used for solving environmental problems"

	Perceived behavioral control (controllability and perceived consumer effectiveness)	Yes	Yes
	Personal / moral norm / moral obligation (included: consumer environmental responsibility)	Yes	Yes
	Values[14]	Yes	Yes
	Mindfulness[15]	Yes	No
Consumer' s characteristics	Consumer willingness to obtain information	No	Yes
	Perceived consumer trust (PCT)	Reported but not sufficiently investigated	Reported but not investigated
	Perceived consumer effectiveness	Yes	Yes
	Consumer innovativeness	Yes	Yes
	Perception of themselves as communicating and influencing others	No	Yes
	Perception of themselves as communicating and influencing others	No	Yes
Product' s characteristics	Perceived product effectiveness	Yes	No
	Economic determinants	No	Yes
	Product availability	No	Yes
	Perceived product safety	No	Yes
Socio-demographic	Age	Yes	Yes
	Gender	Yes	Yes
	Income	Yes	Yes
	Education	Yes	Yes

An important element that has arisen from this comparison of determinants is the presence of a well-documented "**attitude/intention-behaviour gap**" in the sustainable consumption domain, reporting on the contradiction between what individuals express (the *attitude* and *intention*) and how they actually act (the *behaviour*). However, results from studies trying to explain the gap have

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[14] Values are "desirable trans-situational goals that reflect what people find important in life in general" (Geiger et al., 2019, p. 80)

[15] Mindfulness refers to a mental state and is characterized by two components: "the first component involves the self-regulation of attention so that it is maintained on immediate experience, thereby allowing for increased recognition of mental events in the present moment. The second component involves adopting a particular orientation toward one's experiences in the present moment, an orientation that is characterized by curiosity, openness, and acceptance." (Bishop et al., 2004, p. 232)

been inconclusive. It can be foreseen that this gap, although not yet reported in the context of bio-based products seen the novelty of the products, will also be present. Therefore, future studies should focus on avoiding possible bias and including diverse variables in the prediction of the acceptance of these specific products.

Mindfulness has been found to promote green behaviour. Not only has its predictive power been found to excess its of the TPB and habits, but mindful individuals have been found more likely to carry out their intention than less-mindful individuals. The relationship and causal explanation however, has scarcely been investigated. It can be hypothesized that since mindful individuals are more flexible and open to new information, it leads them to have informed non-habitual and non-automatic purchasing behaviour (Tripathi & Singh, 2016). Although we have reported the impact of the variable "consumer willingness to obtain information" on the acceptance of bio-based products, which could be seen as related to the concept of mindfulness, the role of mindfulness has yet to be investigated more precisely in this context.

Although seldomly investigated in the context of sustainable behaviour, the role of **environmental knowledge** has been found to have a significant positive impact on the attitude component. As this concept was not encountered in our search regarding the acceptance of bio-based products, it might be beneficial to include it in future research.

Specific to product acceptance is the idea of trust toward the brand and the product (**perceived consumer trust**). The concept has yet to be investigated in the context of the acceptance of bio-based products, and has only been sporadically investigated in the broader context of sustainable consumption. Likely, the concept of **perceived product effectiveness** has been found to impact individuals' usage of green product (the perception that the "green" product is less effective lead to an overuse of the said product), but it's relationship with intention and consumption behaviour has yet to be investigated, which is also the case in a bio-based product context.

Overall, based on Table 3, it can be observed that most determinant of the acceptance of sustainable products have been investigated in the context of bio-based products acceptance, with the exception of: environmental knowledge, mindfulness, perceived consumer trust and perceived product effectiveness. Seen the impacts of these variable on the acceptance of sustainable products, it might be interesting to investigate them in the context of bio-based product acceptance.

3.3   Review of similar projects

Besides the literature review on waste sorting behaviour and consumer acceptance, a search was performed to identify similar projects in the field of the circular economy. Their work has been screened and taken into account for the WaysTUP project (cfr Chapter 3). In the upcoming months, contacts will be taken with the relevant projects in order to exchange lessons learned and to start collaborative activities on the social dimension of the circular economy.

3.3.1   RES URBIS (ended)

RES URBIS (RESources from URban BIo-waSte) is a European (Horizon 2020) project that aim to "integrate into a single facility and to use one main technology chain for the conversion of several types of urban bio-wastes into valuable bio-based products, while also minimizing any residual or consequent waste to be disposed of." The project includes among others a market analysis for the full exploitation of bio-based products. The focus of the project is mainly to convert urban biowaste into polyhydroxyalkanoate (PHA) and related PHA-based **bioplastics**, **bio-based solvents** (to be possibly used also in PHA extraction) and **fibers** (to be used for PHA-based biocomposites).

The activities take place Trento (Italy), Barcelona (Spain), Lisbon (Portugal, South Wales (UK) and Copenhagen (Denmark).

The project has published two studies and consumer's acceptance that have already been included in the "Chapter 3.1 Consumer" acceptance.

- "*Marketing a new generation of bio-plastics products for a circular economy: The role of green self-identity, self-congruity, and perceived value*" (Confente et al., 2019)
- "*From trash to treasure: The impact of consumer perception of bio-waste products in closed-loop supply chains*" (Russo et al., 2019)

More information can be found at http://www.resurbis.eu/overview

3.3.2   BIOFOREVER (ended)

BIOFOREVER (BIO-based products from FORestry via Economically Viable European Routes) is a European project (Horizon 2020) that aim to "demonstrate the feasibility of conversion of lignocellulosic feedstocks like wood into chemical building blocks and high added value products". The project's objective is to demonstrate the technical and economical aspects of 5 different value chains from feedstock to final product.

There has been one press release on psychological mindset of consumers towards bio-based products:

- "In-depth psychological market research finds surprising insights into consumers' mindset towards bio-based products"

In this document, it is reported that consumers have a bad understanding of bio-based products overall. First, they mainly see plastic as harmful made out of "chemical" and "artificial" ingredients, where chemistry is seen as "toxic magic" and are unaware of bio-based and biodegradable plastic. Once they learned about this possibility, they associated the raw material from which bio-based plastic could be made off with food plants due to their analogous characteristics (soft, flexible, resistant, etc.), and expressed concerns related to hygiene, bad smells and potential pollution with the idea of using food waste. In this line of thought, consumers understand the concept of "plant-based" better than "bio-based". Consumers also expressed their need to have a concise, easy-to-understand label to help them identify good materials, and that this was the role of the government to make.

More information can be found at https://www.bioforever.org/

3.3.3   ValueWaste (ongoing)

VALUEWASTE general objective is to "develop a system for urban biowaste valorization through the development of three value chains that can be integrated following a cascading approach".

Since the project just started its second year, there are, to date, no relevant input to be reported here. However, there will be a Work Package dedicated to evaluate the social acceptance of biowaste derived products (WP8). The goal is to increase knowledge and understanding of citizens' opinions towards biowaste valorization, as well as to evaluate consumer's take up and acceptance of biowaste derived products. This role is taken up by the Savonia University of Applied Sciences in Finland.

More information can be found at https://www.valuewaste.eu

3.3.4   SCALIBUR (ongoing)

The SCALIBUR project is a European project (Horizon 2020). Its main goal is to "demonstrate innovative solutions to transform urban food waste and sewage sludge into high value-added products, helping cities to increase their recycling rate and creating new circular economy business opportunities". The project aims to identify and develop best practices for selective collection, transport, sorting and pre-treatment, and characterisation of urban biowaste and sewage sludge. The activities are taking place Lund (Sweden), Albano Laziale (Italy), Madrid (Spain and Kozani (Lithuania).

There is no relevant information to be reported yet.

 More information can be found at http://www.scalibur.eu/

3.3.5 URBIOFIN (ongoing)

URBIOFIN is a European project (Horizon 2020) which goal is "demonstrate the techno-economic and environmental viability of an integrated and innovative biorefinery for the transformation of the organic fraction of municipal solid waste (MSW) into new marketable bioproducts, chemical building blocks, biopolymers and additives".

There is no relevant information to be reported yet.

More information can be found at https://www.urbiofin.eu

3.3.6 EMBRACED (ongoing)

The goal of the European project (Horizon 2020) EMBARCED is to establish a "first-of-its-kind demonstration plant of an integrated biorefinery, based on the valorization of the cellulosic fraction of post-consumer AHP (Absorbent Hygiene Products) waste towards the production of bio-based building blocks, polymers and fertilizers".

There are no relevant information to be reported yet.

More information can be found at https://www.embraced.eu

3.4 First framework of determinants for WaysTUP!

Based on the two literature reviews that were conducted in the framework of this deliverable, we propose the following framework of determinants of the behaviours included in the WaysTUP! project (see Figure 4), namely "**biowaste sorting**" and "**acceptance of bio-based products**". As can be observed, both behaviours share a number of determinants: attitude, subjective norm, perceived behavioural control, moral norm, knowledge, past behaviour, environmental attitude and socio-demographics variables. It has to be noted that these variables are behaviour specific, meaning that they need to be investigated specifically for each behaviours (with the exception of the socio-demographic and environmental attitude component). Furthermore, key determinants for biowaste sorting were found to be the descriptive norm, perceived inconvenience, situational aspects. Regarding the acceptance of bio-based derived products, key determinants were self-identity, values, consumer characteristics and product features.

More than a summary of findings, this framework will inform the upcoming behaviour change strategy, to be reported in D4.2 "Toolkit: Interventions for change".
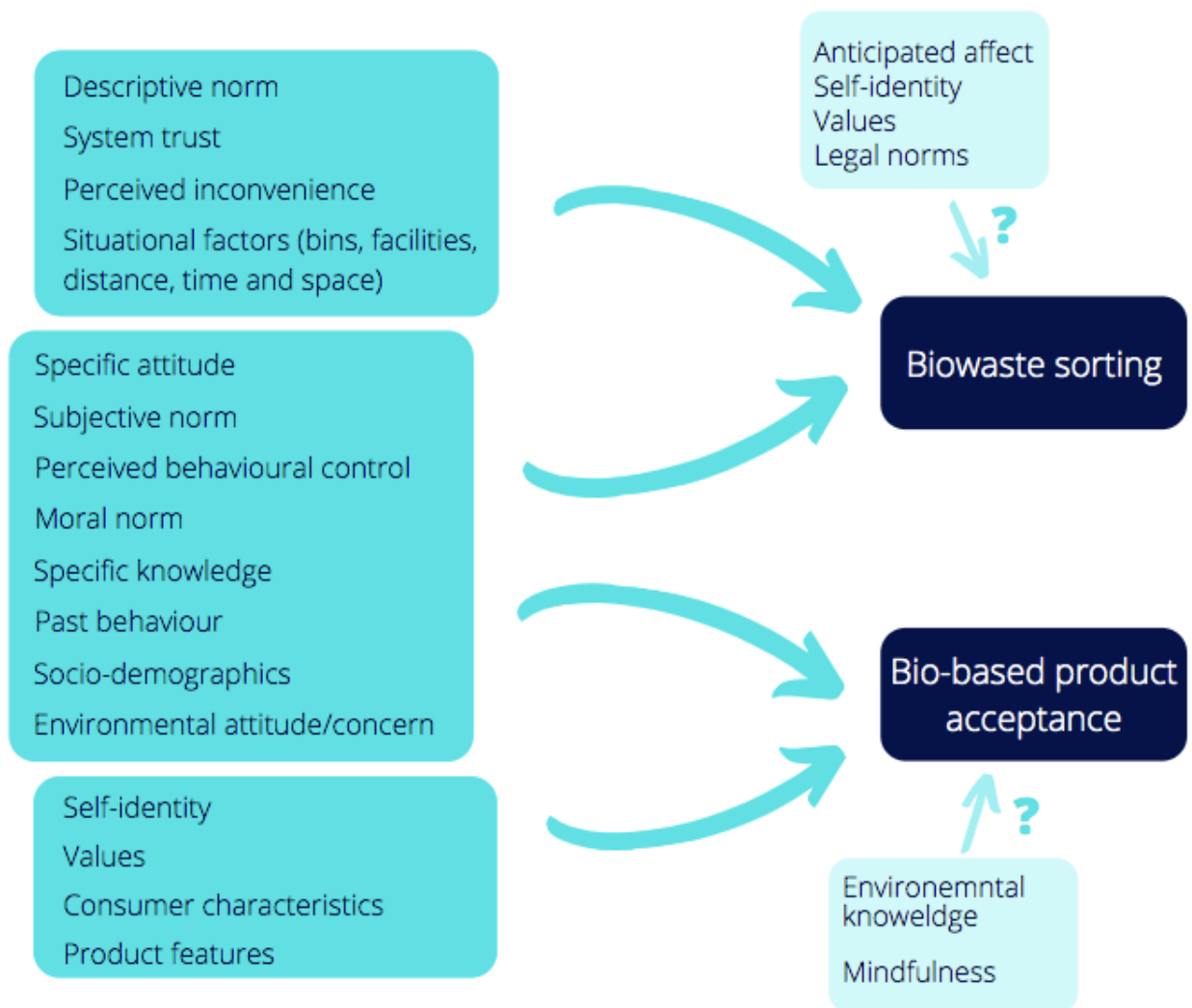
Figure 4: First framework of determinants for WaysTUP!

4. Identification of target audience and behaviour objectives – Expert interviews

For each of the pilot studies that is part of WP4 (Pilots 1, 5, and 6), the populations targeted by the behaviour change interventions were selected. Convenience samples of each population were identified in terms of pre-existing communities in the urban environments where Pilots would take place. The selection of the target populations and the identification of communities (as samples) was conducted through experts interviews. The local coordinator of each pilots (SAV, AMB, HSPN, SUST) were identified as experts, as they possess specific knowledge and expertise regarding their own pilot community. A common process was applied in all three Pilots with the aim to better understand how to reach the pre-defined **behavioural objectives**:

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

Step 1. **Community targeting: identification of candidate target communities**
During this step, a list of candidate target communities is identified by the Pilot partners. To that purpose, the Pilot partners were invited to complete a first questionnaire (see Appendix 1) and to participate in an expert interview.

Step 2. **Behavioural insights: description of community behavioural profiles and preliminary selection of behavioural objectives**
During this step, preliminary information about the behavioural profiles of the target community members is provided by the Pilot partners. The term behavioural profiles refers to behavioural patterns of the target community members (related to the main behavioural goals of WP 4) and potential determinants of those patterns. Any information provided is based on the Pilot partners' knowledge of the target communities and on previous empirical evidence (if available). The information is provided by the Pilot partners by means of a questionnaire (see Appendix 2) and a expert interview. Based on the preliminary behavioural profiling and determinant mapping as well as on the Pilot partners' expected outcomes from the behaviour change intervention study, a first set of behavioural objectives for the change intervention is derived.

Step 3. **Evaluation of target communities: assessment of readiness for behavioural change, effectiveness and efficiency of responding to change mechanics**
This evaluation aims at segmenting the target communities into sub-target groups, to whose profiles the behaviour change intervention design can be tailored. The target communities are evaluated and segmented based on: a) the community members' readiness stage for behaviour change; b) the expected effectiveness and efficiency of their reaction to the behaviour change intervention. The readiness stage evaluation builds on the 'stages of change model' (Prochaska, Norcross, & DiClemente, 1994), according to which individuals go through a series of stage when changing their behaviour. These stages range from precontemplation about the desired behaviour

to termination of the behaviour change goal and establishment of the desired behaviour. Further evaluation of the target communities is done by assessing their potential for effectiveness and their potential for efficiency in achieving the desired behaviour change. A set of criteria, proposed in social marketing approaches, is being used to conduct the above-mentioned assessments (Lee & Kotler, 2016).

In the next sections, we detail each of these steps per Pilot, based on the questionnaires (appendix 1 and 2) filled in by the experts, as well as based on a thematic analysis of the experts interviews.

4.1 Pilot 1: Valencia

4.1.1 General pilot description

Pilot 1 will be located in the SAV facilities in Valencia (Spain). Feedstock will consist of: meat by-products, such as blood, bones, meat trimmings, skin, fatty tissues, horns, hoofs, feet, skull and viscera, among others; fish by-products, consisting of head, tails, skin, entrails, fins and frames; and spent coffee grounds, provided by SAV. The Pilot will have a capacity of 52.000 tpy (tonnes per year) of waste treated.

The development and implementation of a behaviour change intervention will be organized with the involvement of local stakeholders, led by ADMW (ADM Wild Valencia, S.A.U.) and NS (Nutrition Sciences N.V), with relevant links to social innovation activities already in place.

4.1.2 Community targeting: identification of candidate target communities

As target communities, the Pilot 1 partner SAV identified **local restaurants, (food) markets** (including the VLC central market and MercaValencia), **local fishermen cooperatives**, as well as **local citizens** of Valencia. The inclusion of an additional target community of interest, that of a **local business federation**, will be considered by SAV.

The target numbers for the Pilot of Valencia are as follow:

- Approx. 1000 students and parents from the Valencian Community
- 100 workers and managers from Valencians businesses
- 2000 employees from SAV

Communication with the aforementioned target communities has not yet been established. To this purpose, available communication channels to be utilized are channels provided by the Valencia City Council. During this step of community targeting, contact with the local stakeholders ADMW and NS could not be established. Additional input from these two Pilot 1 partners will be sought during the next steps of designing the behaviour change intervention study. Given that no contact has been established yet with the candidate target communities, only information about their location and geographical spread can be provided -in approximation. Additional information regarding the: a) minimum number of community members, per target community, required in order to meet the bio-waste amount requirements for the technical operations of Pilot 1, b) the expected variability in the produced bio-waste of each target community, and c) the maximum number of community members that can be reached per target community will be provided in the course of the behaviour change design development by SAV.

4.1.3 Behavioural insights: description of community behavioural profiles and preliminary selection of behavioural objectives

The target communities' behavioural profile in terms of their current waste management practices can be described as follows. First, local Valencia citizens **are provided with external space containers for waste separation** to be picked up by the municipal services. Similarly, restaurants also have access to waste separation containers. In markets, a scheme for collecting separated bio-waste is also available. Information is expected to be received from the Pilot partner about the bio-waste separation practices of the fishermen cooperatives. Second, in terms of performance, it is said that **the bio-waste separation performance of local citizens can still improve further**. Previous engagement of local Valencia citizens in waste separation actions have shown encouraging findings regarding citizens' behavioural change over time. In describing the waste separation practices of the local citizens, special attention was drawn to the **younger segments** of the local population as being more aware of the bio-waste management practices and environmental sustainability issues. Younger citizens are, therefore, considered a potential sub-target group that can facilitate the behaviour change intervention for local citizens of older age who are, generally speaking, less receptive to similar interventions. As potential motives underlying the engagement of target community members in bio-waste sorting behaviours, personal motives and environmental attitudes have been mentioned. Information about the barriers faced by target community members in engaging with biowaste sorting as well as information about their acceptance of biowaste derived products and its determinants is currently lacking. Finally, preliminary objectives for the behavioural change interventions, per target community, will be set with the Pilot partner during the behaviour change design development.

Furthermore, it appears primordial to this pilot partner to **switch the vocabulary used** from (kitchen, food, biodegradable, organic) waste to "**leftovers**" or "**surplus food**", and this with the aim of changing people's perception regarding the material towards something that still has value.

4.1.4 Evaluation of target communities: assessment of readiness for behavioural change, effectiveness and efficiency of responding to change mechanics

Information about the readiness stage of each target community for behavioural change as well as about the expected effectiveness and efficiency of their response to the behaviour change mechanics will be provided by SAV in the course of the behaviour change design development.

4.2 Pilot 5: Athens

4.2.1 General pilot description

Pilot 5 will be located at the premises of NTUA (National Technical University of Athens) in Athens (Greece). This pilot focuses on the biochemical conversion of separately collected household food waste to bioethanol. It is a pre-existing installation developed in the framework of the LIFE WASTE2BIO project. Feedstock material will be source separated biowaste from households. The provision of this material will be under the responsibility of SUST (City Network for Sustainable Development and Cyclical Economy).

The development and implementation of a behaviour change intervention will be organized with the involvement of local stakeholders, led by HSPN (Hellenic Society for the Protection of Nature) and supported by SUST, with relevant links to social innovation activities already in place.

4.2.2 Community targeting: identification of candidate target communities

As target communities, the Pilot 5 supporting partners, namely HSPN and SUST, identified the following: a) **households** located in two selected municipalities (municipalities of Elliniko-Argyroupoli and Vari-Voula-Vouliagmeni) already involved in the bio-waste separation and collection activities for the technical operation of Pilot 5 (by NTUA), b) **students and teachers** of schools located in the two selected municipalities as well as, if necessary, schools involved in HSPN network activities, c) **hotels** (including staff and guests) of the 'Green Key' network of HSPN, d) **local restaurants**, e) **local bakery stores**, f) **farmers-sellers** operating in the open markets of the Elliniko-Argyroupoli municipality.

Communication with the aforementioned target communities has not yet been established. To this purpose, available communication channels to be utilized are channels provided by HSPN and SUST, including both direct contact with the target community members and contact via online (social) media.

Concrete information about the location of activity for the open market farmers' community can be provided by SUST. Given that contact with the rest of the target communities has not yet been established, information about their location and geographical spread can be provided in rough approximation. Particularly for the hotels' target community, it can be said that their geographical spread is expected to be larger, compared to that of the other target communities, as they are not concentrated in the two aforementioned municipalities.

The target numbers for the Pilot of Athens are as follow:
- 5000 citizens from the municipality of Elliniko – Argyroupoli
- 5000 citizens from the municipality of Vari – Voula - Vouliagmeni
- 1000 students from schools in the municipality of Elliniko – Argyroupoli and the municipality of Vari – Voula – Vouliagmeni
- 500 HSPN members
- 50 hotels from the Green Key network
- 10 hotels in the area of Athens
- 5 Greek NGOs
  50 teachers of the HSPN education network

4.2.3 Behavioural insights: description of community behavioural profiles and preliminary selection of behavioural objectives

The target communities' behavioural profile in terms of their current waste management practices can be described as follows. Household community members in the municipality of Vari-Voula-Vouliagmeni **have been provided with bins for biowaste separation**, placed in public spaces. Households in the municipality of Elliniko-Argyroupoli **do not currently have access to such bins** and any biowaste produce is disposed of unsorted. However, the municipality, who appears to be quite proactive regarding pro-environmental interventions, is looking to install organic waste bins. The biowaste produced in the open farmer markets of Elliniko-Argyroupoli is collected by municipality tracks and transferred to the premises of NTUA. Information is lacking about the current biowaste separation practices of restaurants, schools, bakery stores and hotels - it is

expected, though, that such target communities will be lacking the necessary equipment and the daily practice of biowaste separation.

Information about the motives and the barriers underlying the target community members' engagement with biowaste sorting as well as information about their current performance level is currently lacking. Similarly, information about the acceptance of bio-waste derived products, and its underlying determinants, by the target communities is also currently not available. Nevertheless, the Pilot partners' expert knowledge and experience in similar projects has helped to formulate a list of potential determinants that may hinder target communities' engagement with biowaste sorting behaviour. These determinants include: a) **lack of economic benefits**, b) **insufficient knowledge** about (bio-)waste management practices, c) the **difficulty experienced** in sorting biowaste, d) **absence of a single system providing information** about and promoting the recycling of organic materials, e) **missing behaviour change methodologies and designs tailored** to the needs of the local population, and f) **difficulties** faced by local municipalities **in ensuring procurement for biowaste separation equipment**, such as bins. Information about the target community's acceptance of bio-waste derived products is currently lacking.

Objectives for the behaviour change interventions have been proposed by the Pilot partners. **The objectives concern primarily the target community group of local households, followed by the bakery store community members.** These two target communities have been selected as the most feasible to approach and invite to participate (the remaining target communities will remain out of the current scope due to the COVID-19 consequences on their operations). The proposed behavioural objectives include: a) achieving a biowaste separation rate of 100%, b) increasing citizens' acceptance of bio-waste derived products and circular economy products in general, c) improving citizens' overall waste management practices (e.g. their perception of waste, their overall recycling performance, etc.), d) prompting municipalities to increase their recycling schemes and operations, e) prompting municipalities to increase the provision of composting bins for household use and for use in public spaces, f) prompting municipalities to consider proper biowaste transfer vehicles.

4.2.4 Evaluation of target communities: assessment of readiness for behavioural change, effectiveness and efficiency of responding to change mechanics

Information about the target communities' stage of readiness for behaviour change has been provided by the Pilot partners. Partner responses to the readiness stage question were given with the use of 4 possible options, including: a) problem (i.e. biowaste sorting) resolved in the past 6 months, b) action to address the problem already taken in the past 6 months, c) action to address the problem intended to be taken in the coming 1 month, d) action to address the problem intended to be taken in the coming 6 months. Partner responses are given based on the best of their knowledge regarding the target communities' behavioural patterns.

Out of the identified target communities for Pilot 5, three of them (households, schools, and bakery stores) are reported to have taken action to address the problem in the past 6 months. Taking into account the involvement of the open market farmers in the operations of NTUA, the open market farmer community can also be reported as having been exposed in actions taken to address the problem in the past 6 months. None of the communities is perceived as intending to take action in the coming 1 month, due to the COVID-19 restriction measures.

Any action to be taken in the upcoming 6 months seems to be largely influenced by the consequences, at the individual and collective level, of the COVID-19 restriction measures. For

example, the target communities of hotels, restaurants and schools may express interest in behavioural change in the upcoming 6 months (focusing mainly towards the end of that period). Their willingness and readiness to change, however, are expected to be heavily influenced by the shifts of their activity focus towards combating the consequences of the COVID-19 crisis. For example, it is deemed unlikely that the hotel community will be available to participate in the behavioural change intervention due to the severe financial damage incurred by the restriction measures. A similar consideration about the target communities' readiness to change can also be reported for the farmer target community. The school community may be ready to take action at the start of the next academic year. The household and bakery communities may be more ready, compared to the other communities, to change as a large part of their daily activities -related to bio-waste production- has remained unaffected by the restriction measures. Nevertheless, and as with all target communities, their readiness for behavioural change may be affected by any social consequences incurred by the restriction measures.

Information about the potential effectiveness of the behaviour change intervention for each of the target communities was also provided by the Pilot partners. Defining the criterion of problem severity as a combination of high unsorted bio-waste amount and low consumption of bio-waste derived products, and taking into account the maximum number of community members that can be reached per target community, it appears that the hotel and household communities would yield the highest effectiveness scores (i.e. the communities with the largest 'market' size relative to potential effectiveness). These two communities are followed, in their potential effectiveness, by the school, restaurant, bakery store and farmer communities. However, and as will be in detail presented below, the potential effectiveness scores cannot alone guide the selection of the target communities. Rather, the latter needs to take the target communities' efficiency potential into account as well.

Finally, the efficiency potential of the target communities is estimated by taking into account the following criteria: organizational capabilities (i.e. partner experience & expertise in assisting the intervention study for the community, e.g. frequent communication capacity), incremental costs (i.e. costs for implementing circular economy practices, incl. waste sorting & consumption), reachability (i.e. easiness of identifying & reaching the community, e.g. via communication channel availability), general responsiveness (community willingness to meet the behavioural objective, e.g. environmentally concerned), responsiveness to behavioural (sorting and consumption) influences (e.g. others' behaviour, economic incentives). For each of the target communities, their potential efficiency is described as follows:

- household community: low efficiency due to low scores on 4 out of 5 criteria
- school community: high efficiency due to high scores on all 5 criteria
- hotel community: moderate efficiency due to high scores on 3 out of 5 criteria
- farmer community: low efficiency due to low scores on all 5 criteria
- restaurant community: low efficiency due to low scores on all 5 criteria
- bakery store community: low efficiency due to low scores on 4 out of 5 criteria

Taking into consideration both the effectiveness and efficiency scores for each target community, the hotel community would be the priority target community. However, due to the negative consequences of the COVID-19 crisis on hotel operations and reachability, this target community needs to be excluded. The target communities to target next are the school and household communities. In a similar vein, due to the COVID-19 crisis, the school community may be approached only at the beginning of the next academic year, whereas the household community can be gradually approached upon the lifting of the COVID-19 restriction measures. Finally, and

despite its relatively low effectiveness and efficiency scores, the bakery store community is selected as a target community to be approached soon. The rationale behind this choice lies in the fact that bakery stores continue their operations during the restriction period and they are expected to return to full operation mode faster than other businesses, such as restaurants. Moreover, the bakery store community provides a particular biowaste material (starch) needed for the technical operation part of Pilot 5. Last, the Sustainable City network can support the approach of this target community.

4.3 Pilot 6: Barcelona

4.3.1 General pilot description

Pilot 6 will be located at the premises of IMECAL in L'Alcudia (Valencia, Spain). This pilot focuses on the production of bio-ethanol from cellulosic rejection streams from waste and wastewater treatment plants from the Barcelona Metropolitan Area.

The development and implementation of a behaviour change intervention will be organized with the involvement of local stakeholders, led by AMB (Area Metropolitana de Barcelona), with relevant links to local user communities.

4.3.2 Community targeting: identification of candidate target communities

As target communities, the Pilot partners had first identified the following: a) **local citizens** in two neighbourhoods of the Barcelona Metropolitan Area, namely Tiana and Bon Pastor, b) the cellulose waste water treatment plant of **Besòs**, c) **ECOPARC**, located in Montcada, a municipal mechanical and biological treatment plant for rejected paper. However, the sanitary measures following the COVID-19 pandemic have forbidden collection of diapers from nurseries and elderly homes in Barcelona, therefore impeding the foreseen waste stream for Pilot 6. Following this change in the waste stream, the target audience for the behaviour change track had to be modified, as nurseries and elderly homes can no longer be involved. AMB had foreseen to involve the citizens of Barcelona as a mitigation track. However, in a near future, a new biowaste collection scheme and an associated awareness raising campaign targeting citizens are planned to be implemented by the Barcelona City Council. While AMB is the public administration of Barcelona and holds authority regarding waste management (waste treatment), it is the City Council which is responsible for the waste collection and the related awareness raising campaign. Therefore, it was decided to modify the target communities to seek synergies with the City Council, rather than implementing a parallel intervention. Therefore, the target community of Pilot 6 will be the citizens and businesses of the Sant Just Desvern municipality, where the new biowaste collection scheme will be implemented by the Barcelona City Council. The target numbers are as follow:

- Approx. 250 stakeholders from ARC
- Approx. 8k households of the Sant Just Desvern municipality
- Approx. 400 businesses of the Sant Just Desvern municipality
- Approx. 5k associations

4.3.3 Behavioural insights: description of community behavioural profiles and preliminary selection of behavioural objectives

The target communities' behavioural profile in terms of their current waste management practices can be described as follows. Citizens in local neighbourhoods are **already engaging in bio-waste sorting**, the collection of which takes place either via street containers. The abovementioned system has been in operation for more than 12 years. It promoted the participation and positive results of gross separate collection and at the same time it is a well-accepted system by the population (good perception). Although Sant Just Desvern municipality percentage of separate collection is slightly above 50%, being one of the highest in the metropolitan area municipalities with a 5-fraction street container model for waste disposal, it is not enough in order to comply with the new regulations. The requirements of the new European regulations determine that it will be necessary to reach recycling targets of 50% by 2020 and 65% by 2035.

To further motivate the target community of local citizens in bio-waste sorting, an individualized waste collection model in order to arrive at a system of 'pay by waste generation' model. Increasing the waste sorted by the local citizens is estimated to result into decreased tradesmen costs for the municipality and, subsequently, decreased taxation for the local citizens. The option of designing and implementing a behaviour change intervention in the context of implementing the individualized waste collection scheme is under consideration.

Information about the target community's acceptance of bio-waste derived products is currently missing. Finally, preliminary objectives for the behavioural change intervention will be set with the Pilot partner during the behaviour change design development.

4.3.4 Evaluation of target communities: assessment of readiness for behavioural change, effectiveness and efficiency of responding to change mechanics

Information about the readiness stage of each target community for behavioural change as well as about the expected effectiveness and efficiency of their response to the behaviour change mechanics will be provided by the Pilot partner in the course of the behaviour change design development.

Conclusion

The objective of this deliverable was to **define the scope of the behavioural change intervention** aiming to improve citizen's and communities' participation in sorting biowaste as well as improving their acceptance of bio-based products. In doing so, the behavioural change study will contribute to a sustainable economic system whereby the aim is to reduce the consumption footprint and increase the circular material use rate.

After having briefly described in Chapter 1 the MBAA model on which WP4 will be based, in Chapter 2 we detail the two separate literature reviews that allowed to highlighted the main determinants (barriers and drivers) of the waste sorting behaviour and of the acceptance of bio-based products. Furthermore, a comparison to the determinants of the broader behaviours of waste sorting and on the acceptance of sustainable products has revealed overlaps and gaps in the investigation of the biowaste specific behaviours. After having described several related finished and ongoing projects for which possible synergies can be found, the chapter end by presenting a first **behaviour change framework** for both behaviours.

Finally, the last chapter of this deliverable focuses on the identification of target audiences for each pilot (1, 5 and 6) through a close collaboration with the partners via the following process: (1) identify the target audiences (or "target communities"); (2) gain insights into the target communities (behavioural) profiles and define the desired behavioural objectives; (3) evaluate the target communities in terms of their expected reaction to the behavioural change intervention. The takeaways of this chapter reside in the **diversity of target audiences** identified by the partners: hotels, bakeries, food market, citizens, fishermen cooperatives, etc. Although the communication channels still needs to be identified with most of the target audiences, **citizens' in the different pilots have been involved in some kind of waste sorting**. Pilot partners however, all underline that their participation could be improved. **Information regarding** target audience's **acceptance** of bio-based product **is missing** in all three pilots.

The content of this deliverable will inform the design of the behaviour change intervention that will be reported in D4.2 "Toolkit: Interventions for change".

References

Abrahamse, W., & Steg, L. (2011). Factors Related to Household Energy Use and Intention to Reduce It: The Role of Psychological and Socio-Demographic Variables. *Human Ecology Review*, *18*(1), 30–40. Scopus.

Aerni, P., Scholderer, J., & Ermen, D. (2011). How would Swiss consumers decide if they had freedom of choice? Evidence from a field study with organic, conventional and GM corn bread. *Food Policy*, *36*(6), 830–838. https://doi.org/10.1016/j.foodpol.2011.08.002

Ajzen, I. (1991a). The theory of planned behavior. *Organizational Behavior and Human Decision Processes, 50*(2), 179–211.

Ajzen, I. (1991b). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, *50*(2), 179–211. https://doi.org/10.1016/0749-5978(91)90020-T

Aprile, M. C., & Fiorillo, D. (2019). Intrinsic incentives in household waste recycling: The case of Italy in the year 1998. *Journal of Cleaner Production*, *227*, 98–110. https://doi.org/10.1016/j.jclepro.2019.04.184

Ashton, A. S., Scott, N., Solnet, D., & Breakey, N. (2010). Hotel Restaurant Dining: The Relationship between Perceived Value and Intention to Purchase. *Tourism and Hospitality Research*, *10*(3), 206–218. https://doi.org/10.1057/thr.2010.5

Basri, N. E. A., Abd Ghani, S. F., Zain, S. M., & Ghee, T. K. (2017). Waste Generation and Students' Perception on Waste Separation Program at Cafeterias Ukm Bangi Campus. *Journal of Engineering Science and Technology*, *12*, 80–90.

Bees, A. D., & Williams, I. D. (2017). Explaining the differences in household food waste collection and treatment provisions between local authorities in England and Wales. *Waste Management*, *70*, 222–235. https://doi.org/10.1016/j.wasman.2017.09.004

Benis, K. Z., Safaiyan, A., Farajzadeh, D., Nadji, F. K., Shakerkhatibi, M., Harati, H., Safari, G. H., & Sarbazan, M. H. (2019). Municipal solid waste characterization and household waste behaviors in a megacity in the northwest of Iran. *International Journal of Environmental Science and Technology*, *16*(8), 4863–4872. https://doi.org/10.1007/s13762-018-1902-9

Bernad-Beltran, D., Simo, A., & Bovea, M. D. (2014). Attitude towards the incorporation of the selective collection of biowaste in a municipal solid waste management system. A case study. *Waste Management*, *34*(12), 2434–2444. https://doi.org/10.1016/j.wasman.2014.08.023

Bernstad, A., Jansen, J. la C., & Aspegren, A. (2013). Door-stepping as a strategy for improved food waste recycling behaviour Evaluation of a full-scale experiment. *Resources Conservation and Recycling*, *73*, 94–103. https://doi.org/10.1016/j.resconrec.2012.12.012

BIPRO, Copenhagen Resource Institute (CRI), Directorate-General for Environment (European Commission), Weißenbacher, J., Dollhofer, M., Herczeg, M., Bakas, I., McKinnon, D., & Seyring, N. (2015). *Assessment of separate collection schemes in the 28 capitals of the EU: Final report*. Publications Office of the European Union. https://data.europa.eu/doi/10.2779/49194

Bishop, S. R., Lau, M., Shapiro, S., Carlson, L., Anderson, N. D., Carmody, J., Segal, Z. V., Abbey, S., Speca, M., Velting, D., & Devins, G. (2004). Mindfulness: A Proposed Operational Definition. *Clinical Psychology: Science and Practice*, *11*(3), 230–241. https://doi.org/10.1093/clipsy.bph077

Blomsma, F., & Brennan, G. (2017). The Emergence of Circular Economy: A New Framing Around Prolonging Resource Productivity. *Journal of Industrial Ecology*, *21*(3), 603–614. https://doi.org/10.1111/jiec.12603

Browne, D., O'Mahony, M., & Caulfield, B. (2012). How should barriers to alternative fuels and vehicles be classified and potential policies to promote innovative technologies be evaluated? *Journal of Cleaner Production*, *35*, 140–151. https://doi.org/10.1016/j.jclepro.2012.05.019

Bruvoll, A., Halvorsen, B., & Nyborg, K. (2002). Households' recycling efforts. *Resources, Conservation and Recycling*, *36*(4), 337–354. https://doi.org/10.1016/S0921-3449(02)00055-1

Carus, M., Eder, A., & Beckmann, J. (2014). GreenPremium Prices Along the Value Chain of Biobased Products. *Industrial Biotechnology*, *10*(2), 83–88. https://doi.org/10.1089/ind.2014.1512

Chen, H., Yang, Y., Jiang, W., Song, M., Wang, Y., & Xiang, T. (2017). Source separation of municipal solid waste: The effects of different separation methods and citizens' inclination-case study of Changsha, China. *Journal of the Air & Waste Management Association*, *67*(2), 182–195. https://doi.org/10.1080/10962247.2016.1222317

Chen, Y. (2013). Towards green loyalty: Driving from green perceived value, green satisfaction, and green trust. *Sustainable Development*, *21*(5), 294–308. https://doi.org/10.1002/sd.500

Confente, I., Scarpi, D., & Russo, I. (2019). Marketing a new generation of bio-plastics products for a circular economy: The role of green self-identity, self-congruity, and perceived value. *Journal of Business Research*. Scopus. https://doi.org/10.1016/j.jbusres.2019.10.030

Dai, Y. C., Lin, Z. Y., Li, C. J., Xu, D. Y., Huang, W. F., & Harder, M. K. (2016). Information strategy failure: Personal interaction success, in urban residential food waste segregation. *Journal of Cleaner Production*, *134*, 298–309. https://doi.org/10.1016/j.jclepro.2015.12.104

Delshad, A., & Raymond, L. (2013). Media Framing and Public Attitudes Toward Biofuels. *Review of Policy Research*, *30*(2), 190–210. ProQuest Central. https://doi.org/10.1111/ropr.12009

Dhokhikah, Y., Trihadiningrum, Y., & Sunaryo, S. (2015). Community participation in household solid waste reduction in Surabaya, Indonesia. *Resources Conservation and Recycling*, *102*, 153–162. https://doi.org/10.1016/j.resconrec.2015.06.013

Ekere, W., Mugisha, J., & Drake, L. (2009). Factors influencing waste separation and utilization among households in the Lake Victoria crescent, Uganda. *Waste Management*, *29*(12), 3047–3051. https://doi.org/10.1016/j.wasman.2009.08.001

Elimelech, E., Ert, E., & Ayalon, O. (2019). Exploring the Drivers behind Self-Reported and Measured Food Wastage. *Sustainability*, *11*(20), 5677. https://doi.org/10.3390/su11205677

Ellen MacArthur Foundation. (2013). *Towards The Circular Economy: Opportunities for the consumer goods sector*.

European Commission. (2012a). *Review of the 2012 European Bioeconomy Strategy.* Luxemburg: Publications Office of the European Union.

European Commission. (2012b). Innovating for Sustainable Growth: A Bioeconomy for Europe. *Publications Office of the European Union, Luxembourg*, *8*(2), 57–61. https://doi.org/10.1089/ind.2012.1508

European Commission. (2015). *Closing the loop—An EU action plan for the Circular Economy (COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS).*

European Environment Agency. (2020). *Bio-waste in Europe: Turning challenges into opportunities.* Publications Office. https://data.europa.eu/doi/10.2800/630938

European Parliament. (2008). *DIRECTIVE 2008/98/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 19 November 2008 on waste and repealing certain Directives.* Council of the European Union. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=OJ:L:2008:312:TOC

European Union. (2008). *Green Paper on the Management of Biowaste in the European Union.* Directorate-General for the Environment.

Ezzat, A. M. (2016). Sustainable Development of Seaport Cities through Circular Economy: A Comparative Study with Implications to Suez Canal Corridor Project. *European Journal of Sustainable Development*, *5*(4), 509–509. https://doi.org/10.14207/ejsd.2016.v5n4p509

Fiorillo, D. (2013). Household waste recycling: National survey evidence from Italy. *JOURNAL OF ENVIRONMENTAL PLANNING AND MANAGEMENT*, *56*(8), 1125–1151. https://doi.org/10.1080/09640568.2012.709180

Fransson, N., & Gärling, T. (1999). Environmental Concern: Conceptual Definitions, Measurement Methods, and Research Findings. *Journal of Environmental Psychology*, *19*, 369–382. https://doi.org/10.1006/jevp.1999.0141

Garces, G. A., Bonjour, E., & Rakotondranaivo, A. (2016). New product acceptability evaluation and improvement model with knowledge reuse. *IFAC-PapersOnLine*, *49*(12), 1104–1109.

Geiger, J. L., Steg, L., van der Werff, E., Ünal, A. B., & Environmental Psychology. (2019). A meta-analysis of factors related to recycling. *VOLUME=64;STARTPAGE=78;ENDPAGE=97;ISSN=0272-4944;TITLE=Journal of Environmental Psychology.* NARCIS. https://www.rug.nl/research/portal/en/publications/a-metaanalysis-of-factors-related-to-recycling(5742039d-7900-4275-ab61-79a736fe859c).html

Geissdoerfer, M., Savaget, P., Bocken, N. M. P., & Hultink, E. J. (2017). The Circular Economy – A new sustainability paradigm? *Journal of Cleaner Production*, *143*, 757–768. https://doi.org/10.1016/j.jclepro.2016.12.048

Ghani, W. A. W. A. K., Rusli, I. F., Biak, D. R. A., & Idris, A. (2013). An application of the theory of planned behaviour to study the influencing factors of participation in source separation of food waste. *Waste Management*, *33*(5), 1276–1281. https://doi.org/10.1016/j.wasman.2012.09.019

Ghose, A., & Chandra, B. (2020). Models for Predicting Sustainable Durable Products Consumption Behaviour: A Review Article. *Vision*, *24*(1), 81–89. https://doi.org/10.1177/0972262919860962

Gonçalves, H. M., Lourenço, T. F., & Silva, G. M. (2016). Green buying behavior and the theory of consumption values: A fuzzy-set approach. *Set-Theoretic Research in Business*, *69*(4), 1484–1491. https://doi.org/10.1016/j.jbusres.2015.10.129

Grimmer, M., & Bingham, T. (2013). Company environmental performance and consumer purchase intentions. *Journal of Business Research*, *66*(10), 1945–1953. https://doi.org/10.1016/j.jbusres.2013.02.017

Halder, P., Pietarinen, J., Havu-Nuutinen, S., Pöllänen, S., & Pelkonen, P. (2016). The Theory of Planned Behavior model and students' intentions to use bioenergy: A cross-cultural perspective. *Renewable Energy*, *89*, 627–635. https://doi.org/10.1016/j.renene.2015.12.023

Hao, H.-T. N., Karthikeyan, O. P., & Heimann, K. (2015). Bio-Refining of Carbohydrate-Rich Food Waste for Biofuels. *Energies*, *8*(7), 6350–6364. https://doi.org/10.3390/en8076350

Hartmann, P., & Apaolaza-Ibáñez, V. (2012). Consumer attitude and purchase intention toward green energy brands: The roles of psychological benefits and environmental concern. *Journal of Business Research*, *65*(9), 1254–1263. https://doi.org/10.1016/j.jbusres.2011.11.001

Haws, K. L., Winterich, K. P., & Naylor, R. W. (2014). Seeing the world through GREEN-tinted glasses: Green consumption values and responses to environmentally friendly products. *Journal of Consumer Psychology*, *24*(3), 336–354. https://doi.org/10.1016/j.jcps.2013.11.002

Herbes, C., Beuthner, C., & Ramme, I. (2018). Consumer attitudes towards biobased packaging – A cross-cultural comparative study. *Journal of Cleaner Production*, *194*, 203–218. Scopus. https://doi.org/10.1016/j.jclepro.2018.05.106

Hobson, K., & Lynch, N. (2016). Diversifying and de-growing the circular economy: Radical social transformation in a resource-scarce world. *Futures*, *82*, 15–25. https://doi.org/10.1016/j.futures.2016.05.012

Holbrook, M. (1999). *Consumer value: A framework for analysis and research*. London : Routledge and Kegan Paul,.

Homrich, A. S., Galvão, G., Abadia, L. G., & Carvalho, M. M. (2018). The circular economy umbrella: Trends and gaps on integrating pathways. *Journal of Cleaner Production*, *175*, 525–543. https://doi.org/10.1016/j.jclepro.2017.11.064

Huang, Y. Y., Tamas, P. A., & Harder, M. K. (2018). Information with a smile—Does it increase recycling? *Journal of Cleaner Production*, *178*, 947–953. https://doi.org/10.1016/j.jclepro.2018.01.006

Jerzyk, E. (2016). Design and Communication of Ecological Content on Sustainable Packaging in Young Consumers' Opinions. *Journal of Food Products Marketing*, *22*(6), 707–716. https://doi.org/10.1080/10454446.2015.1121435

Kainz, U. W. (2016). *Consumers' Willingness to Pay for Durable Biobased Plastic Products: Findings from an Experimental Auction*. 143.

Kalsher, M. J., Rodocker, A. J., Racicot, B. M., & Wogalter, M. S. (1993). *Promoting recycling behavior in office environments*. *1*, 484–488. Scopus.

Kilbourne, W., & Pickett, G. (2008). How materialism affects environmental beliefs, concern, and environmentally responsible behavior. *Journal of Business Research*, *61*(9), 885–893. https://doi.org/10.1016/j.jbusres.2007.09.016

Kirchherr, J., Reike, D., & Hekkert, M. (2017). Conceptualizing the circular economy: An analysis of 114 definitions. *Resources, Conservation and Recycling*, *127*, 221–232. https://doi.org/10.1016/j.resconrec.2017.09.005

Klein, F., Emberger-Klein, A., Menrad, K., Möhring, W., & Blesin, J.-M. (2019). Influencing factors for the purchase intention of consumers choosing bioplastic products in Germany. *Sustainable Production and Consumption*, *19*, 33–43. https://doi.org/10.1016/j.spc.2019.01.004

Knickmeyer, D. (2020). Social factors influencing household waste separation: A literature review on good practices to improve the recycling performance of urban areas. *Journal of Cleaner Production*, *245*, 118605. https://doi.org/10.1016/j.jclepro.2019.118605

Koutsimanis, G., Getter, K., Behe, B., Harte, J., & Almenar, E. (2012). Influences of packaging attributes on consumer purchase decisions for fresh produce. *Appetite*, *59*(2), 270–280. https://doi.org/10.1016/j.appet.2012.05.012

Kurka, S., & Menrad, K. (2009). Biorefineries And Biobased Products From The Consumer'S Point Of View. *University of Weihenstephan-Triesdorf, Straubing Centre of Science, Conference Papers*.

Lacy, P., & Rutqvist, J. (2015). *Waste to Wealth: The Circular Economy Advantage*. Palgrave Macmillan. https://books.google.be/books?hl=en&lr=&id=DmKkCgAAQBAJ&oi=fnd&pg=PP1&dq =Waste+to+Wealth:+The+Circular+Economy+Advantage&ots=7WSGuD-V75&sig=ncPEsZ7AGPdpm6ER5WLt5v7crkY&redir_esc=y#v=onepage&q=Waste%20to% 20Wealth%3A%20The%20Circular%20Economy%20Advantage&f=false

Lanzini, P., Testa, F., & Iraldo, F. (2016). Factors affecting drivers' willingness to pay for biofuels: The case of Italy. *Journal of Cleaner Production*, *112*, 2684–2692. https://doi.org/10.1016/j.jclepro.2015.10.080

Lee, M., Choi, H., & Koo, Y. (2017). Inconvenience cost of waste disposal behavior in South Korea. *Ecological Economics*, *140*, 58–65. https://doi.org/10.1016/j.ecolecon.2017.04.031

Lee, N. R., & Kotler, P. (2015). *Social Marketing: Changing Behaviors for Good*. SAGE Publications.

Lehmann, L. V. (2015). The Garbage Project Revisited: From a 20th Century Archaeology of Food Waste to a Contemporary Study of Food Packaging Waste. *SUSTAINABILITY*, *7*(6), 6994–7010. https://doi.org/10.3390/su7066994

Liao, C., Zhao, D., & Zhang, S. (2018). Psychological and conditional factors influencing staff's takeaway waste separation intention: An application of the extended theory of planned behavior. *Sustainable Cities and Society*, *41*, 186–194. https://doi.org/10.1016/j.scs.2018.05.046

Liu, Q., Li, H., Zuo, X., Zhang, F., & Wang, L. (2009). A survey and analysis on public awareness and performance for promoting circular economy in China: A case study from Tianjin. *Journal of Cleaner Production*, *17*(2), 265–270. https://doi.org/10.1016/j.jclepro.2008.06.003

Liu, Y., & Huang, J. (2014). Rural domestic waste disposal: An empirical analysis in five provinces of China. *CHINA AGRICULTURAL ECONOMIC REVIEW*, *6*(4), 558–573. https://doi.org/10.1108/CAER-05-2013-0076

Loan, L. T. T., Nomura, H., Takahashi, Y., & Yabe, M. (2017). Psychological driving forces behind households' behaviors toward municipal organic waste separation at source in Vietnam: A structural equation modeling approach. *Journal of Material Cycles and Waste Management*, *19*(3), 1052–1060. https://doi.org/10.1007/s10163-017-0587-3

Mamadzhanov, A., McCluskey, J. J., & Li, T. (2019). Willingness to pay for a second-generation bioethanol: A case study of Korea. *Energy Policy*, *127*, 464–474. Scopus. https://doi.org/10.1016/j.enpol.2018.12.001

Mariasiu, F. (2013). Consumers' Attitudes Related to Biofuel Use in Transportation. *International Review of Management and Marketing*, *3*(1), 1. ProQuest Central.

Merli, R., Preziosi, M., & Acampora, A. (2018). How do scholars approach the circular economy? A systematic literature review. *Journal of Cleaner Production*, *178*, 703–722. https://doi.org/10.1016/j.jclepro.2017.12.112

Metcalfe, A., Riley, M., Barr, S., Tudor, T., Robinson, G., & Guilbert, S. (2012). Food waste bins: Bridging infrastructures and practices. *Sociological Review*, *60*, 135–155. https://doi.org/10.1111/1467-954X.12042

Miafodzyeva, S., & Brandt, N. (2013). Recycling Behaviour Among Householders: Synthesizing Determinants Via a Meta-analysis. *Waste and Biomass Valorization*, *4*(2), 221–235. https://doi.org/10.1007/s12649-012-9144-4

Murray, A., Skene, K., & Haynes, K. (2017). The Circular Economy: An Interdisciplinary Exploration of the Concept and Application in a Global Context. *Journal of Business Ethics*, *140*(3), 369–380. https://doi.org/10.1007/s10551-015-2693-2

Oliver, J., & Rosen, D. (2010). Applying the environmental propensity framework: A segmented approach to hybrid electric vehicle marketing strategies. *Journal of Marketing Theory and Practice*, *18*(4), 377–393. Scopus. https://doi.org/10.2753/MTP1069-6679180405

Payne, A., & Holt, S. (2001). Diagnosing Customer Value: Integrating the Value Process and Relationship Marketing. *British Journal of Management*, *12*(2), 159–182. https://doi.org/10.1111/1467-8551.00192

Pearson, D., & Perera, A. (2018). Reducing Food Waste: A Practitioner Guide Identifying Requirements for an Integrated Social Marketing Communication Campaign. *Social Marketing Quarterly*, *24*(1), 45–57. https://doi.org/10.1177/1524500417750830

Pedersen, J. T. S., & Manhice, H. (2020). The hidden dynamics of household waste separation: An anthropological analysis of user commitment, barriers, and the gaps between a waste system and its users. *Journal of Cleaner Production*, *242*, UNSP 116285. https://doi.org/10.1016/j.jclepro.2019.03.281

Phillips, P. W. B., & Corkindale, D. (2002). Marketing GM foods: The way forward. *AgBioForum*, *5*(3), 113–121.

Potting, J., Hekkert, M. P., Worrell, E., & Hanemaaijer, A. (2017, January). *Circular Economy: Measuring Innovation in the Product Chain* [Book]. Planbureau Voor de Leefomgeving; PBL Publishers. http://localhost/handle/1874/358310

Prochaska, J. O., DiClemente, C. C., Velicer, W. F., Ginpil, S., & Norcross, J. C. (1985). Predicting change in smoking status for self-changers. *Addictive Behaviors*, *10*(4), 395–406.

Purvis, B., Mao, Y., & Robinson, D. (2019). Three pillars of sustainability: In search of conceptual origins. *Sustainability Science*, *14*(3), 681–695. https://doi.org/10.1007/s11625-018-0627-5

Qu, M., Lin, Y., & Halder, P. (2019). Analysis of Chinese pupils' intents in using bioenergy through the application of structural equation modeling approach. *Journal of Cleaner Production*, *231*, 386–394. Scopus. https://doi.org/10.1016/j.jclepro.2019.05.242

Radics, R. I., Dasmohapatra, S., & Kelley, S. S. (2016). Public perception of bioenergy in North Carolina and Tennessee. *Energy, Sustainability and Society*, *6*(1). Scopus. https://doi.org/10.1186/s13705-016-0081-0

Refsgaard, K., & Magnussen, K. (2009). Household behaviour and attitudes with respect to recycling food waste—Experiences from focus groups. *JOURNAL OF ENVIRONMENTAL MANAGEMENT*, *90*(2), 760–771. https://doi.org/10.1016/j.jenvman.2008.01.018

Reid, L., Sutton, P., & Hunter, C. (2010). Theorizing the meso level: The household as a crucible of pro-environmental behaviour. *Progress in Human Geography*, *34*(3), 309–327. https://doi.org/10.1177/0309132509346994

Reid, M., Sparks, P., & Jessop, D. C. (2018a). The effect of self-identity alongside perceived importance within the theory of planned behaviour. *European Journal of Social Psychology*, *48*(6), 883–889. https://doi.org/10.1002/ejsp.2373

Reid, M., Sparks, P., & Jessop, D. C. (2018b). The effect of self-identity alongside perceived importance within the theory of planned behaviour. *European Journal of Social Psychology*, *48*(6), 883–889. https://doi.org/10.1002/ejsp.2373

Reinders, M. J., Onwezen, M. C., & Meeusen, M. J. G. (2017). Can bio-based attributes upgrade a brand? How partial and full use of bio-based materials affects the purchase intention of brands. *Journal of Cleaner Production*, *162*, 1169–1179. https://doi.org/10.1016/j.jclepro.2017.06.126

Roberts, J. A. (1996). Green consumers in the 1990s: Profile and implications for advertising. *Journal of Business Research*, *36*(3), 217–231. https://doi.org/10.1016/0148-2963(95)00150-6

Russo, I., Confente, I., Scarpi, D., & Hazen, B. T. (2019). From trash to treasure: The impact of consumer perception of bio-waste products in closed-loop supply chains. *Journal of Cleaner Production*, *218*, 966–974. Scopus. https://doi.org/10.1016/j.jclepro.2019.02.044

Sariatli, F. (2017). Linear Economy Versus Circular Economy: A Comparative and Analyzer Study for Optimization of Economy for Sustainability. *Visegrad Journal on Bioeconomy and Sustainable Development*, *6*(1), 31–34. https://doi.org/10.1515/vjbsd-2017-0005

Scaringelli, M. A., Giannoccaro, G., Prosperi, M., & Lopolito, A. (2017). Are farmers willing to pay for bio-plastic products? The case of mulching films from urban waste. *New Medit*, *16*(3), 56–63. Scopus.

Scherer, C., Emberger-Klein, A., & Menrad, K. (2017). Biogenic product alternatives for children: Consumer preferences for a set of sand toys made of bio-based plastic. *Sustainable Production and Consumption*, *10*, 1–14. https://doi.org/10.1016/j.spc.2016.11.001

Schultz, P. W. (2001). The structure of environmental concern: Concern for self, other people, and the biosphere. *Journal of Environmental Psychology*, *21*(4), 327–339. https://doi.org/10.1006/jevp.2001.0227

Schultz, P. W., Gouveia, V. V., Cameron, L. D., Tankha, G., Schmuck, P., & Franěk, M. (2005). Values and their Relationship to Environmental Concern and Conservation Behavior. *Journal of Cross-Cultural Psychology*, *36*(4), 457–475. https://doi.org/10.1177/0022022105275962

Sheth, J. N., Newman, B. I., & Gross, B. L. (1991). Why we buy what we buy: A theory of consumption values. *Journal of Business Research*, *22*(2), 159–170. https://doi.org/10.1016/0148-2963(91)90050-8

Sijtsema, S. J., Onwezen, M. C., Reinders, M. J., Dagevos, H., Partanen, A., & Meeusen, M. (2016). Consumer perception of bio-based products—An exploratory study in 5 European countries. *Social Science Perspectives on the Bio-Economy*, *77*, 61–69. https://doi.org/10.1016/j.njas.2016.03.007

Stern, P. C., Dietz, T., Abel, T., Guagnano, G. A., & Kalof, L. (1999). A Value-Belief-Norm Theory of Support for Social Movements: The Case of Environmentalism. *Human Ecology Review*, *6*(2), 81–97. JSTOR.

Stern, P. C., Dietz, T., & Kalof, L. (1993). Value Orientations, Gender, and Environmental Concern. *Environment and Behavior*, *25*(5), 322–348. https://doi.org/10.1177/0013916593255002

Stern, T., Ploll, U., Spies, R., Schwarzbauer, P., Hesser, F., & Ranacher, L. (2018). Understanding Perceptions of the Bioeconomy in Austria—An Explorative Case Study. *Sustainability*, *10*(11). https://doi.org/10.3390/su10114142

Straughan, R. D., & Roberts, J. A. (1999). Environmental segmentation alternatives: A look at green consumer behavior in the new millennium. *Journal of Consumer Marketing*, *16*(6), 558–575. https://doi.org/10.1108/07363769910297506

Tellis, G. J., Yin, E., & Bell, S. (2009). Global consumer innovativeness: Cross-country differences and demographic commonalities.(Report). *Journal of International Marketing*, *17*(2), 1. https://doi.org/10.1509/jimk.17.2.1

Thogersen, J. (2006). Norms for environmentally responsible behaviour: An extended taxonomy. *Journal of Environmental Psychology*, *26*(4), 247–261. https://doi.org/10.1016/j.jenvp.2006.09.004

Tran, V. C. M., Le, H. S., & Matsui, Y. (2019). Current status and behavior modeling on household solid-waste separation: A case study in Da Nang city, Vietnam. *Journal of Material Cycles and Waste Management*, *21*(6), 1462–1476. https://doi.org/10.1007/s10163-019-00899-1

Tripathi, A., & Singh, M. P. (2016). Determinants of sustainable/green consumption: A review. *International Journal of Environmental Technology and Management*, *19*(3–4), 316–358. https://doi.org/10.1504/IJETM.2016.082258

Tseng, S.-C., & Hung, S.-W. (2013). A framework identifying the gaps between customers' expectations and their perceptions in green products. *Journal of Cleaner Production*, *59*, 174–184. https://doi.org/10.1016/j.jclepro.2013.06.050

Van Dael, M., Lizin, S., Swinnen, G., & Van Passel, S. (2017). Young people's acceptance of bioenergy and the influence of attitude strength on information provision. *Renewable Energy*, *107*, 417–430. Scopus. https://doi.org/10.1016/j.renene.2017.02.010

Velde, L., Verbeke, W., Popp, M., Buysse, J., & Van Huylenbroeck, G. (2009). Perceived importance of fuel characteristics and its match with consumer beliefs about biofuels in Belgium. *Energy Policy*, 3183–3193. https://doi.org/10.1016/j.enpol.2009.04.022

Vliet, O. van, Vries, B. de, Faaij, A., Turkenburg, W., & Jager, W. (2010). Multi-agent simulation of adoption of alternative fuels. *Transportation Research Part D: Transport and Environment*, *15*(6), 326–342. https://doi.org/10.1016/j.trd.2010.03.006

Walter, F. J. (2011). Seeking consumers for industrial biotechnology. *Industrial Biotechnology*, *7*(3), 19–191. https://doi.org/10.1089/ind.2011.7.190

Winans, K., Kendall, A., & Deng, H. (2017). The history and current applications of the circular economy concept. *Renewable and Sustainable Energy Reviews*, *68*, 825–833. https://doi.org/10.1016/j.rser.2016.09.123

Xiao, J. X., & Siu, K. W. M. (2018). Challenges in food waste recycling in high-rise buildings and public design for sustainability: A case in Hong Kong. *RESOURCES CONSERVATION AND RECYCLING*, *131*, 172–180. https://doi.org/10.1016/j.resconrec.2018.01.007

Xu, L., Ling, M., Lu, Y., & Shen, M. (2017). Understanding Household Waste Separation Behaviour: Testing the Roles of Moral, Past Experience, and Perceived Policy Effectiveness within the Theory of Planned Behaviour. *Sustainability*, *9*(4), 625. https://doi.org/10.3390/su9040625

Zailani, S., Iranmanesh, M., Hyun, S. S., & Ali, M. H. (2019). Applying the theory of consumption values to explain drivers'willingness to pay for biofuels. *Sustainability (Switzerland)*, *11*(3). Scopus. https://doi.org/10.3390/su11030668

Zeng, C., Niu, D., Li, H., Zhou, T., & Zhao, Y. (2016). Public perceptions and economic values of source-separated collection of rural solid waste: A pilot study in China. *Resources Conservation and Recycling*, *107*, 166–173. https://doi.org/10.1016/j.resconrec.2015.12.010

Zhang, H., Liu, J., Wen, Z., & Chen, Y.-X. (2017). College students' municipal solid waste source separation behavior and its influential factors: A case study in Beijing, China. *Journal of Cleaner Production*, *164*, 444–454. https://doi.org/10.1016/j.jclepro.2017.06.224

Zhang, W., Che, Y., Yang, K., Ren, X., & Tai, J. (2012). Public opinion about the source separation of municipal solid waste in Shanghai, China. *Waste Management & Research*, *30*(12), 1261–1271. https://doi.org/10.1177/0734242X12462277

Appendixes

Appendix 1: First questionnaire to Pilot partners

Contact information

Please, complete the following contact information about your pilot:

Pilot number	
City / Country	
Pilot coordinator	
Main contact point(s) for WP 4 activities *This can be the same person as the pilot coordinator, or can be the community manager, communication specialists, etc.* *Please provide the name, and email address*	

Interview questions

Please, read carefully the questions presented below. Fill in your answers in the blank space provided. If you don't know the answer to a specific question, please indicate it as "I do not know".

For any queries about this interview, please contact: carina.veeckman@imec.be and olga.tsoumani@imec.be

1. **Provide a description of the target group(s) in your community which you plan to engage in the pilot study.**
   A target group is a group of people which you wish to involve in the behaviour change analysis of the project, for instance the hotel and catering industry in Valencia, schools in Athens, a neighbourhood association, a volunteering group, etc.

Target group 1:

Target group 2:

Target group X:

2. **What kind of profile information do you have available about the target community group(s)? Such information may include:**
- **socio-demographic information (age, gender, profession, income, etc.)**
- **If known: the environmental profile (e.g. openness to pro-environmental campaigns, environmental attitudes and behaviour)**
- **geographical spread**
- **Any other additional information**

3. **Has any psychological study been previously conducted about the general environmental attitudes and behaviours (not specific to bio-waste) of the target community group(s)? If yes, please provide the link to the report.**

4. **Which communication channels and tools are currently being used to communicate with the target community group(s)?**

Communication tool 1:

Communication tool 2:

Communication tool X:

5. **Has there already been any communication to inform your target community group(s) about the waysTUP! Project (e.g. newsletter, Facebook posts, local meetings, etc.)?**

6. Which are the ways in which the target community group(s) is/are currently engaged with the separation of biowaste material. Examples may include practices and means used for separating biowaste (e.g. recycling, composting, use of public bins, etc.) that are relevant for the pilot study.

7. What are the main motives that lead the members of the target community group(s) to engage in biowaste separation? Examples may include pro-environmental attitudes, economic incentives, etc.

8. How would you assess the performance of the target community group(s) in terms of biowaste separation? Your assessment may be based on measures, such as the amount of biowaste sorted and collected, etc.

9. What are the main obstacles or barriers due to which engagement with biowaste separation has not reached its full potential in the target community group(s)? Examples may include lack of means (e.g. no public bins nearby), lack of information, etc.

10. What is the current level of acceptance, by the members of the target community group(s), of biowaste derived products? Acceptance may be reported as attitudes and/or purchase behavior.

11. What are the main factors affecting the level of acceptance, by the members of the target community group(s), of biowaste derived products?

12. Do you have former experience with activities aiming to engage local community members in biowaste separation and/or promote acceptance of biowaste derived products? If yes, which factors do you identify as most promising for each of these two aims?

Appendix 2: Second questionnaire to Pilot partners

Pilot & Partner Information

waysTUP! Pilot study number	
waysTUP! WP partner name	
waysTUP! WP partner contact	

Scope setting: identification of target communities

As part of defining the scope of the behaviour change analysis, each of the candidate target communities is evaluated in terms of its potential effectiveness and efficiency in participating in a behaviour change intervention, as well as its readiness stage for behaviour change.

With the present questionnaire, we kindly ask you to evaluate each candidate target community according to a predefined set of criteria measuring effectiveness and efficiency in participating in a behaviour change intervention. The set of criteria comprising the present questionnaire are selected based on their applicability to the behavioural objectives relevant to the WaysTUP! broader goals. Additionally, we ask you to categorize each candidate target community based on their readiness stage for behavioural change.

The outcomes of this evaluation, in combination with the responses of the community to the invitation for participating in the study, will be used to select the target communities that will receive the behaviour change intervention.

The questionnaire is organized in three Sections, to be found below. For any queries, please contact: carina.veeckman@imec.be or olga.tsoumani@imec.be

Section A: Synthesis of previous results

This section provides a synthesis of the previous results.

Please, review this synthesis by editing the already completed cells or by completing the currently empty ones.

	Minimum size of target community necessary for meeting requirements (own knowledge)	Maximum (potential) size of target communities that can be involved in the intervention study	Variability in the waste composition of the community (high/average/low)
Target community			

Section B: Readiness stage evaluation

This section aims at categorizing the candidate target communities in terms of their readiness for behavioural change.

Please, indicate the readiness change state in which you *think* that each target community is. You may fill in 'yes' under the column representing your response. Feel free to add any extra information you may consider relevant.

	They solved the (sorting) problem more than 6 months ago	They have taken action within the past 6 months	They intend to take action in the next month	They intend to take action in the next 6 months
Target community				

Section C: Effectiveness and efficiency evaluation

This section aims at evaluating the candidate target communities in terms of their effectiveness and efficiency in meeting the behavioural change objectives. Please, fill in your answer (open text) under each column.

	Problem severity (i.e. high amount of non-sorted biowaste & low consumption of circular products by community)	Organizational capabilities (i.e. partner experience & expertise in assisting the intervention study for the community, e.g. frequent communication capacity)	Incremental costs (i.e. costs for implementing circular economy practices, incl. waste sorting & consumption)
Target community			

	Reachability (i.e. easiness of identifying & reaching the community, e.g. via communication channel availability	General responsiveness (i.e. community willingness to meet the behavioural objective, e.g. environmentally concerned)	Responsiveness to behavioural (sorting & consumption) influences (e.g. others' behaviour, economic incentives
Target community			

Notes

In the space below, you may add any additional information you consider useful for supporting the selection of the target communities (e.g. missing evaluation criteria, complications due to current COVID-19 restricting conditions, etc.).