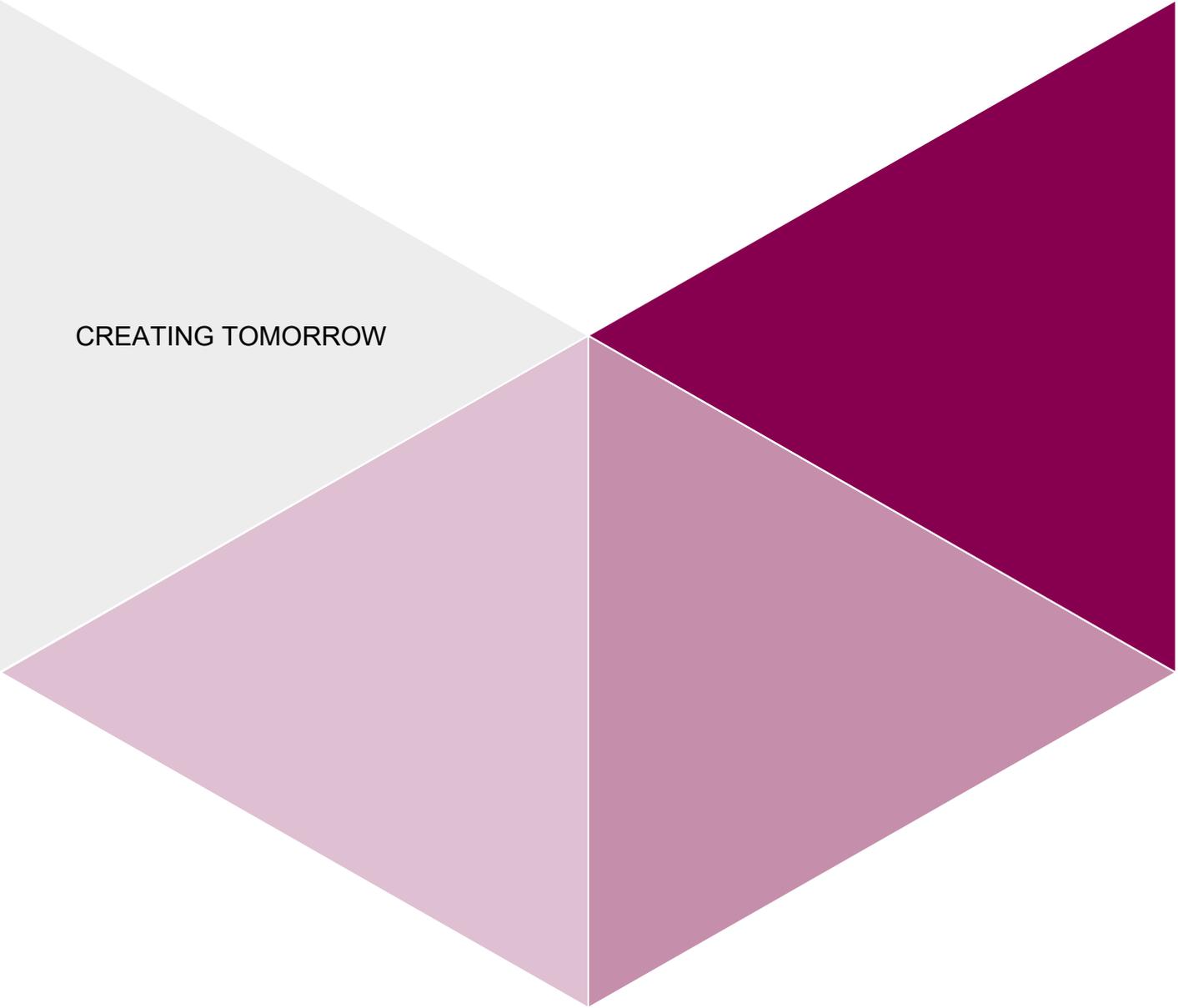


CIRCULAIR WOOD FOR THE NEIGHBOURHOOD – STAKEHOLDER ANALYSIS

**UNDERSTANDING WILLINGNESS TO RECYLCE WOOD IN THE DAPPERBUURT, AMSTERDAM**

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## 1. EXTENSIVE SUMMARY

Since 2016, the Amsterdam Dapperbuurt in the East of Amsterdam, has its own *Zero Waste Lab* (ZWL), a collection and recycle centre for separated household waste. Drawing on the specific case of wood as a waste-stream, the project *Circulair Wood for the Neighbourhood* supports the ZWL (initiative of the foundation *De Gezonde Stad*) realizing two of their ambitions: (A) to transition from recycling to up-cycling; (B) to transition from awareness raising to social engagement and shared ownership. The project is a partnership between the ZWL, the Amsterdam University of Applied Sciences (Research Group Psychology for Sustainable Cities & Research Group Digital Production) and *Verdraaid Goed* (a Rotterdam based company up-cycling devalued materials by research and design). The project *Circulair Wood for the Neighbourhood* contains three components/sub-projects, 1) research on the wood waste stream and possibilities for production; (2) research on design possibilities, and (3) research on stakeholder involvement. This is the final report of the sub-project *stakeholder involvement* led by the research group Psychology for Sustainable Cities. This sub-project specifically examined the psychology behind the decision making process of residents to hand in (or not) separated household wood waste to the ZWL in the neighbourhood of the Dapperbuurt and proposes possible interventions. The psychology behind the decision making process was analysed using the COM-B approach. Within this approach behaviour (B) is understood by analysing it along the triangle: capability (C), opportunity (O) and motivation (M). Based on the findings of the COM-B analysis the Behavioural Change Wheel concept (Michie, Atkins and West 2014) was applied to identify suitable interventions for change.

Through literature research and interviews with residents in the Dapperbuurt we analysed the psychological incentives for residents to start separating their wood waste and hand it in to the ZWL. We conducted this research at the same time with the intervention by the group Urban Technology. The latter studied the possibilities of waste wood in this neighbourhood as an upcycled product, potentially feeding back into the neighbourhood. We as well looked at the current intervention by the ZWL of providing wood-coins (local neighbourhood currency) to motivate residents to hand in their wood waste.

Based on the findings of our research we see that there are roughly two types of residents in the Dapperbuurt neighbourhood: the ZWL members who already recycle through the ZWL lab, and the non-members. The most significant difference between these two groups was their *motivation* to recycle: financial incentives seemed only important for the non-members. The ZWL members were not very motivated via financial stimuli, instead they were motivated through positive feedback which stimulates them with the reward of “feeling good” about their contribution to the environment. The two groups showed a difference in how they perceive the world. The members are aware of the environment and their own responsibility. The non-members showed less awareness of the impact of waste in general on the environment. Our finding is that if the non-members would be better informed, this could contribute to their motivation to recycle. Our research findings furthermore show that receiving up-cycled products made out of their wood waste was not enough to make them fully engaged in the practise of (wood) waste recycling. Residents wood waste recycling behaviour is influenced by a whole set of psychological factors informing us about the need for other additional interventions. An analysis based upon the COM-B model shows that residents in the Dapperbuurt are stimulated to hand in their waste wood at ZWL not only by motivation but also when the process would be less complicated for them and if the location would be closer to their houses, this would increase their *opportunity* to recycle wood waste. Furthermore if they would learn more about the why, how and when of recycling, if the ZWL would become more visible to them and more inviting, when prompts are used (to remind them to recycle, why and how), when more practical information about recycling in the neighbourhood would be provided, this will improve their *capability* to engage in recycling wood. Another very important finding was that residents didn’t have that much wood at all available to recycle. If they had wood quality was often of poor quality, thus hard to recycle or up-cycle this also negatively contributes to their capability to hand in wood waste .

To analyse which interventions could be used to improve motivation, opportunities and capabilities we use the Behavioural Change Wheel concept. When putting our COM-B analysis on the wood waste recycle behaviour of residents in the Dapperbuurt at the centre of the Behavioural Change Wheel, we arrived at an integrated set of interventions that potentially could stimulate successful recycle behaviour in this neighbourhood. The interventions are developed by students in Applied Psychology. The first four interventions are straightforward interventions, namely;

- 1) ZWL posters, flyers, stickers and bags” as promotion materials, to increase knowledge in the neighbourhood and change the social norm;
- 2) ZWL- Containers,” to provide collection points within walking distances to households;
- 3) ZWL Pick-Up Bicycle/Cargo-bike,” to simplify handing in larger pieces of wood;
- 4) ZWL- Products for the neighbourhood, to reward and motivate residents by showing them how their recycled wood can contribute to the neighbourhood;

The fifth intervention proposed integrates the first four:

5) the “ZERO-Waste-L-APP,” is an proposed app (and additional website) which enables to increase the social norm by connecting residents in the neighbourhood using an innovative digital reward system, as well ideas are collectively shared on how wood can be used/designed for the neighbourhood. Additionally in this app participating residents commit to recycling efforts in front of others, which is (a proven) psychological motivator for people.

Furthermore our research results showed that it might be beneficial to start working with the schools in the neighbourhood to increase knowledge (capability), visibility (opportunity) and to increase motivation of residents to recycle.

## 2. INTRODUCTION

The city of Amsterdam aims to almost triple its volume of waste recycling by 2020 (a percentage of 27% in 2017 to 65% by 2020). To achieve this ambition the municipality cooperates with local partners, one of them is the foundation *De Gezonde Stad* operating the *Zero Waste Lab* (ZWL). The mission of ZWL is to locally reuse its recycled waste as much as it possibly can (e.g., by reusing relatively good quality furniture from residents in a community centre). What is left, is collected by the municipality that distributes this waste to private companies who again process this waste at their own premises in the periphery of the city. Compared to the large volumes processed by these companies, the impact of the ZWL waste separating activities is still limited. The main aim in its first phase of existence is not processing this waste, instead, the main aim of the lab is to first increase awareness of citizens of the necessity of separating waste within the neighbourhood. The ZWL aims to motivate residents in the neighbourhood of the Dapperbuurt to start separating their waste and hand it in to ZWL. A first stimulant introduced by the lab is a reward system with a local currency (wood coins) that can be used in shops in the Dapperbuurt. The long-term aim is, of course, to make separating waste a common practice (by intrinsic motivation, thus without any award needed). While the ZWL offers an opportunity for residents of the Dapperbuurt to hand in their waste, until now no possibilities are available to hand in household wood. This project started to investigate wood waste as it seemed like a missed opportunity, because wood is the largest household waste stream (42%) in the Dapperbuurt area, Amsterdam Oost (fig.1).

**Samenstelling Grofhuishoudelijk afval Stadsdeel Oost  
(inclusief gescheiden ingezamelde stromen)**

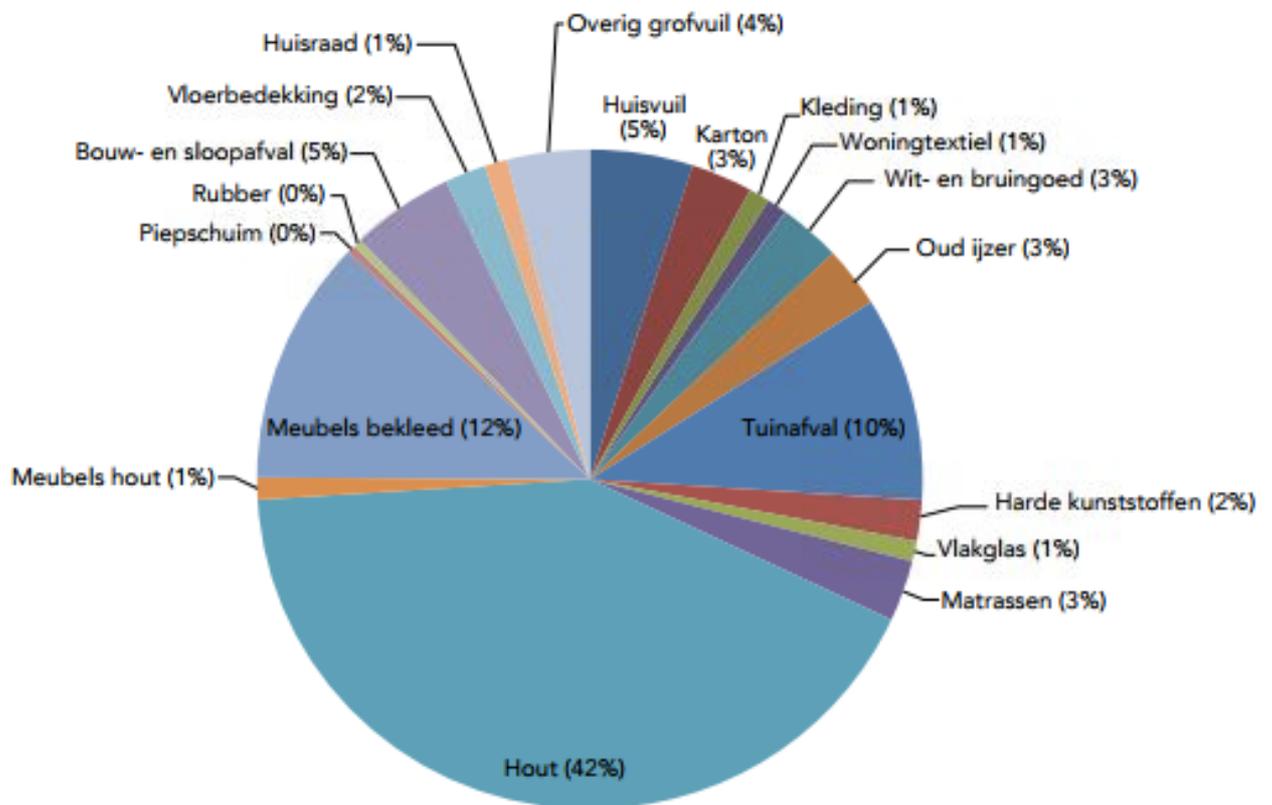


Figure 1: "Afvalketen in beeld [waste chain visualized]"

Source: Gemeente Amsterdam; Ruimte en Duurzaamheid. (2015, October).



Figure 2: Observation of wood waste in the Dapperbuurt (2018), Source: Erno Langenberg (Urban Technology Group, Amsterdam University of Applied Sciences)

Currently this wood waste stream is mixed with general waste. If this wood would be collected separately the lower quality wood could not only be recycled as biofuel and for generating sustainable energy in bio-energy plants, but also the separated higher quality wood could be up-cycled to make new products for the consumer. This project assumed this is the potential value of the household waste wood in the Dapperbuurt. Based on this assumption we examined the psychological barriers and stimuli for residents to separate their (wood) waste and hand it in to the ZWL, and based on these insights we propose interventions that will most likely increase recycling behaviour in the Dappertbuurt neighbourhood.

### **RESEARCH QUESTION**

What are the psychological barriers and stimuli for residents to separate their (wood) waste and hand it in to the ZWL?

### **METHOD**

In the period 1 February – 24 June 2018, 29 students (organised in 5 research groups) of the second year of the Bachelor Applied Psychology (Amsterdam University of Applied Sciences) conducted research in two phases: Phase 1) Literature & Fieldwork Research, and Phase 2) Design Research for Practical Interventions (Phase 1 informed Phase 2). In a third phase, researchers of the group Psychology for Sustainable Cities examined this data further by analysing the collected data following the COM-B model and the Behavioural Change Wheel concept. Students developed interventions, the researchers selected the best proposals and validated them by using the COM-B and BCW model.

The research was structured with the following sub-questions:

- 1.) What are the existing stimuli and barriers influencing recycle behaviour known from the literature?
- 2.) What are the existing interventions and measures beneficial to increase recycle behaviour known from the literature?
- 3.) What are the stimuli and barriers of the Dapperbuurt inhabitants to hand in waste wood to the ZWL (fieldwork)?

As the Urban Technology (UT) Group designed up-cycled products from waste wood in the neighbourhood the additional research question have been studied:

- 4) In what way could up-cycled wood products motivate the Dapperbuurt inhabitants to start handing in their wood waste at ZWL?

During the project we added another relevant research question:

- 5) Based on insights from the literature and fieldwork, are there any other interventions which would stimulate the inhabitants in the Dapperbuurt to start handing in their wood waste at ZWL?

### 3. EXISTING STIMULI & BARRIERS OF RECYCLING BEHAVIOUR

From the existing literature we identified ten key stimuli and barriers behind recycling behaviour namely: socio-economic and demographic factors, rewards/incentives, accessibility, subjective notion of distance, access to a structured recycling program, self-efficacy, social norms, connectedness and solidarity in a community, worldview of the individual, and knowledge on the subject.

The literature shows that **socio-economic and demographic factors** such as income, education, age, population density and urbanity are decisive for recycling behaviour. A higher ages and higher incomes have positive effects on the degree of recycling. High population densities and urbanity influence recycling practises negatively (Callan & Thomas, 2006; Sidique, Joshi & Lupi, 2010).

People will recycle because they are **rewarded**, this can be financial (Seacat & Boileau, 2018) (Lakhan, 2014) (Callan & Thomas, 2006) or by feeling satisfied by the contribution to the quality of the environment (Hornik, 1995). It is self-evident that recycling is significantly lower when people have to “pay” for the recycling (Seacat & Boileau, 2018).

The degree of **accessibility** of recycling bins has a lot of influence on the recycling behaviour of people (Zhang et al., 2016). This study revealed that people who do not normally separate their waste would do so if recycling bins become easily accessible (within a few minutes walking distance from the household). When extra efforts were

required for the recycling of waste (large walking distance, heavy waste materials), the degree of recycling decreased significantly. Luben and Bailey (1979) showed that the volume of recycled waste increased by 47% in a park after they had placed six additional recycling waste bins there. Furthermore, research shows that if people perceive the recycle process as complicated, they are less likely to start recycling (Tonglet, 2004). Generally, the smaller the effort, the greater the chance the individual will exhibit recycling behaviour (Miafodzyeva & Brandt, 2012).

A more recent study (Lange et al., 2014) demonstrated that a perceived **distance** to a recycling point **can be subjective**. This means that the experience of the distance and the actual distance is often not the same. People can therefore experience a higher threshold when a trip to a recycling point is experienced as negative, even if this distance is not very large. Several factors can influence this, for example whether the person has a car, or a bicycle, or is less physical mobile, or if the street scene does not give a safe feeling. Additionally **the kind of location** of the waste bins is an important factor for people to recycle. If waste bins are within the common areas of flats, this can cause unclean situations, residents prefer to use nearby waste separation facilities places outside, for example on the sidewalk (Yau, 2010, Saphores et al., 2011).

Other studies show that people with **access to a structured recycling program** recycle much more than people who do not have access to it (Derksen and Gartrell, 1993; Saphores et al., 2011). Examples of such programs are pick-up or drop-off services, where the recycled waste can be either collected or handed in. Also specified times at which waste is collected was shown as beneficial for recycling behaviour. When people do not have access to this, it is perceived as a barrier that plays a role in recycling behaviour (Saphores et al., 2011). Recycling behaviour is highest when waste is systematically collected at home (Miafodzyeva & Brandt, 2012). Research shows that the presence of a pick-up service and existing recycling centres have a positive influence on the degree of recycling in a neighbourhood (Callan & Thomas, 2006, 2010). A study in China showed that when all participants had an equally strong willingness to recycle, the group with easy access to recycling facilities showed 25% more actual recycling behaviour than the group that did not have easy access to them (Zhang, 2016).

**Self-efficacy** is seen as an important barrier to recycling behaviour (Zhang et al., 2016). Self-efficacy is a theory of Bandura, which states that people are motivated more quickly for a certain action when they believe that they

can also perform this action successfully. For example, if a person recycles and finds it difficult and believes that he cannot, or thinks he has little control over it, this person will not recycle (according to the self-efficacy theory). Thus, a weak sense of self-efficacy can lead to a barrier with regard to sustainability behaviour and recycling.

**Social norms** within the social environment of the individual can exert social pressure. Various studies have shown that when the social norms of recycling exist in specific environments people easily adapt to it (Myafodzyeva & Brandt, 2012; Sachdeva, Jordan & Mazar, 2015; Burn, 1991). The extent into which people feel **connected to their social environment** has been identified as a predictor of recycling behaviour (Hornik, 1995). Additionally, the more sense of **solidarity in a community**, the more positive the influence is on the recycling behaviour of the individual. The sense of community even has as much influence on recycling behaviour as someone's personal standards on recycling (Myafodzyeva & Brandt, 2012).

The **world-view** of people has been shown to be important. People with strong recycling attitudes and recycling behaviour often have a low anthropocentric orientation (the idea that people are the centre of life) (Huffman, 2014). People feel a moral responsibility to recycle when they have an environmentally conscious world-view (Saphores et al., 2011), thus will be more inclined to recycle waste. Research by Steg and Vlek (2008) has shown that pro-social, altruistic and nature-conscious values have a strong influence on the display of environmentally aware behaviour. If one has a low sense of responsibility and a negative attitude towards the environment, this can act as a barrier (Welfens, Nordmann & Seibt, 2016). Individuals generally tend to recycle more when they feel personally responsible to contribute to this (Myafodzyeva & Brandt, 2012).

Research shows that **knowledge** of recycling has an effect on the extent into which people will recycle (Hornik, 1995). Knowledge is also important to ensure that people do not experience recycling as something difficult. Awareness about the need for recycling is important, if people feel the need, the personal standard will not change (Chan & Bishop, 2013). Informative campaigns and educational programs related to recycling have shown a positive and significant correlation with recycling behaviour (Myafodzyeva & Brandt, 2012). It also has been shown that knowledge about the existence and precise location of a waste point is very important (Saphores et al., 2011). Furthermore knowledge about the costs of non-recycling has been shown to have a positive effect on recycling behaviour (Kollmuss and Agyeman, 2002; Saphores et al., 2011).

## 4. EXISTING INTERVENTIONS SUPPORTING RECYCLING BEHAVIOUR

Several interventions have been developed in the past that support recycling behaviour. Research has shown that a combination of several interventions often is most effective to achieve lasting behavioural change (Varotto & Spagnolli, 2017). In the field of psychology the Behavioural Change Wheel (fig. 2) has proven to be a successful model to identify which set of (integrated) interventions are likely to lead to preferable change in a particular context. In the following we link six existing key interventions stimulating recycle behaviour to the Behavioural Change Wheel. First, we will introduce the wheel.

The Behavioural Change Wheel (Michie, Atkins, West, 2014) consists of three layers. The hub of the wheel identifies the sources of the behaviour that could prove fruitful targets for intervention. Figure 2 shows in simplified form how a behavioural intervention can be designed according to this structured approach. The model analyses the motives for a behaviour by looking at suitability (Capability), the opportunity (Opportunity), and the motivation (Motivation). This is called the COM-B model. Depending on the outcomes of the COM-B analysis, nine intervention functions are presented that could lead to the desirable behaviour. The outer layer, the rim of the wheel, identifies seven types of policies that one can use to deliver these intervention functions. The wheel has been proven to be a very useful tool for behavioural change analysis and the design of an intervention and policies to support a behavioural change in a specific context.

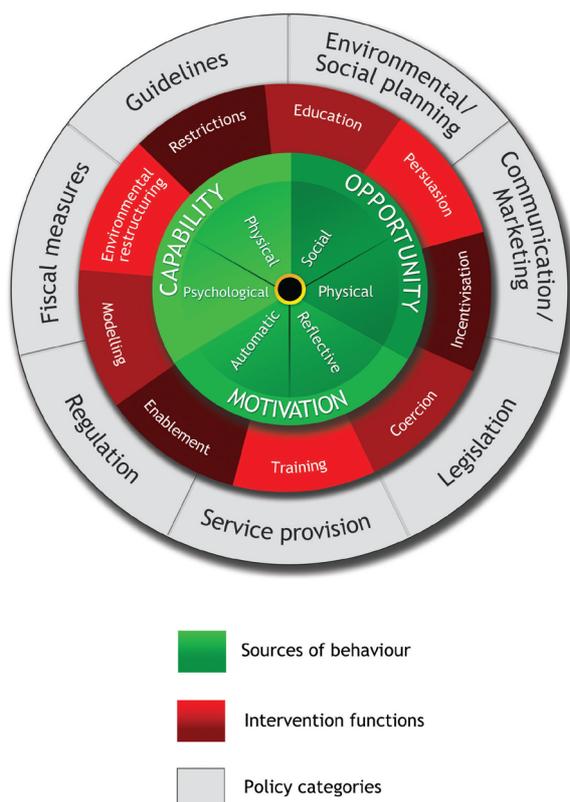


Figure 2: The Behavioural Wheel of Change.  
Source: Michie, Atkins, West, 2014, page 18.

The Behavioural Wheel of Change uses the COM-B model to identify the sources of the behaviour that could prove fruitful targets for intervention. COM-B stands for Capability Opportunity Motivation – Behaviour. The COM-B model is the starting point used by the Behavioural Wheel of Change for understanding behaviour in the context in which it occurs (Michie, Atkins and West, 2014, 62). The central tenet of the model is that for any behaviour to occur:

1. there must be the ‘capability’ to do it: the person or people concerned must have the physical strength, knowledge, skills, stamina etc. to perform the behaviour;
2. there must be the ‘opportunity’ for the behaviour to occur in terms of a conducive physical and social environment: e.g. it must be physically accessible, affordable, socially acceptable and there must be sufficient time;
3. there must be sufficient strong ‘motivation’: i.e. they must be more highly motivated to do the behaviour at the relevant time than not to do the behaviour, or to engage in a competing behaviour (Figure 3).

These components interact as illustrated by the interlinking arrows so that, for example, increasing opportunity or capability can increase motivation. Increased motivation can lead people to do things that will increase their capability or opportunity by changing behaviour. For example, owning a bicycle (*opportunity*) or being able to ride a bicycle (*capability*) might increase motivation to ride a bicycle but *motivation* alone will not improve riding skills or afford access to a bicycle unless the individual acts (*behaviour*) on this motivation to buy a bike or to practise bicycle riding (Michie, Atkins, West, 2014, 63).

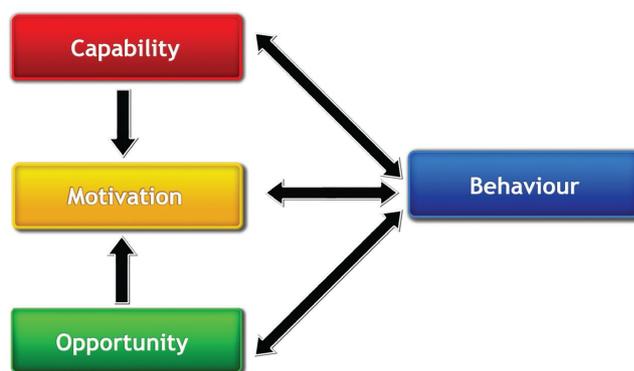


Figure 3: The COM-B model.  
Source: Michie, Atkins, West, 2014, page 62

In the literature on existing successful interventions for recycling behaviour, we identify six key-interventions that can be categorized and presented as a COM-B analysis (based on theory): (1) social modelling and (2) adjustment in the environment (*Opportunity*), (3) prompts and information, (4) feedback (*Capability*), and (5) incentives and (6) commitment (*Motivation*).

#### 1) Social modelling

Interventions based on 'social modelling' intervene by having people learn by observing the behaviour of others or by having them identify with the social group exhibiting the preferred behaviour, which will lead to imitation of the group behaviour. This happens mainly when the other person's behaviour is easy to understand for the individual, has a positive purpose and seems meaningful for the individual himself (Varotto & Spagnolli, 2017). The research by Burn (1991) also confirms that the use of 'social modelling' is effective. For example, a person who has an example function within a social group will influence other individuals of the social group rather

easily, while the same behaviour or discussion by a person from outside the group is less easily accepted. Mirroring behaviour of others communicates social approval, thus when someone within a social group starts recycling and s/he persuades others within that group to do the same, this will create a new social recycling norm within the community. An intervention that uses 'social modelling' is usually very efficient in terms of costs. What is very important for the success of social modelling is the extent into which the residents perceive themselves as part of the community, or want to be part of that community. The stronger the feelings of community, the better the intervention will work and vice versa (Varotto & Spagnolli, 2017).

## 2) Adjustments to the environment

Interventions by making adjustments to the environment aim at making recycling easier and simpler by creating a more facilitating physical environment. Different studies (Phillips 2011, Schultz et al., 1995) show how waste bins can act as 'nudges'. With the placement of various waste bins the environment is changed. The bins provide a trigger, individuals seeing them will associate the bin with litter and waste, and the effort to litter becomes small because the bin is easy in reach. Other research showed that making the bins very visible, for example by repainting them with bright colours, awareness also increased for potential recyclers (Lin, Wang, Li, Gordon and Harder, 2016).

## 3) Prompts and information

Prompts and information given to people helps to encourage persons to start recycling behaviour (this can be done by providing facts and convince people, or only by using prompts as reminders to recycle). Information is also useful in cases when the individual is willing to recycle, but does not know how. Of course it is really important to be able to provide the correct and most suitable information to the different target groups. For example, people who do not recycle need different information than people who already recycle (Varotto & Spagnolli, 2017).

## 4) Feedback

Feedback provides information to individuals or a group, about the extent into which they show successful (or not) recycling behaviour. When people start recycling, feedback will make their change (and impact) more visible. Feedback is based on the examination to what extent the current behaviour of an individual or group differs

from past behaviour (Varotto & Spagnolli, 2017). Internet has started to play a major role in this strategy, as eco-feedback technologies have been developed that send targeted and personal feedback to the individual via the mobile phone or other devices (Varotto & Spagnolli, 2017). The eco-feedback technology is particularly effective for those who are already working or are enthusiastic about recycling (Boulay, Metcalfe, Barr and Shaw, 2014). Also feedback on the social comparison with the rest of the group or other individuals, with which the individual can identify, increases the degree of recycling behaviour (social modelling see above). At the same time, group feedback seems to contribute to recycling behaviour as it is able to normalize the behaviour: changing the social norm of recycling (Varotto & Spagnolli, 2017). The disadvantage of feedback is that it requires constant monitoring (Katzev and Mishima, 1992).

#### 5) Incentives/rewards

Interventions based on incentives include rewards, refunds, gifts, discount coupons, lots and so on. In the context of recycling, interventions are often based on the individual receiving a reward as a result of participation in the recycling program (Varotto & Spagnolli, 2017). Research by Harder and Woodard from 2007 showed that individual rewards work better than rewarding the performance of the entire group. It was also found, however, that the possibility to win a large prize immediately by participating in a lottery, still led to a much larger participation than receiving a certain amount as participation in the recycling of waste (Diamond & Loewy, 1991). There are three drawbacks by using of interventions based on incentives. Rewarding people for their behaviour, means they constantly need to be monitored. In addition, research by Schultz et al. (1995) shows that the costs of an incentive/rewarding system often outweigh the economic benefits of recycling. Finally, interventions based on incentives after termination the reward program often result in a relapse of the behaviour then the situation is again as before (Schultz et al, 1995). This means incentives/rewards are useful for rapid change to start the transitional process, for lasting change we need other interventions based on intrinsic motivation.

#### 6) Commitment

The intervention based on commitment is focused on the need of people to stick to their word in the presence of others. In this intervention, an individual has to set a goal for himself in the presence of others, in our wood-waste recycling case, the commitment for example could be: 'always separate my wood-waste.' When this is said in front of other (witnesses) the individual usually becomes highly motivated to achieve this goal. This is because

it is considered socially undesirable if one does not keep his / her word or will fail his her commitment (Cialdini, 2014). The biggest disadvantage for interventions that use commitment is that the strategy can hardly be applied to an entire society. Commitment works best when it is linked to an individual and a smaller group, commitment are less effective when it is used as a group goals (Wang and Katzev, 1990).

## 5. PSYCHOLOGY OF RECYCLING IN THE DAPPERBUURT, THE CASE OF WOOD WASTE

The following presents the stimuli and barriers of the residents in the Dapperbuurt to hand in their waste wood at the ZWL. The results are based on an analysis of data collected from qualitative (codified) interviews with eighty-three residents of the Dapperbuurt. Forty-six of these residents have been interviewed by proactively approaching them at the Dapper market, another eighteen have been interviewed at the Zero Waste Lab being members of the Lab, the remaining residents have been interviewed in or near their homes.

Not surprisingly, there was a sharp difference in behaviour between the members of the ZWL and the non-members. The ZWL members actively separate their waste - plastic, paper and residual waste. They perceive this as little **effort** as it is easy for them, most of them mentioned that this is especially so because the ZWL is nearby their homes. Residents, however, not being ZWL members perceived it as too much of an **effort** to separate waste, which demotivates them to hand in their waste at the ZWL, instead they put it in the street to be collected by the municipal waste collecting company.

The non-ZWL members mentioned that it likely would motivate them if they would have more **knowledge** about what will be done with the waste wood they hand it in. They also mentioned that if ZWL would become more visible in their neighbourhood and would communicate better on how they could recycle wood, that this also likely would motivate them to bring their waste wood to ZWL. The ZWL members on the other hand do have knowledge about the waste collection at ZWL. Most of them, however, didn't need the ZWL to be visible or pro-active because they got this **knowledge** by proactively searching for information on how to recycle their waste when moving into the neighbourhood.

The non-ZWL members who did divide waste, say they do so because they feel **social pressure**. It seems there is certain **social control** in some circles of friends in the Dapperbuurt with regard to recycling. As one resident put it, *"If I see that my colleagues or friends are doing it, I think I will too."* As mentioned above, the ZWL members have brought their recycling behaviour from home or from the previous place of residence. This means for them it has been a **social norm** for them to recycle before arriving to the Dapperbuurt.

The residents who do recycle (including the ZWL members), do so because it has become their **personal norm** (they are internally motivated to recycle). Almost all of them mention they are motivated because it makes them feel good about themselves, as they believe this action contributes to preserving and improving the environment. One respondent explained this as following, *"I separate waste for a cleaner future, my children and for my grandchildren who have to grow up in a clean environment."*

About providing **rewards** with local wood coins, the non-ZWL members are divided in their opinion. Sixty percent of the respondents experience a reward with local wood coins as motivating: *"A reward with coins seems to me very effective, it would motivate me in any case."* A smaller group, finds rewards with local wood coins not necessary, for example one of these residents explains: *"The coins are fun but it would certainly not be a condition. If I know that there is a good solution and is not thrown away. It must be clear what is being done with that wood."* The members of the ZWL experience the local wood coins as a reward from ZWL as fun but not necessary, up-cycling from wood to products for the home or the neighbourhood is seen more as a reward. Additionally they feel their reward comes from feeling good about recycling in general.

The **key-barriers** for the residents to hand in their wood to the ZWL found in these interviews are (not surprisingly) similar with four of the determinant we identified as well as stimuli (when considered in negative sense), namely: **efforts, knowledge, visibility of the ZWL, social norms in the neighbourhood**.

Residents perceive it still as a **too great of an effort to bring their waste wood to the ZWL due to location** (when residents live too far away from the lab). They also **perceive wood as a too heavy** and often a **too big material**

to bring to the Lab. Related to the latter they mention they have **no space in their homes to store the wood**, they prefer to put it directly in the street to be collected by the municipality (*grofvuil*). One of these residents explained this as following: "*If it's heavy or something, I'll just throw it away, that's too much trouble, it's easy when someone comes to the door and takes it for you.*" Another residents' explanation demonstrates how distance is an issue as well: "*Look, if it was nearby, within walking distance, because I live on the other side, and then that is quite a walk.*" Residents as well mention **they find ZWL not very visible in the neighbourhood** and when they know about the existence of ZWL they experience the ZWL space as non-inviting.

Residents furthermore are in **need of more knowledge about the separate waste trajectory for wood**. Examples are given such as language barriers and knowledge about the collection points. Furthermore residents would like to know more about what will happen with the waste wood. The ZWL-members have most of this knowledge, however they mentioned that they would prefer more knowledge about how waste must be separated. Additionally the ZWL-members mention that **the usefulness of recycling in general should be promoted more widely in the neighbourhood**. As well, they mention it might help if residents in the neighbourhood know more about what happens to the wood and where the collection points are in the neighbourhood. Additionally, because there is **not that much waste wood to collect on a regular basis**, it difficult to make wood recycling a routine behaviour.

Based on these determinants (motivators and barriers), residents shared ideas for interventions on how to increase their own and other people's willingness to bring wood to ZWL. The first idea to limit effort was to **introduce a pick-up service** that will collect the wood from the homes at specific times and dates. The ZWL members proposed to pick up large wood waste two times per week. Other residents mention a fixed time is not necessary they prefer they call for the pick-up of the wood (as there is not that much wood anyway).

To increase knowledge about how to engage in the practice to recycle wood and work with the ZWL, the residents proposed to **make the lab itself more visible to the residents** and **make the ZWL space/location more inviting to the residents**. The ZWL members also mention more knowledge about ZWL is needed. They also share with us that they think the location/space of the ZWL potentially has the potential to become a central place in the

neighbourhood and could therefore help to strengthen the feeling of solidarity in the neighbourhood. The latter they say, likely will contribute to the willingness of people to participate (do together).

Related, residents also believe it would help if general information general **about recycling and up-cycling** would be more wide spread in the neighbourhood.

The residents mention it would help if ***the waste wood would be used as a reward for the neighbourhood***: giving back products to the neighbourhood, instead of to the residents personally. The majority of the respondents mentioned they prefer products for the neighbourhood: planters, benches, playground, and decorative (art) objects. Some of them mention to produce recycled wood products for people who have less (as a social project), or contribute recycled wood products to the Dapperschool (they mention a shuffleboard, a swing etc.). They also mention to involve the children by asking them what they would like to see in the vicinity of up-cycled waste wood. Only a minority of the respondents preferred products for their homes, and then with some nostalgia for the history of the wood. For example one respondent mentions: "I find up-cycled wood products for the house fun, because then you can say; this used to be my table leg."

The ZWL members mention that receiving coins does not correlate for them with rewards, but the good feeling that people receive by recycling and the attention for this is what rewards them. They propose to focus more on rewarding people in the neighbourhood with this ***"feeling good" reward*** not with the local wood coins. Some respondent mentioned that this research project already has contributed to this "feeling good" reward (members indicate that the feedback they received by our research project in which we ask them about their recycling efforts also increases directly their willingness to continue to recycle).

## 6. INTEGRATING RESEARCH RESULTS WITH COM-B & BCW-MODEL

Drawing on the results of the literature and field research, we categorized the results into the COM-B model (Table 1), and furthermore looked at how our results related and can be understood with the Behavioural Change Wheel model to inform the design/proposal of an integrated set of intervention for the Dapperbuurt.

**Table 1. Analysis Stimuli, Barriers, Interventions integrated with COM-B concept**

	Existing (data from literature)		Dapperbuurt residents (data from interviews)	
	<i>Stimuli &amp; barriers</i>	<i>Successful Interventions</i>	<i>Stimuli &amp; barriers</i>	<i>Suggested Interventions</i>
<b>Opportunity</b>	Accessibility to waste collecting location Subjective notion of distance Access to a structured recycling program	Adjustments to the environment	Effort too great: Distance waste collecting location is perceived as a too far, wood as material is perceived as too heavy and a too big material, there is not much wood waste on a regular basis in these households	Pick-up service by "bakfiets" at specific times and dates /call for appointment
	Socio-economic and demographic factors Social norms Connectedness and solidarity in a community	Social modelling/ when a small group starts others might copy Feedback Having people commit in front of a group/others rewards/incentives	Social control/social pressure/social norm is perceived as a great influencer	Posters, flyers & stickers (Dappermarkt distribution or for ZWL-members)
<b>Capability</b>	Knowledge on the subject	Prompts and providing information	More knowledge on recycling is needed (why recycle wood) More visibility of the ZWL is needed (who and where to recycle) More knowledge about the trajectory to separate wood is needed (how, when)	
<b>Motivation</b>	Rewards/incentives Worldview of the individual Self efficacy Feedback	Incentives	Initial phase = financial reward is best Long term: reward = feeling good about the action (no need for financial reward)	Example products Products for the neighbourhood: benches, Playgrounds, public artworks Redo the location of ZWL: make it more inviting in appearance

The COM-B model provided the insights on how we need to identify what we need to improve to make residents more Capable, provide them with more Opportunity and with the Motivation to recycle wood and hand it in to ZWL. From the collected data we arrive at the following COM-B analysis:

**The opportunity of the residents to recycle will increase when:**

- We can make it easier for them to do it. Specifically they need support in transporting the wood to the collection points, as well they need collection points to be closer to their home (or they need to perceive the location as not that far).
- When residents see other people in the neighbourhood participating in recycling they will also do it: the social norm will create an opportunity for them;
- When the ZWL will be more visible to them and more inviting.

**The capability of the residents to recycle will increase when:**

- More knowledge will be given to them about the why, how and when of recycling;
- Prompts (to remind them to recycle, why and how) are used and more general information about recycling in the neighbourhood will make them more capable to actually engage in recycling wood.

**The motivation of the residents to recycle will increase when:**

- Rewards and incentives are given to engage residents who are not recycling
- When residents already recycle they need to receive feedback to be rewarded and stimulated to continue;
- Residents need also feedback to enhance their self-efficacy, as well they need more trust they are actually recycling, that the system works and that it is worthy to do it;
- Residents' worldview could change when they get more information, this will contribute to their motivation.

These *opportunities*, *capabilities* and *motivations* are at the centre when using the Behavioural Wheel of Change. When looking at the wheel (see fig. 2), we can see that the COM-B analysis (what needs to be changed) is surrounded by a first (red) layer, which represents nine intervention functions to choose from to achieve the

needed change. These intervention functions are: Environmental restructuring, Education, Restrictions, Persuasion, Incentivisation, Coercion, Training, Enablement and Modelling. Drawing on our particular COM-B analysis (summarized in table 1), the interventions by the residents represent a combination of these (see Table 1): Pick-up service by cargo-bike at specific times and dates (*Environmental restructuring, Persuasion, Enablement*), or call for appointment; posters, flyers & stickers (*Education, Persuasion, Enablement, Training*); example products for the neighborhood (*Persuasion, Incentivisation, Education*); increase the attractiveness of ZWL (*Persuasion, Enablement, Environmental restructuring*). The interventions, *Coercion* and *Restriction* were not mentioned by the residents, but this should not come as a surprising because these are of course restricting measures which the residents would naturally not apply to themselves.

## 7. PROPOSAL FOR AN INTEGRATED SET OF INTERVENTIONS

This chapter presents an integrated set of intervention proposals developed by the Applied Psychology students. Drawing on the insights of the analyses (summarized in the above table 1) these interventions aim to provide the needed Capabilities, Opportunities and Motivations for the residents in the Dapperbuurt to engage in recycling wood. The interventions that were developed, are;

1. "ZWL posters, flyers, stickers and bags" as promotion materials, to increase knowledge in the neighbourhood and change the social norm;
2. "ZWL- Containers," to provide collection points within walking distances to households;
3. "ZWL Pick-Up Bicycle/Bakfiets," to simplify handing in larger pieces of wood;
4. "ZWL- Products for the neighbourhood," to reward and motivate residents by showing them how their recycled wood can contribute to the neighbourhood.
5. A "ZERO-Waste-L-APP," which enables to integrate the first four interventions with the (very important) additional intervention function of increasing the social norm by connecting residents in the neighbourhood, and have them commit to recycling efforts by actively handing in wood, and sharing ideas for how wood can be used/designed for the neighbourhood.

### **1) ZWL Posters, flyers & stickers**

Many of the interviewed inhabitants of the Dapperbuurt never heard of the Zero Waste Lab. More knowledge and visibility of the Lab is the first step for more involvement of these residents. The proposed posters and flyers would contain general information about the Zero Waste Lab, such as the way in which Zero Waste Lab works, the remuneration that the members receive (wood coins) and the core values of the Zero Waste Lab. As well practical information as address, (physical and web), phone number and opening times should be provided in folders and flyers. These promotion materials preferably include images of recycled wood products for the neighbourhood. Stickers and bags will display the ZWL logo + website, bags will be used and stickers can be attached to the waste bins, as to the posters and flyers.

If these materials are as well distributed to residents who already actively participate in the ZWL project, it is likely that this will increase not only visibility but also activate the social norm. If the active residents stick stickers on places like their laptop, their bicycle or other creative places, they will promote their recycle activity to others. The recycled bags with ZWL logo's might similarly help both visibility and to increase the social norm of recycling generally. These bags could be used daily for grocery shopping and at the Dappermarkt for example. The sticker and bags will actively show others in the neighbourhood who is already actively participating which will likely motivate others within this immediate environment to also participate in the project. The flyers, posters, stickers and bags can be developed by Design and Creation students of the Hogeschool van Amsterdam.

When designing posters, flyers, stickers and bags, the many different cultural background of the inhabitants of the Dapperbuurt must be taken into account (45.9% Dutch, 14.5% Western, 12.5% Moroccan, 7.6% Turkish, 9% Surinamese, 3% Antillean and 9.3% other non-Western). It is impossible to handle all these different languages on all these materials. What could be done is to make use of informative images that everyone will understand. Moreover, posters and flyers will be more accessible for people to absorb a story fleetingly through images instead of a whole piece of text. Recommended is that basic information should always be provided like address (web and physical), mission of the ZWL.

Flyers could be distributed on the market. During the handing out of the flyers, more information can be conveyed to the residents about the Zero Waste Lab and this project (circular wood in the neighbourhood). This

is probably more effective than a stall on the market, which residents are less likely to approach on their own. When the posters are placed in central places in the neighbourhood, this will become a phenomenon, residents will talk and wonder about what the ZWL is. This will support the social norm to use the ZWL and recycle. Results published in the literature have shown that this contributes to the recycling behaviour of people.

#### **“ZWL Containers”**

Similar with the literature, the interviewed inhabitants of the Dapperbuurt as well perceive locations on a distance as a threshold: they don't want to walk very far to hand in their waste. This intervention is proposed the ZWL starts working with their own Zero Waste Lab containers. The Dapperplein, where the ZeroWasteLab is located, is approximately centrally located in the Dapperbuurt. To test the idea, this intervention proposes to place containers in the Dapperbuurt neighbourhood, and start first with a test period of six weeks (for more details on costs and logistics contact the authors for the original student report).

#### **“ZWL Pick Up bicycle/bakfiets”**

To remove the barrier to transport the wood to the ZWL a *pick-up service by “bakfiets”* is proposed, this service is in particular for large pieces of wood. Bicycles differ from most other vehicles that can be used to collect wood (trucks, cars) because they are easier to manoeuvre, have low costs, no driver's license is required. Furthermore, the bike is environmentally friendly being electric or manual. This makes the “bakfiets” also potentially interesting to use as a mean to promote the Zero Waste Lab in the neighbourhood. As well the bike could be used by residents themselves: they can make an appointment to collect the “bakfiets” and bring their waste themselves. Residents who are not willing to do this themselves could call for their waste to be collected. Alternatively the ZWL could drive through the neighbourhood on specific times and ring a bell to make themselves heard and visible. Further research might need to be done to decide which form of collecting waste would be preferred with the “bakfiets,” it might be a combination of a few proposed.

#### **“ZWL Products for the neighborhood”**

The presence of up-cycled wood products in the neighbourhood will show to the residents what can be done with the waste wood. Furthermore ZWL will be promoted (if the ZWL logo will be shown as well) in the

neighbourhood through the presence of these products. Up-cycled products can be placed at the Zero Waste Lab as an example. And up-cycled collective products will be placed at strategic locations within the Dapperbuurt neighbourhood. In addition to the ZWL logo, the products might be accompanied by displays providing information on the recycling process and history of the specific product. Examples of products mentioned for the neighbourhood are benches, playgrounds, and flowerpots.

### **“Zero Waste L-APP”**

The Zero Waste L-APP provides an integrative tool stimulating handing in waste wood. As the four interventions above, this tool is specifically designed upon the needs to make the residents in the Dapperbuurt Capable, give them the Opportunity and Motivation to start recycling wood in their neighbourhood. This tool is specifically designed to be an easy collection system for the waste wood, to increase the social norm to start recycling. The tool furthermore introduces an alternative rewarding system for the wood coins. The literature research has shown that financial reward works as stimuli but only in the initial phase to have people engaged. It has been proven financial rewards do not function as long-term motivators for recycling behaviour. This was also confirmed by our fieldwork. Residents are motivated on a long-term basis by emotional reward, feeling good about recycling, contributing to a better world and connect with others by doing this. What also motivates the Dapperbuurt residents is when they could choose what kind of up-cycled product would be produced, both for the neighbourhood and for personal use. The Zero-Waste L-APP responded to this need and proposes to integrate the wood-coin system with the emotional rewarding (feel good) function.

Instead of rewarding with tangible (wood) coins to members, the Zero Waste L-APP (and an additional website) rewards digital coins. Every participating resident has his own account and can log in via the website or app. Via this account residents can check how many coins s/he has saved. With these coins s/he can order standard products or make a suggestion in the suggestions box. The latter, making suggestions, is visible for all members using the Zero Waste L-APP. In the suggestions box, the residents can indicate which product s/he wants and how much wood it would use. Every user can see the suggestions done in this box. Thus, this does not only enable direct involvement in the process, it also brings the residents together sharing their ideas. Other residents can be inspired and even propose wood they have in their houses to be collected for a product. The suggestions box is recommended to be updated every week. If the residents have feasible ideas, an

appointment will be made with the resident to elaborate on the idea and to see how many coins it will cost. Residents can also opt for standard products, such as a chair, a sofa or a table. The residents can order this through the website and indicate details, for example a specific size. Zero Waste Lab will then determine how many coins the product will cost.

If the members would like specific products for collective use in neighbourhood, s/he can give a suggestion, which will be put in an online poll. A poll is a poll in the opinion of the members. The result of a poll reflects the opinion of the respondents. Thus, the members can vote for the product they would like to see in their neighbourhood. If a product has received the most votes in the poll it will be assessed by Zero Waste Lab (by filling out an online form with the necessary information). The precise value of the submitted wood, which differs between the quantity and type of wood, also has to be determined by Zero Waste Lab. This is necessary because there might be practical and technical information missing and this must be communicated to the technical department involved in the production of the wood. The technical department is suggested to be the Urban Technology group at the Hogeschool of Amsterdam, currently involved in this project.

The Zero Waste L-APP, also will be used to communicate times and date for appointments to pick up wood with the cargo-bike. Additionally the residents can also provide information on the weight, size and kind of wood to be picked up to make the collection process easier.

The Zero Waste L-APP is an innovative tool connection people in the neighbourhood through sharing their ideas. As such the app uses the social norm as key-stimuli, it is focusing on rewards through feeling, emotions, sharing. As well it integrates almost all other proposed interventions needed in this neighbourhood to motivate residents to hand in wood to the ZWL (the four interventions above). These tools could be developed by ICT and Communication and Multimedia Design students at the Hogeschool van Amsterdam.

## 8. CONCLUSION

In this research we have studied what the psychological barriers and stimuli are for residents in the Dapperbuurt to separate their (wood) waste and hand it in to the ZWL. Students of Applied Psychology collected the data and

made a first analysis of what the stimuli and barriers are influencing recycling behaviour generally and specifically in the Dapperbuurt neighbourhood. Researchers of the group Psychology for Sustainable Cities deepened the research further by applying the COM-B model, that is part of the Behaviour Change Wheel. The latter provided the necessary insights in how behavioural change interventions could work. Drawing upon that knowledge, a practical proposal for an integrated set of interventions was developed to increase recycling behaviour in the Dapperbuurt.

We learned in this project that first, the opportunity of the residents to recycle will increase if the process is (perceived) as easy (not complicated), and as the location is (perceived) as being near their houses. Second, that the capability of the residents to recycle will increase if more knowledge will be given to them about the “why, how and when” of recycling. Additionally when the ZWL would become more visible to the residents and its location more inviting, when prompts are used (to remind them to recycle, why and how) when more general information about recycling in the neighbourhood is provided this will as well improve their capability to engage in recycling wood. And, third, we learned that the motivation of the residents to recycle increases when financial rewards and incentives are given to engage residents who are not recycling. When residents already recycle, they do not need financial rewards but feedback to continue stimulating them with the reward of “feeling good” about the contribution to the environment.

Based on this COM-B analysis, we used the Behavioural Change Wheel to develop interventions that could stimulate residents to hand in their (wood) waste: “ZWL posters, flyers, stickers and bags,” “ZWL- Containers,” “ZWL Pick-Up Bicycle/Cargo-bike,” “ZWL- Products for the neighbourhood.” These interventions were all more or less integrated in the last proposal the “ZERO-Waste-L-APP.” This app was a tool enabling integrative interventions to be implemented. The app increases the social norm by connecting residents in the neighbourhood using an innovative reward system, as well by collectively sharing ideas about how wood can be used/designed for the neighbourhood, and have them in front of others commit to recycling efforts. We believe this app would be worthwhile of testing in the Dapperbuurt neighbourhood.

Parallel to our research the Urban Technology (UT) Group designed up-cycled products from waste wood in the neighbourhood as an intervention to support recycling behaviour in the Dapperbuurt. Placing these up-cycled

products in the neighbourhood, seems a potential useful intervention as it is making up-cycled ZWL products visible in the neighbourhood. And this also supports the preference of residents for communal products over individual products. Placing these upcycled communal products close to the ZWL and connecting it to the ZWL, it might stimulate residents to contribute to the recycling process. At the same time we have seen that this intervention is just one piece of the puzzle of an integrated strategy of interventions that is needed to really engage the residents in the Dapperbuurt neighbourhood in the recycling process. An important finding as well is that, residents are *not just motivated* through financial rewards or by receiving back up-cycled products, it is just as important (and maybe even more important) to make residents also *capable* and provide them with *the opportunities* to recycle. As we have identified in this research: this demands for a whole additional set of practical and psychological factors to think about (as proposed in the integrative Zero-Waste L-APP).

The study furthermore proved evidence that wood might not be the most obvious material to recycle at the scale of the neighbourhood. Through the research it became clear that residents have low quality types of wood waste available which are not suitable to upcycle and they also don't have wood to recycle on a regular basis (this is further elaborated on the project by UT). The wood in the streets is mostly wood coming from residents who have to move out, or are reconstructing their houses. This waste wood is usually picked up by the municipality. This means if wood would be recycled the logistics how to work with the municipality and the recycling companies should be studied further (how to work with the municipality and the companies who will further process this wood).

A critical note should be given to the research method during this project. The fieldwork was conducted by bachelor students, who are still in their learning process, in result the quality has not always been as expected. Some data is missing on demographics of the interviewed residents. Therefore we could not use this data in the analysis (ages, ethnical background, gender, as well on the location of the household). However, although this data is missing, the general data did provide enough insights for a first orientation and provided useful results for further actions to take. But it would be recommended to validate these results in another phase of research before starting with the interventions proposed. In a second phase of research, an additional quantitative survey (as the Dapperbuurt is a total of 61 ha with about 9755 residents) would also be recommended.

## 9. LITERATURE

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